Circling the Sun, Racing the Wind

Active Games and Creative Dramatics
to Introduce Youngsters to their Fellow Beings
in North America's Temperate Woodlands

By Edith Pucci Couchman

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For Parents and Teachers

The following are an assortment of
games to play and songs to sing and dramatize,
plus a few visually-based projects.

I hope that you'll find at least some of them useful
as you do your important work
helping youngsters learn about
their larger family in Nature
and this wondrous Universe
to which we all belong.

We also hope that
enjoyable forms of education such as these
will help to awaken and nourish
children's appreciation
for the processes that give them
both life and vital opportunities
to contribute uniquely to their Earth Community –
to make it ever
more beautiful and healthy
for all of its members,
large and small,
human and otherwise!

**In the spirit of Thomas Berry, William Morris, Herbert Read,
Robin Wall Kimmerer, Mathew Fox, and David Sloan Wilson**

The same stream of life that runs through my veins night and day runs through the world and dances in rhythmic measures.

Rabindranath Tagore, *Gitanjali* LXIX

For there is symbolic as well as actual beauty in the migration of birds; in the ebb and flow of the tides; in the folded bud ready for the spring. There is something infinitely healing in these repeated refrains of nature...

Rachel Carson, *Lost Woods*

It is easier to act your way into right thinking than to think your way into right acting.

Authorship unclear: John S. White, F. J. Finch, or E. Stanley Jones, 1930's, USA

If we could see the miracle of a single flower clearly, our whole life would change.

Jack Kornfield's interpretation
(in *Buddha's Little Instruction Book*)
of the Buddha's wordless Flower Sermon

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BIOGRAPHY

The resources you'll find here have been developed by Edith Pucci Couchman. Edith has been teaching about the visual arts and environmental science for over twenty-five years in Southern New Hampshire and North Central Massachusetts. She's taught in settings ranging from Nature and Arts Centers to public, independent, and Catholic schools. Most of her students have been five- to twelve-year-olds. However she's also designed classes for three-year-olds with their parents and caregivers, as well as programs on Natural History and Introductory Drawing for adults. She is blessed to be the mother of two wonderful young people and a grandmother to one.

Edith's educational preparation includes a B.S. in General Science with Distinction from the University of Iowa in Iowa City. She was elected to Phi Beta Kappa. Her graduate studies in Environmental Education led to formal teaching certification in Elementary and Science Education for students in grades K to 9. She has participated in the Cooperative and Organic Food Movements since her university days. She has also worked as an illustrator, cartographer, and independent artist. Her artwork has been exhibited in venues including the U. of Wisconsin's Arboretum in Madison, WI, the Springfield Museum of Art in Springfield, MA, the Sharon Arts Center and the Mariposa Museum in Peterborough, NH, as well as the Anne Marie Sculpture Garden and Arts Center in Dowell, Maryland. She was the principle illustrator for the 2020 NH Farm to School Indigeonous Harvest Calendar project. Her paintings and pastels are in numerous private collections.

Mrs. Couchman has been honored to receive the Northeast Organic Farming Association of New Hampshire's 2012 Volunteer of the Year Award, the 2014 Hillsborough County Conservation District's Teacher of the Year Award, and 2017 NH Excellence in S.T. E. M. Teaching Award (Grammar School level) from the Joint Committee of NH Engineering Associations. She has presented workshops at state, regional, and national conferences for organizations including the New England Environmental Educators Alliance, the National Art Education Association, and the Natural Start Alliance of the N. American Association for Environmental Education. Her fifth article for the quarterly Canadian environmental magazine "Green Teacher" was published in the winter of 2018. She is currently the editor of the website https://evolvingbeauty.org.

INTRODUCTION

By sharing this collection of activities and visual materials (which are also available on the website evolvingbeauty.org), I'm trying to offer ideas, inspiration, and practical support for those of you who are also teachers - whether in your homes as parents, grandparents, aunts, uncles, etc., or as paid, underpaid, or volunteer teachers in informal or formal educational contexts.

You are doing such crucial work! It is essential for so many reasons. People need to keep in mind, as almost all teachers do, that in 60 years, most of us will be deceased - or at best, rather old. Soon, an entirely new cohort of people will be steering this two-million-year-old human project. Your actions, ***our*** actions, in our times, help influence the awareness, values, and priorities of these new generations, their understandings of themselves, their capacity for creativity and cooperation, and their sense of belonging within this world / universe. In essence, the enculturation that these young people experience will help determine whether or not they develop the wisdom, compassion, and determination that's needed to guide our species back on course, whether they're capable of turning humanity towards more joyful, just, and healthy ways of life: ways of life that harmonize with the planet as a biodiverse, dynamic, yet fairly steady-state system. Given this perspective, you can appreciate why this particular 'games project' and the educational efforts of many of us are animated by both hope and fear: hope in the form of an abiding vision of how beautiful life can be, and fear regarding what could happen if humanity does not wake up in time. Many of us sense a need to cultivate now, every day, within ourselves and the new generations, a vigorous, defensive love of - and identification with - the sacred biosphere: our home, our ultimate parent, our destiny, and greater Self.

With this in mind, the following activities have been designed to appeal to "whole children": to those energetic, caring, and thoughtful beings who are already enmeshed in dynamic social networks, blessed with rapidly developing intelligences, trusting dispositions, and inherent agendas for survival. How can we effectively prepare them for their futures? What would evolutionary psychology, science, and perennial wisdom recommend?

The games you'll find here represent my attempt to craft a few possible answers to these questions – adapted to my particular bioregion. They're inspired by traditional children's games from the British Isles, the U.S., and continental Europe. As you'll notice, the goal is to re-energize and employ these time-honored structures (i. e. active children's games and nursery songs) for socialization and fun. We're trying to lightly reshape them so they can also serve as vehicles for transferring (or at least introducing) foundational concepts / truths gleaned from the empirical sciences. Many of the following activities contain opportunities for vigorous physical movement (such as racing and chasing), interpersonal interaction, and simple arts involving musical expression, creative dramatics, rhyming chants, and circle dance. Fundamentally, they also rely on real-time, actual, physical cooperation and / or competition: the emotional yin and yang of human (and most other) interactions. In these instances, such forces are embodied in the rhythms and complementary tensions of the games themselves. Evolved over millennia, games such as these can readily transform into precious microcosms of the larger systems within which they function – hence

their inherent capacity as portals allowing youngsters to experience, imagine, and recreate in a focused, aesthetically pleasing way, the fractal realities of healthy natural systems. They challenge youngsters to coordinate for social purposes their own muscles and psyches. I believe that real games of this kind, games that are enjoyable, sociable, active, and truth-centered, need a place in the heart of enculturation – if we are to prepare our youth for vibrant, creative, and Earth-honoring ways of life; if we are to educate them for satisfying, regenerative relationships with each other, and with this beautiful, sun-showered planet.

And because this is a learning project that is deeply concerned with biology and biological creatures, it seems only fitting that the educational techniques we're using attempt to respect, acknowledge, and deploy some of the Material Sciences' best understandings of 'human nature' and cognitive development. The activities should resonate with the same high spirits, camaraderie, and striving for fairness that have characterized the play of secure, well-loved, young humans across the centuries - as described by researchers such as Johan Huizinger, Iona and Peter Opie, Adele Diamond, Herbert Read, and Jean Piaget. The factual science content / learning transmitted here is not restrictively channeled through grim, relentlessly verbal formats. It is not overly dominated by a teacher, book, or electronic device functioning as a knowledge dispenser. While older, more focused (or less agile) minds might find such methodologies effective, current research, anthropological studies, and common sense indicate that such forms of socialization are often aversive and / or counterproductive especially for large groups of children aged eleven and under. Moreover, the games we're trying to offer are exciting without recourse to alarming bombardments of screen-based, commercially- motivated, aural outputs and visual imagery. This is in contrast to the electronic games that are currently impacting so many sedentary, isolated youngsters. Instead, this collection attempts to present authentic, personalized, humanistic education based upon children's inherent, evolutionarily formed, developmental play propensities. These are tendencies that are only just beginning to be understood formally through the empirical sciences, yet many, young and old, can sense these intuitively. The aim is to promote learning through lively, friendly, nature-based, yet imaginative activities – activities which are, enjoyable and worthwhile in both the long and short term for all.

To summarize, the overarching idea is the following: if we expect our youngsters to continue to love learning, just as they did when they were infants or laughing toddlers (tossing toys off their high chairs to see what would happen), then we need to offer them learning experiences that are congruent with their inherited mammalian aptitudes and tendencies. Therefore, most of these games are best played out of doors, under open skies, with a group of children who are not necessarily all of the same age. It's often helpful to have an older moderator guiding the activities, at least initially. And while outside play is by far the best, almost all of these games can also be adapted for use in a classroom, hall, or gymnasium. During these varied activities, children are accorded opportunities to process experiences kinesthetically, viscerally, intuitively, emotionally, and /or rationally. According to esteemed theoreticians such as Jean Piaget and Antonio Damasio, embodied, experiential knowledge in particular, is foundational for later, symbol-based comprehension, especially in realms such as logic, the physical sciences, and even mathematics. Additionally, the survival scenarios (evoked in some of the games) may even be tapping into

human aptitudes for enhanced memory of events seen as having existential value, a possibility explored in the intriguing functional psychology of James S. Nairne and Josefa N. S. Pandeirada. The games are also highly social which adds other dimensions to their emotional valence and the character of the skills acquired. While playing, students are learning to react quickly and to control their muscles / behaviors **in relationship** to the varied forces (physical and social) coming from powerful or less powerful 'external objects' (i.e. – their fellow classmates). They need to calibrate their responses and be sensitive to one another - if the play is to go forward. Once again, much of this learning takes place subconsciously, through trial and error, and through subtle and not so subtle visual and auditory clues.

At the same time, the teacher can assist the youngsters to consciously and verbally notice what's taking place, and to quickly express their intentions. For this reason, teachers are encouraged to observe the game and supply spoken commentary that delineates events and options and recognizes children's achievements. This results in a medley of spoken scientific explanations and strategic and social coaching - some of which is developed and shared after the game in the form of group reflections. And while much of this verbal overlay will be ignored, some will be absorbed by some of the participants, and this can confer real benefits. Such deliberate linguistic translation can expand youngsters' grasp of the natural science topics being studied, as well as their self-understanding - as they propel themselves through their world, physically and socially. The language acquired in some of these games can allow them to interpret, reason, and communicate not only about physical science topics (such as inertia and balance), but also about social interactions and fairness. Clearly structured but flexible games of this nature can contribute significantly to young people's physical health and executive functioning (as described brilliantly in the research of Adele Diamond) as well as to their general capacity / propensity for conviviality, empathy, and teamwork.

As a concrete example, even in the simple Circle of the Seasons game, students have to confront the challenges of reacting in a timely and courteous manner to the pushes and pulls of the other children in the moving ring. They might need to counter the resistance of a neighbor if that child is unaware that the rest of the line has begun to move, or is moving too slowly, or perhaps stumbles. Successful, considerate efforts will be rewarded by a smoothly flowing, happy and interesting game - if players can manage to focus and attend to one another compassionately; if they can synchronize their muscles, motions, and singing; and if they can generally coordinate their energies towards a shared goal. Played in this way, they can experience socially, kinesthetically, rationally, and aesthetically the beauty of Earth's seasonal cycles and phenomena. Yet in many cases, their most significant learning might first be the discovery that pleasant, productive interactions will occur if people can manage to work together to the best of their abilities with a common purpose (in this case, learning about nature, making friends, and having fun). They can realize that diverse aptitudes, knit together, will actually provide team advantages. They can discover that complex goals can be attained if they can be simultaneously cooperative, kind, and aware.

In sum, little by little, we need to develop better ways to enculturate our youngsters - ways and methods that better respect, accommodate, and harmonize with the realities of their innate predispositions for learning and prosociality. We need to help our children become more conscious, attuned, and emotionally connected to the shimmering array of individual beings and ecosystems with whom we share this planet.

We should encourage them to recognize and emulate the beauty of the patterns, biotic and abiotic, that envelop us all and make our lives possible. This kind of learning can eventually help them to appreciate the amazing and ancient networks and systems within which we function and which contribute to our very essence. At the same time, we must ensure that our children's education is not hijacked and erroneously designed to serve the interests of a short-sighted set of 'employers.' Instead, their learning (both informal and formal) should nurture their capacities for compassion, self-knowledge, imagination, and joyful affiliation with Life - even as they acquire many kinds of abstract knowledge and skills in a multitude of practical arts. It is this combination of capacities, acquired in sociable, non-aversive settings, in contexts that offer abundant opportunities for self-direction, expression, and sharing, that will enable new generations to invent and restore pro-social and pro-planetary ways of being on and of the Earth. We are in need of ways of living that honor and enhance biodiversity, dignity, justice, and creativity for all beings, human and otherwise. From my experience, I think that active, nature-centered games can play a role in preparing youngsters for this ongoing endeavor. I hope that you'll agree and find some of these games useful in your teaching.

ADDITIONAL SUPPORTING MATERIALS

Please note, at the website evolvingbeauty.org you can access audio recordings of song melodies for many of the games included in this collection. You can also find other projects related to the Northeastern Forestlands. Often these include downloadable, illustrated activity pages that complement verbal content pertaining to the natural and cultural history of this region as well as biological and ecological principles in general.

Circle of the Seasons: A Year-round Activity for the Youngest

1 - Circle of the Seasons

a singing circle dance with creative dramatics

Ages: 3 to 7

Performance Expectations (for the entire 2 part project):

Through combined experience with discussions centered around a simple colored poster, the cooperative, creative dramatics of the Circle of the Seasons activity, and construction of the Season Clock project, youngsters will begin to better understand the seasonal round of weather patterns in this temperate climate. They'll learn a little about the behavioral patterns of some typical creatures (such as Maple Trees and Chipmunks) within this biome. They will practice coordinating their voices and motions with those of their friends.

They will exercise their memories, manners, and muscles as they participate in the singing circle dance with its opportunities for sociable, imaginative, and empathetic impersonations.

Because they will also be discussing, coloring, and silently reflecting upon some traditional children's activities across the year within the context of the life cycles of neighboring plants, animals, and seasonal weather, they will be developing a deeper sense not only of the dynamism of their environment, its patterns, and the continuity of life, but also of their potential roles within this pageant. They will be able to express their growing insights, knowledge, and empathy in future conversations and visual art productions.

Next Generation Science Standards Alignments

Core and Component Ideas in the Physical Sciences

PS1: Matter and Its Interactions
- PS1.A: Structure and Properties of Matter

PS2: Motion and Stability: Forces and Interactions
- PS2.A: Forces and Motion
- PS2.C: Stability and Instability in Physical Systems

PS3: Energy
- PS3.A: Definitions of Energy
- PS3.B: Conservation of Energy and Energy Transfer

Core and Component Ideas in the Life Sciences:

LS1: From Molecules to Organisms: Structures and Processes
- LS1.A: Structure and Function
- S1.B: Growth and Development
- S1.C: Organization for Matter and Energy Flow in Organism

LS2: Ecosystems: Interactions, Energy, and Dynamics
- LS2.A: Interdependent Relationships in Ecosystems
- LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- LS2.D: Social Interactions and Group Behavior

LS4: Biological Evolution: Unity and Diversity
- LS4.C: Adaptation
- LS4.D: Biodiversity

Core and Component Ideas in Earth and Space Sciences:
- ESS1: Earth's place in the universe
- ESS1.B: Earth and Solar System
- ESS2: Earth's Systems
- ESS2.A: Earth Materials and Systems
- ESS2.D: Weather and Climate

NGSS Practice: 1. Asking questions; 2. Developing and Using Models

NSGS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect; 5. Energy and Matter; 6. Structure and Function; 7. Stability and Change

Materials:

- Enough students to form a circle, plus imagination and good will!
- (For Winter, you could add Paper Snowflakes. Such 'snowflakes' will allow the children to create a pretend blizzard during the last stanza. Including these definitely makes the Winter Game more fun. You can use flattened cupcake liners or round paper lace doilies as snowflakes - if time is short. Alternately, you could personally cut out more realistic snowflakes prior to class or recruit assistance from an older group of students. In programs with very young children with caregivers, I've pre-folded the paper squares into sixths and / or had the adults do this. Then, the crafting of the snowflakes (through strategic trimming) becomes an added art component to the project to the project and is accomplished by the adult/child team. There are many intriguing templates for folded and trimmed snowflakes on-line. Search the images of "snowflake cutting patterns" for a host of dazzling options.

Overview:

I've found this activity to be highly useful for beginning seasonally-based classes. It can help establish a friendly, cooperative, and playful atmosphere. At the same time, it sparks interest in specific creatures and weather phenomena. Psychologically and physically, it gathers youngsters into a team by offering them an occasion for coordinated movement, theatrics, and singing. It can serve as an enjoyable preliminary (or possible antidote!) to sedentary, instructional, and sometimes, verbally-saturated 'circle time.'

Basic Lyrics for the Four Different Circle of the Seasons Games

SUMMER

Winter, Spring, Summer, and Fall, (Join hands and circle round.)

The year goes round and round-oh. (Drop hands in preparation for the next phrase.)

In Spring, the leaves sprout from the trees, (Lift up arms with hands in fists; stretch out fingers and pretend that they're budding leaves.)

In Fall, come tumbling down-oh. (Slowly bend from the waist, lowering hands to the ground with a fluttering motion of the fingers in imitation of falling leaves.)

Spring showers help the plants to grow. (Join hands and circle round.)

Soon flowers are blooming brightly. (Keep circling.)

In nests in trees, the little birds grow. (Keep circling.)

Hopping frogs are singing nightly. (Drop hands and everyone hops up and down. Add frog calls.)

Long summer days help plants grow strong. (Circle.)

Mosquitoes flit past woods and lawns. (Drop hands and stretch out arms behind back to make pretend wings; move forward in imitation of an obnoxious flying insect; make a whiny buzzing sound for fun.)

Birds try to catch them for their young. (Flap and dive rhythmically like a bird pursuing insects.)

Turtles bask in the blazing sun. (Hold still, stretch arms out from your sides, tilt head back, and smile as if you were a turtle on a log, soaking up the sunshine.)

FALL

Winter, Spring, Summer, and Fall, (Same gestures and movements as described earlier.)

The year goes round and round-oh,

In Spring, the leaves sprout from the trees.

In Fall, come tumbling down-oh.

Autumn nights are long and chill.

The leaves turn red, the crickets still. (Drop hands.)

The geese and grackles fly away. (Pretend to flap your 'wings' like a goose as you travel around the circle; add honk and hink sounds – approximations of the sounds of the male and female birds respectively.)

Little chipmunks gather nuts all day. (Crouch and pretend to collect imaginary acorns by repeatedly stretching out curved hands and drawing them back quickly.)

WINTER

Winter, Spring, Summer, and Fall, (Same as described earlier.)

The year goes round and round-oh.

In Spring, the leaves sprout from the trees.

In Fall, come tumbling down-oh.

Winter sun is seldom seen.

Snow falls on fields that once were green.

The turtle and the woodchuck doze. (Tilt head, close eyes, and lift pressed hands to face in imitation of sleep; snoring optional.)

Coyotes cross the frozen snows. (Tiptoe around the circle, one after another, placing feet carefully in the footsteps of the alpha 'coyote.')

Maples rest and larvae curl. (Close eyes and bend head, and hunch back a bit to signify dormancy.)

*Underground while blizzards swirl. (*Pick up precut paper snowflakes from the center of the circle and toss them up like confetti to make a fine blizzard – This is usually a highlight of the activity for the youngsters!)

The phoebe's flown to southern climes, (Flap 'wings' in a pretend migration around the circle.)

But Winter suits the porcupines. (With elbows held close to the waist, put hands up by chest with both hands and fingers sticking out at right angles to imitate the quills of a porcupine; smile confidently.)

SPRING

Winter, Spring, Summer, and Fall, (Same as above.)
The year goes round and round-oh.
In Spring, the leaves sprout from the trees.
In Fall, come tumbling down-oh.

The warm spring sun melts winter snows. (Drop hands and stand swaying - imitating plants sprouting or waking up.)
A million plants begin to grow.
Buds unfold, the leaves unfurl. (Lift arms up gradually, stretching out fists to imitate leaves.)
Pussy willows bloom, and catkins twirl. (With arms lifted overhead and hands pressed together, spin around quickly.*)*

Drowsy bees begin to fly. (Stretch out 'wings' and pretend to fly in a swooping motion with a loud buzzing sound like a princess bumblebee who's searching for a nesting place.)
*Hawks soar in the bright blue sky. (*Continue 'flying' in a smooth, soaring fashion Add a "kee-er, kee-er" cry in imitation of a Red-tailed Hawk's call.)
Grey tree frogs trill and robins sing. (Make a high-pitched trill.)
Rabbits hop and leap in Spring! (Hop and leap repeatedly.)

When the youngsters are first learning this activity, I generally preface the game with a discussion of the Circle of the Seasons illustration which is available on the next page. Then they play the version of the game that matches the time of the year in which we've all gathered.

1.1 Scenes from the Four Seasons

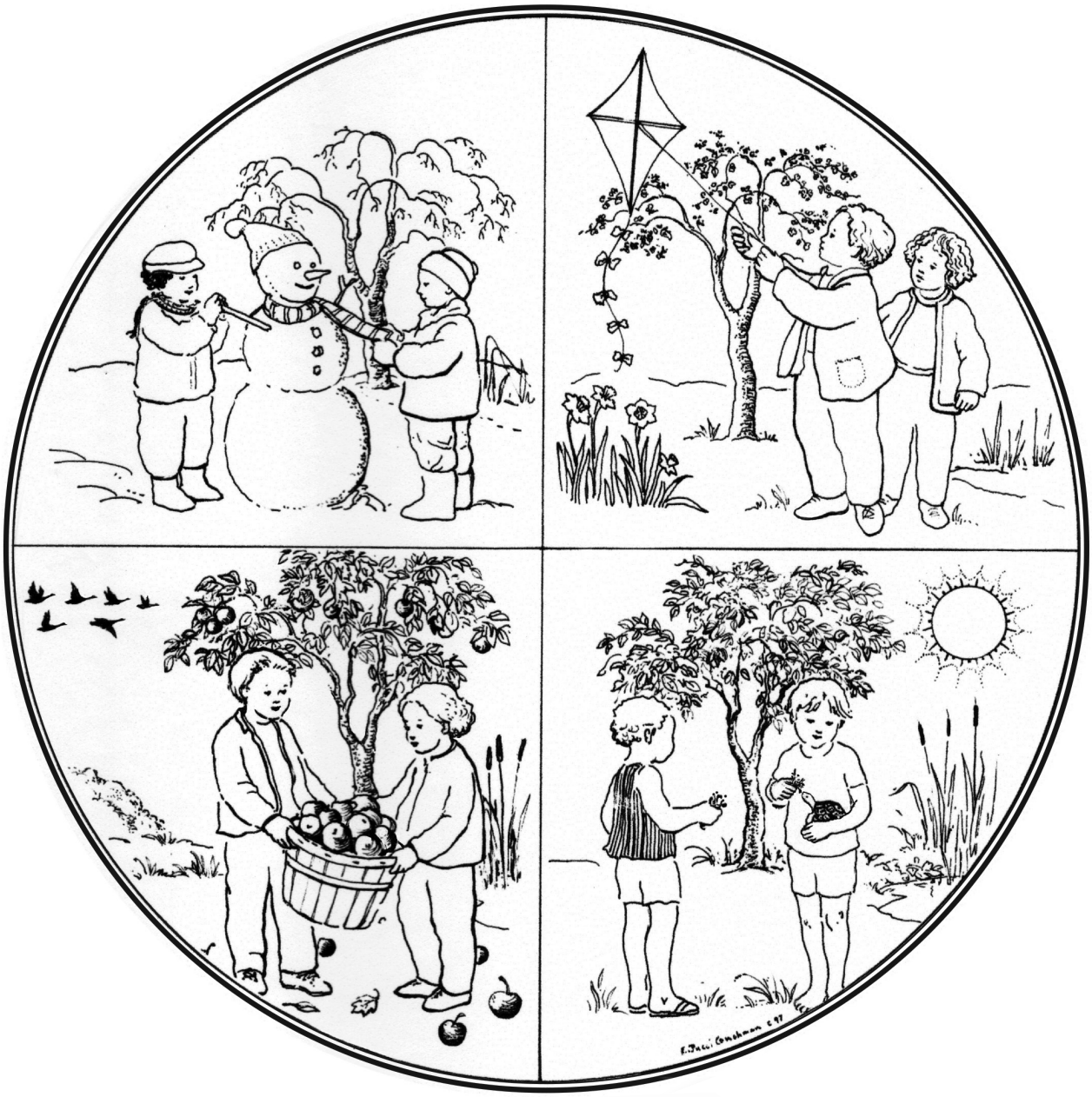
Edith Pucci Couchman © 2020

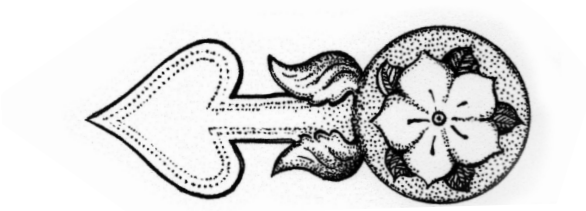
Headband / Crown / Garland Option: Color each of the four seasonal images and then cut them out. Provide each youngster with a 20" long band (approx.) of colorful paper - perhaps patterned wrapping paper that's been folded over in half lengthwise for extra strength and attractiveness. Ask them to glue, tape, or staple the two ends together to create a circular headband. (Make certain, if stapling, that the smooth side is on the inside of the circle). Glue the seasonal pictures in order onto the headband. Decorate, wear and enjoy! Alternately, invite the youngsters (if they seem ready to understand this) to fold the circular band in half once, and then again to create four even sections. Glue each of the four seasons in order in each of the resulting four panels. Add extra images and symbols, perhaps even words, to enhance the beauty and informational density of the resulting crown. Older children could use such an evenly divided band for discussions about the months in each season, the yearly calendar, plant growth in temperate biomes, or the earth's revolution around the sun.

Alternately, the illustrations could be used for birthday-based nametags or other projects of your own design!

1.2 - Circle of the Seasons Clock

Color both the seasons circle and the pointer. Carefully cut them out. Using a push pin, you or your teacher can make a small hole through the center of the seasons circle and the flower on the pointer. Also make a small hole through the very center of a yellow paper plate. (It's yellow to help you remember the importance of the Sun's energy in creating the seasons.) Stack the flower of the the pointer over the center of the seasons circle over the center of the yellow paper plate. Push a brass fastener's arms through all three. Carefully bend the arms of the fastener out flat on the back of the paper plate to secure the layers and permit the pointer to spin.





1.3 - Circle of the Seasons Clock Instructions

Ages: 3 to 4 (with assistance) to 7

Performance Expectations and NGSS Alignments listed in 1.

Materials:

- Circle of the Seasons Illustration (1:1)
- Copies of the Circle of the Seasons Clock: Black and White Activity Page (1.2)
- There should be enough copies for each youngster. Include a few extras just in case!
- Bright yellow paper plates, one for each student. These will form the clocks' backgrounds. The bright yellow color symbolizes the Sun's vital gift of precious electromagnetic energy. Students should be learning that the seasons are caused by the fluctuating amounts of solar energy that reach different parts of our tilted Earth as she revolves / circles the Sun: a journey that all of us, the planet's passengers, complete every year.)
- Colored pencils, graphite pencils, and crayons
- Scissors
- Push Pins
- Brass fasteners (one for each child's project)

Overview:

Constructing a Seasons Clock is usually an engaging activity for five- to seven-year-olds. They're creating an interactive, visual model of this temporal pattern that greatly affects their lives in this temperate climate. (Three- and four-year-olds can also make these clocks when assisted by parents, caregivers, or older 'Buddies' from other classes. Nevertheless, this project can be a bit of a stretch for them conceptually as well as in terms of the crafting.)

While the youngsters are discussing and actually coloring the four sections, you might try

to draw their attention to the idea that the weather changes during the four seasons are in large part a result of the varying quantities of solar energy that reach this region over the course of Earth' orbit around the Sun. The energy input varies due both to changing day length and the sunlight's angle of incidence.

The weather conditions of the four seasons help establish our climate, the context which shapes the lives of all the interlocking biological entities and communities who exist here – including us humans.

Both the Circle of the Seasons Illustration and the Seasons Clock deliberately emphasize:

1. Human children's traditional outdoor activities from the past 300 years (although a few of these have probably been favorites for millennia!)

2. The changes observable over the course of a year in an apple tree (an iconic deciduous plant of New England – although it's definitely not native to this region)

3. The activities of a few conspicuous, local, non-human animals and green plants.

(Side note: We usually encourage the students to associate their particular birth month with one of the seasons. This is a fun way for them to identify with the idea of seasons and to remember more clearly the trio of months typically associated with each one. Knowing this also prompts them to think of themselves - at least for a short time - as members of one of four distinct cohorts: the 'Spring Babies,' the 'Summer Babies,' etc., a distinction that can be made more memorable by using these categories to sort the group into teams on future occasions. The four-year-olds and Kindergarten students seem to particularly enjoy this idea.)

After the Seasons Clock page has been sufficiently embellished, students can hone their motor skills by cutting out the freshly tinted Clock and Pointing Hands. (With some classes, I've trimmed these out beforehand to reduce the challenges that the youngsters must overcome.) There are almost always a few in every class who will need some assistance. Encourage the children to help one another.

Moving along to the clock's assembly, it's worth noting that the very youngest groups seem particularly captivated by the fact that the clock has a kinetic feature – the movable Pointing Hand. This pointer can be spun (thanks to a central brass fastener) if the youngsters can manage deliberate and careful motions of their own hands. This interests many of them and adds yet another layer of fascination to the concept of seasons!

While I might attach the pointer to the scene and plate for the younger students, the older ones like to do this themselves. Simply show them how them how to use a push pin to carefully poke a small hole through the center of the pointer. They should do the same with center of trimmed Seasons' Clock illustration. Next demonstrate how to enlarge the holes just a little by using the sharp pencil as an awl. The trick is to put the pencil point partly through the hole and then to gently spin the point back and forth. (This is another fine-motor skill that they seem to enjoy learning.)

In terms of the paper plate backgrounds, because these are tough, I usually make the holes through their centers **before** we do the project. I find the exact center by folding one plate in half vertically and then horizontally. As you know, the center resides where the fold lines intersect. I then carefully cut out one of the resulting pie shaped quarters and superimpose that over each plate in succession, marking the second plate's center

with the pencil. Using a push pin and pencil as described earlier, I poke a center hole in each of the paper plates. There are other ways of course to do this. You can also use the folding technique to find the center of one plate and then make an extra-large center hole. Next, place that entire plate over the plate to be marked, and mark that lower plate with a pencil point inserted through the large center hole. I happen to prefer the quartering method because it requires more geometrical thought and can be done very quickly and precisely. It's the one I teach to my older students. I find it to be a very versatile and transferable understanding to pass along.

The last step is to connect all the parts. The youngsters simply match the Pointing Hand's center to the center of the colored Seasons' Clock. They stack these two upon the perforated yellow paper plate, again lining up all the centers. (It's a Seasons Clock sandwich – and their artwork is the wonderful filling!) Show them how to join the three pieces together by passing a brass fastener's point through the aligned holes. By bending out and flattening the two brass arms against the back of the paper plate, the clock is completed. Adjust its tightness so that the Pointing Hand turns easily.

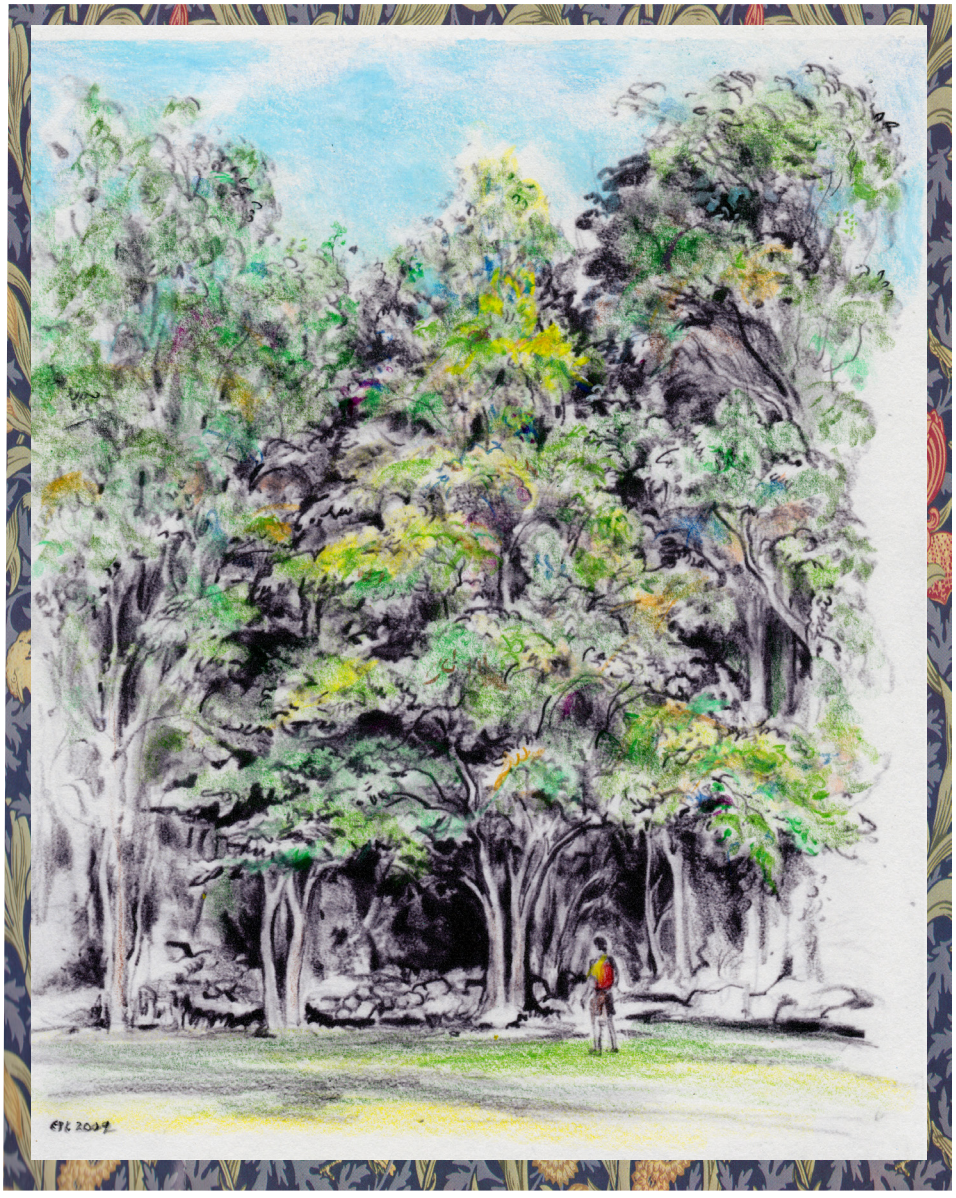
Now students can be asked to rotate the pointer to indicate specific features, seasons, or even their birthdays during subsequent class discussions. As students do this, you can quickly confirm visually whether everyone understands the instructions and concepts. You'll also be able to assess who can or cannot accomplish this fine-motor challenge. The finished clocks can be kept at school to serve as a learning tool for a while, or they can be taken home immediately to share with parents and siblings.

An excellent time to do this project is in early January or late December, close to the arrival of both the Winter Solstice and the official New Year (for those of us using Western European calendars). However, these clocks can be readily made at the beginning of other seasons – which could be convenient for folks working in Environmental Centers where programs begin throughout the year.

As explained earlier, I usually pair this project with the 'Circle of the Seasons' singing game featuring a bit of creative dramatics. I've posted an audio version of the 'Circle of the Seasons' melody - and hope to add a short video of the seasons singing game in the near future - on the website evolvingbeauty.org.

Extensions for Older Students: This 'Four Seasons' Clock' project (without the illustration featured here) can be modified into a wonderful free-hand drawing or collage challenge using blank paper plates (or much larger circular surfaces) divided into quarters. Quantitative data such as temperature and / or rainfall averages can also be included along with the visual imagery. For older age groups, this activity can help focus attention on the dates of the Solstices and the Equinoxes. It can provide opportunities for team projects in which the children create their own designs for each season.

Plants



2 - Seed Song

a singing and impersonating activity

Ages: 3 to 8

Performance Expectations:
Students will learn the name and function of certain key, macroscopic structures of a typical land plant as they act out a short song (or chant) about seed germination. After participating in this activity several times, the children will be better able to understand and verbally describe the life cycle of these amazing creatures: the land plants who reproduce with seeds.

NGSS Disciplinary Core Ideas: PS1.A, B; PS3.D; LS1.A, B, C, D; LS2.A, B

NGSS Practices: 2. Developing and Using Models; 6. Constructing Explanations; 7. Engaging in Argument from Evidence; 8. Obtaining, Evaluating and Communicating Information

NGSS Crosscutting Concepts: 1. Patterns, 2. Cause and Effect: Mechanism and Explanation; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function; 7. Stability and Change

Overview:

This is a brief activity with opportunities for acting and singing that conveys some foundational information about a seed's development into a rooted, photosynthesizing plant. It strengthens children's understanding that plants are alive (which is news for some!), and can help them to focus their thoughts and emotions before an observational walk outdoors to look for seeds that are sprouting, just forming, or being dispersed. It also works well to introduce any sort of seed-planting project, and can serve as an active prelude or conclusion to a story-time focused on gardening, farming, or plant life in general. A version of the melody can be found on the website evolvingbeauty.org.

Lyrics for the Seed Song

I'm a little seed, (Begin by crouching down with your arms clasped around your knees. You're pretending to be a tiny, compact seed.)

Resting underground,

Soaking up the water, (With arms curved and hands completing the circular shape, gradually lift your arms out a little way from your sides to mimic a swelling seed.)

Growing fat and round.

Here are my roots- (Lift up a bit from the ground and stretch out one foot tentatively.)

Stretching far and wide (Still crouching somewhat and balancing on one foot, stretch out the other foot. Move it slowly in a horizontal arc to the left and right.)

Drinking up the water…

Now to this place I'm tied. (Plant foot decisively - yet remain somewhat crouched.)

Here is my stem (Begin lifting your shoulders and straightening your back gradually.)

Arching to the light. (Continue this motion.)

Now I'm in the fresh air (Stand very tall and straight, smile and turn your head, looking about.)

Where it's warm and bright.

Here are my leaves (Lift arms up slowly to the level of the head, with partially cupped hands, palms up imitating leaves.)

Stretching to the sun. (Lift arms high above head, palms up, eyes and chin tilted towards the sun.)

I'm a little green plant. (Continue in this pose smiling broadly.)

My growing's just begun.

3 - For Plants to Live and Grow, They Need to Photosynthesize

an associative learning, collecting game featuring a linked-run race

Ages: 5 to 12

Performance Expectations:
Students will be able to name four key material components that plants need in order to make their own food / photosynthesize. They'll exercise their running muscles and build their social skills

NGSS Disciplinary Core Ideas: PS1.B; PS3.D; PS4.B; LS1.A, B, C; LS2.A, B; ESS1.B

NGSS Practices: 1. Developing and Using models; 8. Obtaining, Evaluating and Communicating Information

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 5. Energy and Matter: Flows, Cycles, and Conservation

Materials

- Trimmed copies of the four different "For Plants to Live and Grow" Cards found at the end of this section. These can be laminated if you think they'll be reused often enough to justify the use of the plastic. (One card will be needed for each student.)

Overview

This is a simple running game that also fosters a basic knowledge of botany, communication skills, interpersonal awareness, and the ability to focus on a shared goal. Children must work together to quickly assemble teams containing a quartet of youngsters who each possess a different ingredient card for photosynthesis.

The game facilitator distributes to each youngster a single card (held face-down). The cards represent:

1. **A Seed in good Soil**
2. **Water**
3. **Carbon Dioxide**
4. **Sunlight.**

At a signal, the children turn their cards over and assume the identity of the component they have received. Alternately, the cards can be scattered on the ground and students can race to find one. In either case, once every child has a card, they must look for other students who represent the varied inputs that complete their suite. Once a complete set of four has been assembled, the youngsters should link hands and form a chain. Without breaking the chain (a difficult task for many groups), they must run across a stretch of open ground. Alternately, in an indoor setting, they can hop across a designated space. The first team to reach the prearranged finish line – as a chain - is deemed the winner. Reaching the finish line signifies that all the needed elements in the system are present and interacting suitably: thus, the seed has sprouted, is rooted, and is growing well – an outcome that the teacher should emphasize at the game's conclusion.

Simplified, illustrated cards for printing are included here. They work especially well for preliterate students. You could use these exact cards or let your students design their own.

As mentioned earlier, four cards are necessary. There is the Seed in good Soil card (you might point out that each seed carries a precious cargo of genetic information garnered over several billion years of evolution). There is a Sun card (Earth's nearest star and the traditional energy / light source for photosynthesizing plants). There is also an essential Water card, and a vital Carbon Dioxide card. Three small images surround the Seed in Good Soil card to remind the youngsters which four entities must all be present for photosynthesis to occur in a healthy well-sprouted plant. Similarly, there must be four children, each holding a different card, gathered together before this new team (representing a sprouting seed) can make its linked dash to the finish line.

A set of more complex, visually descriptive cards are also included for older students.

Auxiliary information: Notice that we actually refer to Carbon Dioxide and not just 'air' as one of the four essentials for photosynthesis. This is unlike other many elementary science texts and even unlike the Next Generation Science Standards – which withhold this key bit of information for students until sometime between the sixth and eighth grade year of instruction. We use this word intentionally because young children are able to learn and remember vocabulary much more easily than either adolescents or adults. For this reason, I think that they should be given opportunities to learn the precise term, Carbon Dioxide, as soon as they begin learning about the major inputs in photosynthesis.

Such knowledge can help young people appreciate more thoroughly the beauty of the complementary processes of plant photosynthesis and animal (and plant) respiration - and combustion. Indeed, while the process of photosynthesis releases O2 into the air, it also draws CO2 out of the atmosphere and stores it away in the plant's body, above and below the ground, in the form of sugars and carbohydrates, etc. Aerobic Respiration and Combustion / Fire, in contrast, draw O2 from out of the air and then release energy and CO2 into the atmosphere (following the breakage of the chemical bonds that previously held together those sugars, carbohydrates, or oil molecules). It is this released chemical energy that can then fuel

either the Fire or the organism's metabolism. This is key knowledge / information to grasp, if one is to be an educated human who understands the fundamentals of matter and energy transfer within our biosphere. Knowing that plants and cyanobacteria (mostly in the oceans) are busy releasing O2 and absorbing CO2 as they photosynthesize, enables children to understand how carbon sequestration works. And if they know this, I would warrant that they'll be better prepared to understand the folly of burning too many fossil fuels in a short span of time or, on a more positive front, better prepared to appreciate how regenerative, organic agriculture, agroecology, and / or permaculture can serve to at least partially reverse the Carbon Dioxide build-up in Earth's atmosphere, and in this way, counter Climate Change.

An understanding of the reciprocity between photosynthesis and respiration is important because even children in Elementary School are aware of - and fearful of - the effects of human disruptions to the biosphere's energy and matter systems. Young people need to have hope that there are in fact readily available ways to begin reversing the rise in atmospheric Carbon and attendant Climate Change – this unfolding disaster caused largely by the profligate burning of Earth's fossil fuel stores (accumulated over millions of years) during a mere 200 years of industrialization and mass production. Equipped with such knowledge, new generations of humans will be more likely to support reductions of fossil fuel use and the preservation of forestlands and carbon-storing peat bogs across the globe. Additionally, they'll recognize Carbon Dioxide's positive and negative qualities (in terms of impact on human activities and the biosphere that sustains us), rather than associating the word solely with anxiety-provoking media messages. This game, which can be played even by groups of young children, cultivates their familiarity with this key molecule and its photosynthetic interactions, in a light-hearted yet scientifically aligned context that also allows for additional questions, clarifications, and discussions directed by trained teachers.

In terms of the practical logistics of this activity: try to make certain that there are sufficient card sets to permit the maximum number of teams to self-assemble. Encourage any students 'left over' at the end of the assembling process to just run for the fun of it - even though they are not in a team. Explain that unless the class total is a multiple of four, there are always going to be a few extra runners in this game who aren't in a team. You might play multiple rounds (if necessary, with a few sitting out) just so that everyone has an opportunity to race as part of a four-person set. (And as you can see, you could even use this activity as a prompt for exercising math skills.)

Additionally, you might advise the youngsters that forming teams with their best friends is often 'counterproductive' (a fun word to share). This is true since this will slow down the formation of groups, and thereby diminish a team's chance of succeeding. If a team is to win, it's vital that the four essential components gather together as speedily as possible - regardless of whether everyone is close friends. (This instruction can help counteract some of the social angst that sometimes occurs during the choosing process.)

It's also helpful if the players communicate and cooperate well during the linked run. Fast runners should be careful not to roughly drag the slower members of their group. Someone could get hurt! Also, if players run too fast, their chain will break. Whenever this happens, the entire group must stop and put itself back together. Students racing towards the finish line individually will not qualify to win. Being sensitive and considerate of other people will

allow everyone to win!

In a way this game functions as an emotionally and kinesthetically-engaging social fractal that models / replicates the complex **teamwork / cooperation** that occurs at the molecular level - and below - during the process of photosynthesis. It also helps teach children valuable human lessons: the vital role of each individual in a true team, and the benefits of being able to work together attentively.

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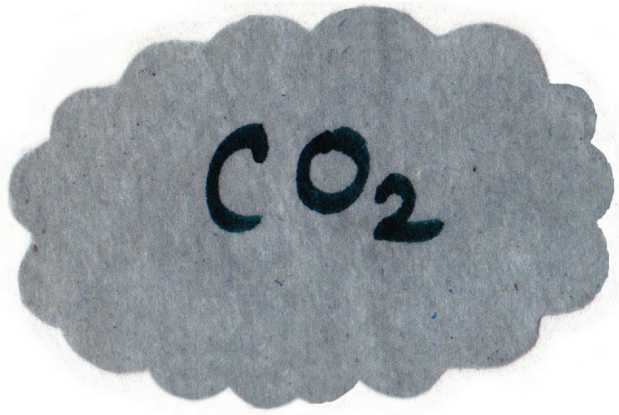
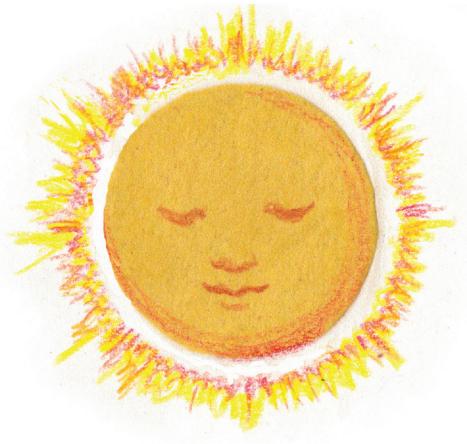
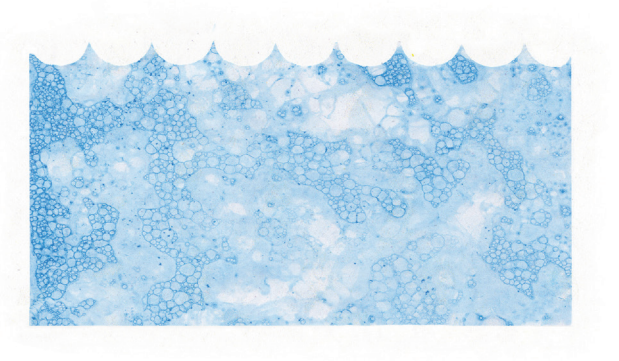
3.1 - For Plants to live and grow, they need to Photosynthesize (cards for the youngest students)

This wonderful process can happen when the following components are present: Seeds with their amazing genetic inheritance (ideally sprouting in good soil), **Water**, **Carbon Dioxide**, and **Sunlight** (the main source of energy reaching our planet every day.)

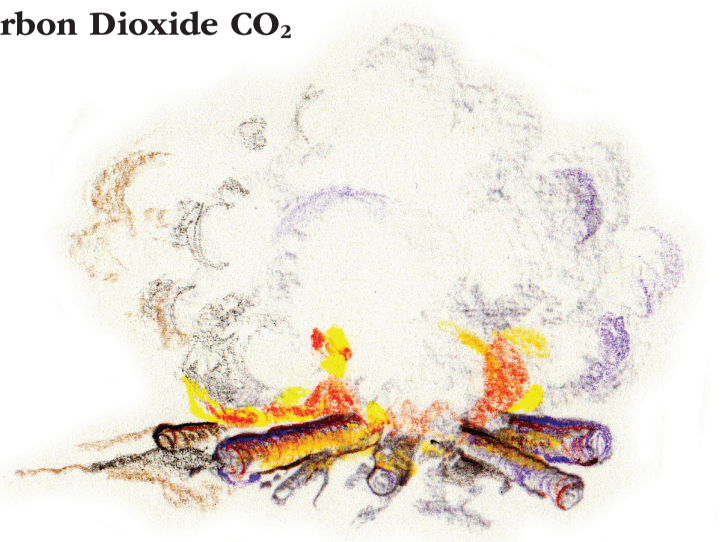




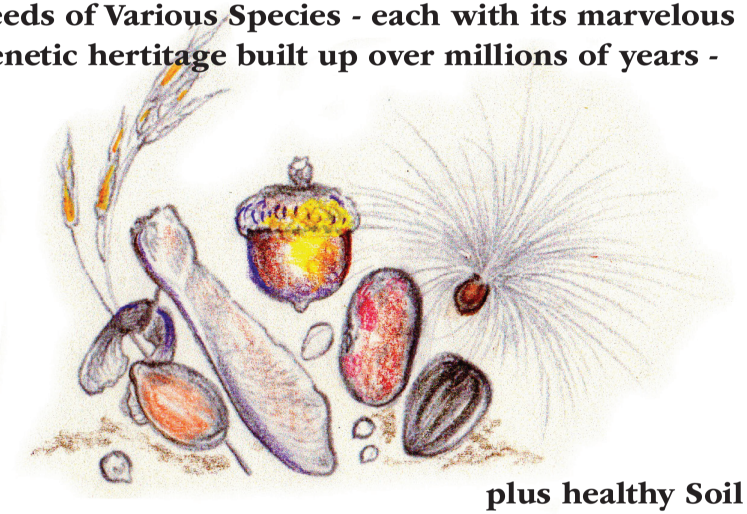


3.2 - For Plants to Live and Grow, They Need to Photosynthesize (cards for the older students)

Carbon Dioxide CO_2

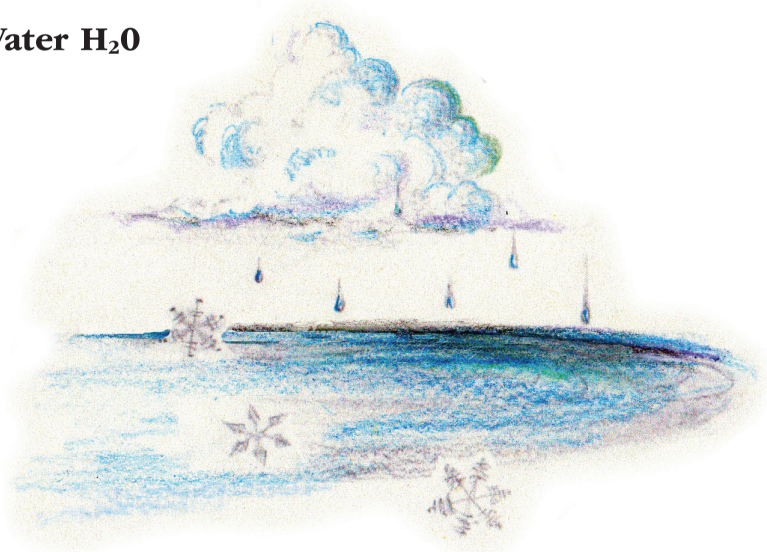


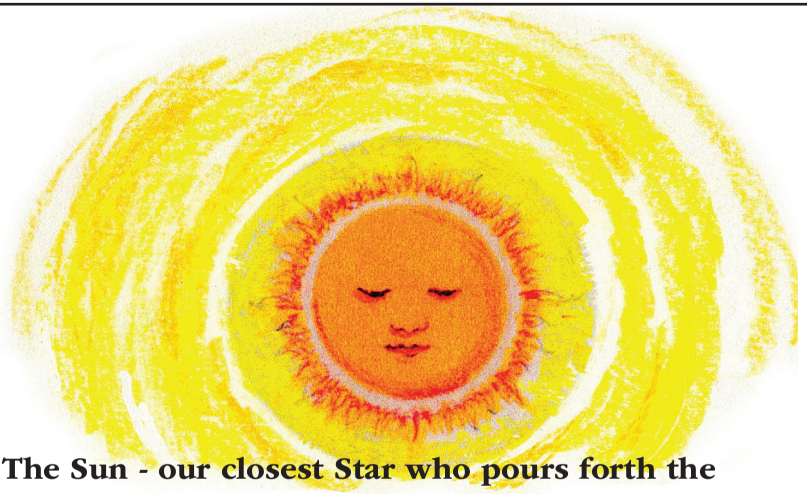
Seeds of Various Species - each with its marvelous genetic hertitage built up over millions of years -



plus healthy Soil

Water H_20





The Sun - our closest Star who pours forth the electromagnetic waves that are the main source of energy reaching the Earth

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4 - Sprouting Seeds Game

a 'Progress towards a Goal' group game of chance

Ages: 5 to 9

Performance Expectations:

After playing this game, students should be able to understand some of the variables affecting the growth of plants from seeds. They should be able to list a certain number of positive and negative factors influencing seeds' development into photosynthesizing plants (depending upon the age of the students).

NGSS Disciplinary Core Ideas: PS1.A, B; PS2.A, B, C; PS3.D; LS1.A, B, C; LS2.A, B, C, D; LS4.C, D; ESS1.B, ESS2.A, D; ESS3.A, C

NGSS Practices: 2. Using models

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 4. Systems and System Models; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function; 7. Stability and Change

Materials:

- Trimmed Copies of Individual **Sprouting Seeds' Event Cards**

Overview:

This is a game of chance that can easily be played by individuals (in a group of six or less) or by teams (for a school group). It can be even more meaningful if the youngsters name themselves or their team after a favorite native plant - or after a plant from some other biome that they've studied.

Here's the basic playing procedure for teams:

Each set of children represents hundreds of seeds whose growth depends upon the environmental conditions that they encounter. Growth is represented by their progress towards a predetermined line / goal that symbolizes a well-established and flourishing collection of plants. The two or more teams arrange themselves along a starting line on the playing field so that each team is able

to move as a unit. A volunteer moderator reads the shuffled cards alternating between teams. Depending upon the events described on the chosen cards, each group moves forward, backwards, or stays in place. The first team to actually reach the finish line is declared the most fortunate set of seeds – these plants have all sprouted and grown - and these youngsters win the prize – whatever that is! Perhaps it's the option of selecting the next game or a hike destination, or just the glory of being lucky.

To encourage the youngsters to consider and discuss the needs and dangers confronting the seeds, brainstorm a collection of appropriate perils and boons. During class, have them write or type and print and cut out their own event cards. Here are a few possibilities that could be used to start this process or to try out the game:

4.1 - Sprouting Seeds Event Cards

Cold

BACK 1

Sunny

FORWARD 2

Warm

FORWARD 2

Eaten by birds

BACK 2

No rain

BACK 3

A very heavy rain.
You're washed into
a creek

BACK 1

Slow steady rain

FORWARD 2

Well drained,
nutrient rich soil

FORWARD 3

A Cutworm (a type
of moth larva) eats
some of the newly
sprouted stems

BACK 2

continued 4.1 Sprouting Seeds Event Cards

Bright sunshine

FORWARD 2

Nice, slow rain

FORWARD 2

Plenty of NPK (the elements nitrogen, phosphorous, and potassium)

FORWARD 2

Not enough nutrients in garden

BACK 2

Hungry rabbits and woodchucks

BACK 3

Cow manure added – good soil

FORWARD 2

Abundant sunlight and carbon dioxide and plenty of water in the soil. Photosynthesis (a word that describes how plants make their food) is going along well in your first leaves

FORWARD 2

Good soil

FORWARD 3

Hungry insects are gnawing on your leaves

BACK 1

Other plants are out-competing you for sunlight and minerals **BACK 3**	Plenty of earthworms aerating the soil and adding nutrients **FORWARD 2**	Stepped on repeatedly by a people **BACK 1**
Tended well by people **FORWARD 2**	Too much shade from a nearby tree **BACK 3**	Hail damages your newly sprouted stems **BACK 2**
Lots of ladybird beetles, praying mantises, spiders, and brachonid wasps are eating insect predators. These beneficial insects are keeping the number of pesky insects low **FORWARD 4**	Plenty of organic material in the soil **FORWARD 2**	Too much competition for water from the roots of nearby plants **BACK 3**

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continued 4.1 Sprouting Seeds Event Cards

Fine temperatures for growth

FORWARD 3

Too much water crowds the oxygen out of the soil. Anaerobic bacteria (bacteria who thrive when there's no oxygen) begin gobbling your roots

BACK 2

Other aggressive plants crowd and shade you

BACK 3

The soil contains just the right amount water-absorbing humus (organic material)

FORWARD 3

Too many rocks for your roots

BACK 2

Excellent weather for making food from sunlight, water, and Carbon Dioxide!

FORWARD 3

Stepped on repeatedly by a careless dog

BACK 1

Hungry insects munch on your leaves

BACK 1

Nematodes (a kind of round worm) ruin your roots

BACK 1

Hungry mice are chomping on many seeds **BACK 2**	A strong wind is drying out both the soil and your leaves **BACK 1**	There is a good mix of absorbent clay, sand for drainage and aeration, and humus particles in the soil in which you've been planted **FORWARD 3**
A gentle rain helps provide water / H20 for growth **FORWARD 3**	Helpful mycorrhizal fungi colonize your developing roots allowing them to obtain more vital minerals. As part of this partnership/mutualism, you provide the fungi with food molecules such as sugars and starches. Both you and the fungi benefit! **FORWARD 4**	There are lots of helpful single-cell soil organisms (such as beneficial bacteria and archaea) in this plot of ground **FORWARD 2**
People walking on the ground right after a rain compact the soil and make it harder for you to extend your roots **BACK 2**	Partly cloudy weather provides plenty of solar energy for your new leaves, but keeps the temperatures moderate **FORWARD 2**	Single-celled soil organisms (such as the bacteria) have been decomposing dead plant and animal materials. They've released chemical components such as nitrogen back into the ground. Now you'll be able to use those materials to make vital proteins **FORWARD 2**

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The little leaf litter layer creatures (including millipedes, mites, and isopods) are thriving. They're doing their part to keep this garden's soil healthy

FORWARD 3

Protozoa munching on bacteria are producing nitrogen containing compounds that you can readily use

FORWARD 4

A variety of spiders are reducing the numbers of plant-eating arthropods by catching them in their small webs

FORWARD 33

Greedy nematodes and insect larvae are being kept in check by busy little soil mites

FORWARD 2

Humans operating heavy machines have seriously compacted the soil, reducing its ability to store water and oxygen

BACK 3

Some well-aged compost (made from kitchen scraps) is added to this ground. It stores water and provides extra minerals and compounds for growth

FORWARD 3

Soil arthropods (such as ants and springtails) are busy shredding organic matter as they gobble up their dinners. They help the recycling process in the soil and move materials around

FORWARD 2

Tiger beetles are defending you from greedy caterpillars

FORWARD 2

Hungry starlings eat some of the newly sprouted seeds

BACK 2

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continued 4.1 Sprouting Seeds Event Cards

One of your two cotyledons (seed leaves) was eaten by a small grasshopper nymph

BACK 2

There's enough sunshine and water available for your new true leaves to begin growing

FORWARD 3

A person trying to water you has poured on too much water too quickly, and some of the s oilhas washed away from your delicate roots

BACK 1

A Phoebe (bird) catches several cabbage white butterflies who would have otherwise laid lots of eggs on your newly developed leaves. The eggs would have hatched into greedy larvae, but those won't be a problem now

FORWARD 3

Many other plants are shading you and making it difficult for you to photosynthesize / make food even though you've sprouted and have some tiny true leaves

BACK 3

There are wood sorrel and ground ivy plants growing right next to the area where you've sprouted. They're absorbing much of the water and making it difficult for you to obtain enough water with your small, developing roots

BACK 2

5 - Recipe for a Forest

an associative learning and collecting game featuring a linked-run race

Ages: 6 to 12

Performance Expectations:
Students will be able to describe five key components that must be interacting for forests to grow on a particular piece of ground. They will become more aware of the interlocking nature of these factors and their roles in the development of these complex and beautiful networks of life – i.e. forest ecosystems.

NGSS Disciplinary Core Ideas: ESS1.B, ESS2.A, C; LS1.A, B, C, D; LS3.A; LS4.B, C

NGSS Practices: 2. Using models

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 4. Systems and System Models; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function; 7. Stability and Change

Materials:

- Trimmed Copies of the "Recipe for a Forest" cards (one card per student) These are available at the end of this section.

Overview:

This is a team game for older students using a 'linked run' model similar to that just described in "For Seeds to Sprout." Its physical activity mimics the way multiple factors work together in nature to generate biological phenomena - in this case a living forest. This activity can be a nice accompaniment to lessons and field trips focused on Forest Succession.

The premise is that a forest can exist only if at least five aspects of the natural world are present. These interacting factors are:

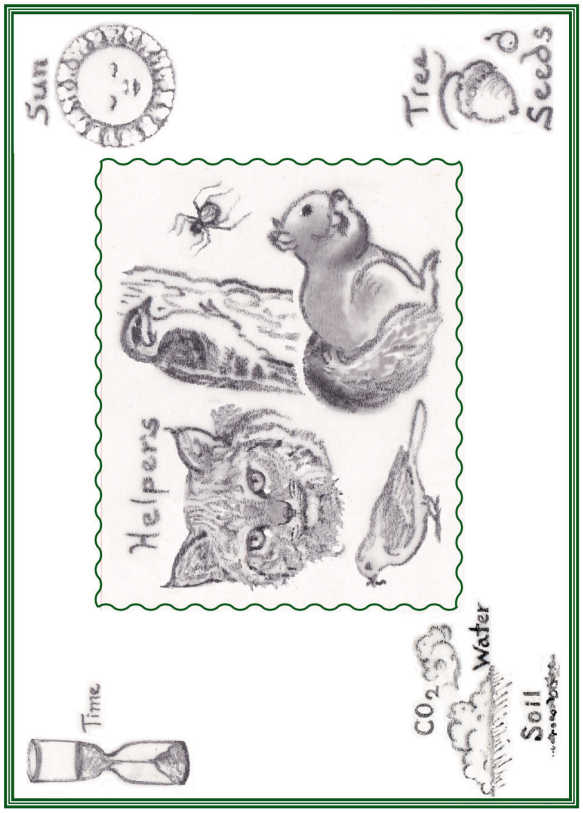
1. **Sunlight** - the immediate and ongoing energy source
2. **Carbon Dioxide, Water, Soil, and other mostly abiotic factors** (For the moment, we're focusing on the minerals within the soil and the rocky substrate - rather than the soil's living microbiome)
3. **Tree Seeds** - genetic heritage
4. **Various Living Helpers -** such as blue jays, bobcats, woodpeckers, owls, squirrels, spiders, bees, recycling bacteria, mycorrhizal fungi, etc. These creatures have evolved varied partnerships, patterns of interaction, and relationships that benefit the forests' general thriving. Some of these creatures protect trees from excessive predation by eating other living beings who tend to feed on trees (trophic cascades). Some are pollinators or seed dispersers. Some decompose various materials so that their components can be released back into the environment. Others absorb, transform, or transport minerals or various organic or inorganic compounds among the varied plants of the forest. These helpers have all coevolved with the other living beings in the forest in ways that allow the forest (as a system) to persist and flourish.
5. **Time** - so important! Forests require decades and often centuries and even millenia to attain their mature splendor and complexity.

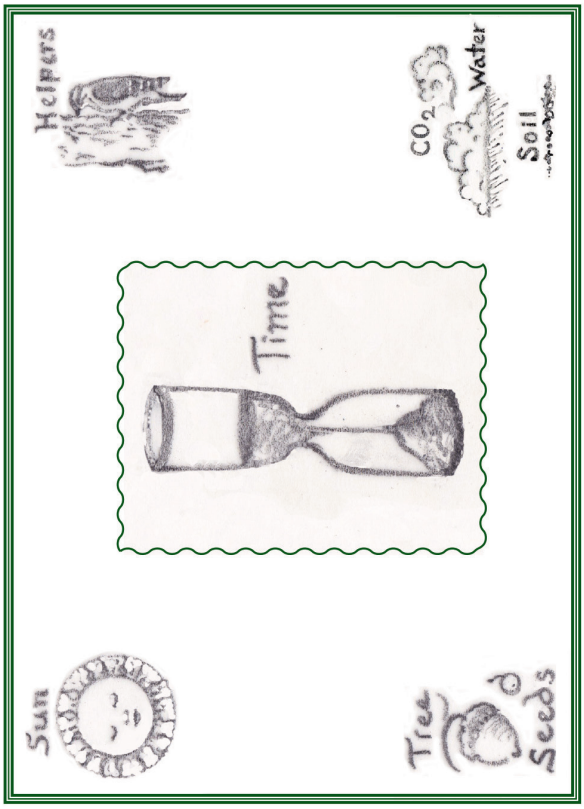
Each student is given a card that shows all five components. One of the components is featured prominently in the center while the other four appear at a smaller scale on each of the card's four corners. (All five are shown to help children remember and eventually learn about these key forest 'ingredients')

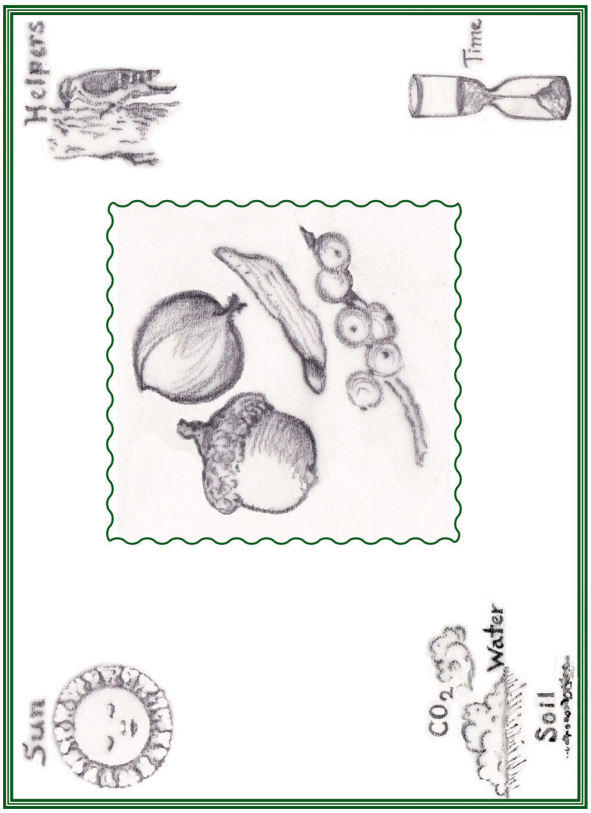
At a signal, the youngsters turn their cards over and 'become' whatever component is in the center of their particular card. Each student must now go in quest of their four missing partners. When five different 'components' have actually managed to find each other and join hands, they sprint or hop across the designated playing ground. They can only progress as a group of five. Therefore, if their chain breaks, they must stop and reassemble before going forward. The first group to reach the finish line as a linked team becomes the winner. They represent a healthy forest that's growing and thriving.

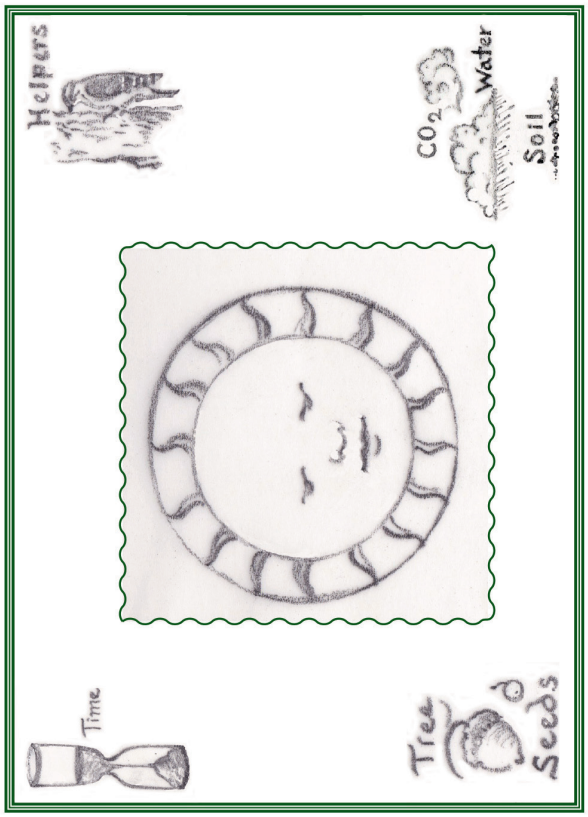
Students can debrief from this game by explaining why each of the five factors is essential for the forest's existence. Alternately, they might discuss what tactics helped them to assemble and run together well. A conversation of this sort allows them to think objectively and reflectively about behaviors / interactions that they've just experienced. They can articulate some of the strategies they used and consider together how these helped or hindered the achievement of their collective goals.

5.1 - Recipe for a Forest Cards - Part 1









5.1 *continued* Recipe for a Forest Cards - Part 2

Recipe for a Forest Cards

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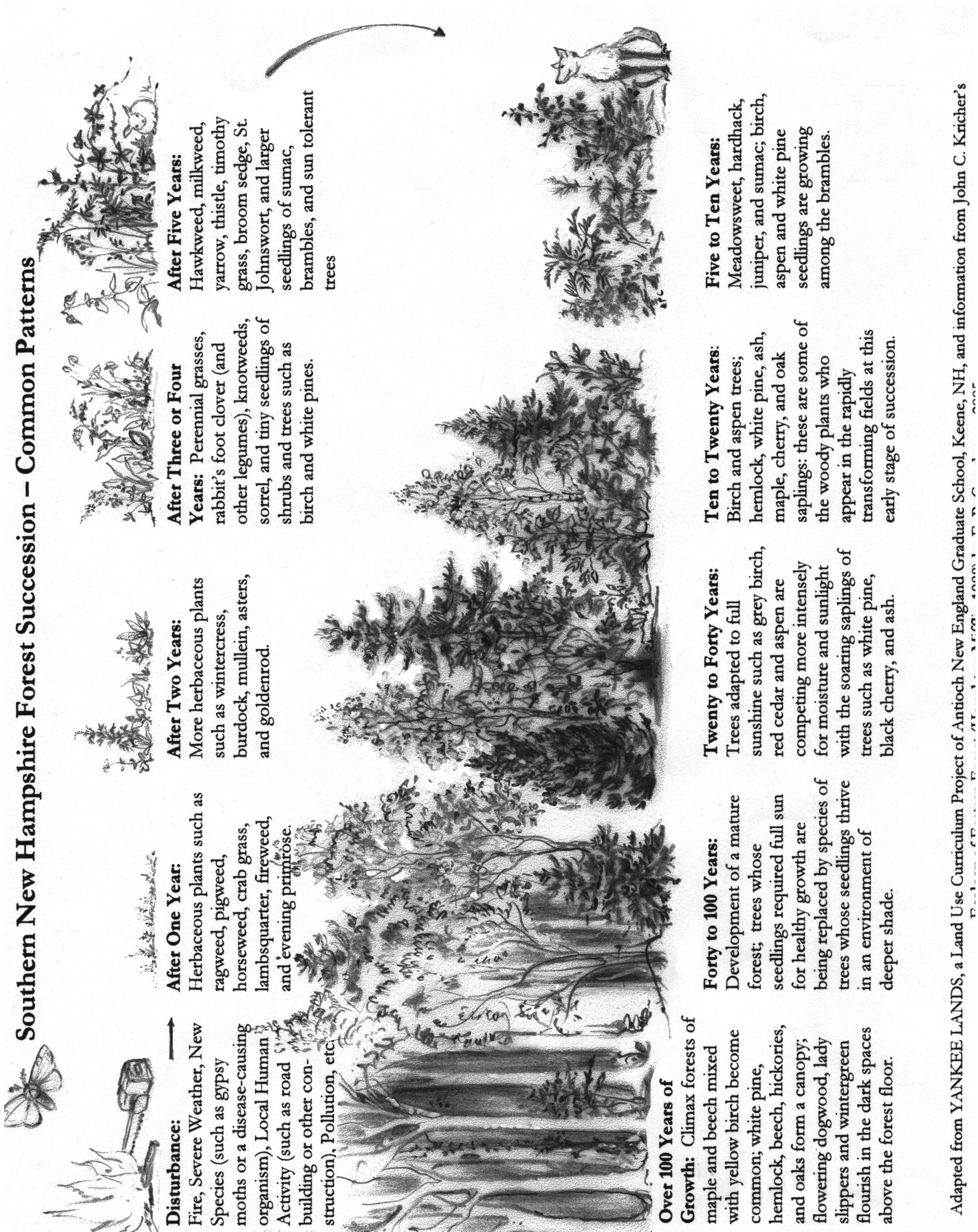
5.2 - New Hampshire Forest Succession



Southern New Hampshire Forest Succession – Common Patterns

Disturbance: Fire, Severe Weather, New Species (such as gypsy moths or a disease-causing organism), Local Human Activity (such as road building or other construction), Pollution, etc.

After One Year: Herbaceous plants such as ragweed, pigweed, horseweed, crab grass, lambsquarter, fireweed, and evening primrose.

After Two Years: More herbaceous plants such as wintercress, burdock, mullein, asters, and goldenrod.

After Three or Four Years: Perennial grasses, rabbit's foot clover (and other legumes), knotweeds, sorrel, and tiny seedlings of shrubs and trees such as birch and white pines.

After Five Years: Hawkweed, milkweed, yarrow, thistle, timothy grass, broom sedge, St. Johnswort, and larger seedlings of sumac, brambles, and sun tolerant trees

Five to Ten Years: Meadowsweet, hardhack, juniper, and sumac; birch, aspen and white pine seedlings are growing among the brambles.

Ten to Twenty Years: Birch and aspen trees; hemlock, white pine, ash, maple, cherry, and oak saplings: these are some of the woody plants who appear in the rapidly transforming fields at this early stage of succession.

Twenty to Forty Years: Trees adapted to full sunshine such as grey birch, red cedar and aspen are competing more intensely for moisture and sunlight with the soaring saplings of trees such as white pine, black cherry, and ash.

Forty to 100 Years: Development of a mature forest; trees whose seedlings required full sun for healthy growth are being replaced by species of trees whose seedlings thrive in an environment of deeper shade.

Over 100 Years of Growth: Climax forests of maple and beech mixed with yellow birch become common; white pine, hemlock, beech, hickories, and oaks form a canopy; flowering dogwood, lady slippers and wintergreen flourish in the dark spaces above the forest floor.

Adapted from YANKEE LANDS, a Land Use Curriculum Project of Antioch New England Graduate School, Keene, NH, and information from John C. Kricher's

6 - Old White Pine is Falling Down

a singing, processional game with a final 'Tug-of-War

Ages: 4 to 7

Performance Expectations:
Students will be able to describe at least two or three plausible events in the life of a White Pine tree. They will develop a more detailed appreciation of the fact that plants are living beings. They will be able to cite at least two of the animals who find shelter / make a home in such a tree. They will understand more clearly that even when a tree is old and dying, it can help foster new life (particularly in other species). They will also be able to name at least one of the creatures who feeds on aging trees, and thereby, helps recycle plant materials back into the forest food web.

NGSS Disciplinary Core Ideas: PS1.A, B, C; LS1.A, B, C, D; LS2.A, B

NGSS Practices: 2. Using models

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 4. Systems and System Models; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function; 7. Stability and Change

Materials:

- A 20 or 30' length of natural fiber rope with a knot in the middle is ideal for a large class, but not essential. The game can be played more casually with the youngsters just forming the lines by holding hands. (If you are using a rope, I recommend checking online for safety recommendations for 'tug-of-war.' Key points: Make certain that youngsters do not wrap the rope around their fingers or hands, and never use springy nylon ropes.)
- 3 markers to designate key lines on the playing field. These could be long, dried plant stems from cattails or goldenrods, thin sticks, lengths of yarn, or arrays of stones or pine cones

Overview:

Here's a version of ***London Bridge*** that is suitable for young children. It helps them understand how individual plants, or more precisely, trees are eventually vanquished over time by weather conditions and various creatures such as fungi and munching insects. At the same time, it also offers the consoling prospect that new life emerges from the process of decay. Through the lyrics of the chant, students learn about some of the specific living beings whose very existence is supported by trees that are in decline or actually dead. The youngsters practice their singing skills and have the suspense and fun of being caught in 'falling branches.' They also participate in a tug of war to determine whether the white pine will be replaced by a beech or a maple tree (an introductory nod to the topic of forest succession and the way that certain species replace other species in particular kinds of forests). The premise for the end of this game is that the little chipmunks (who are carrying either beech nuts or maple samaras) are very startled when the pine tree finally topples. They drop their seeds and dash for safety into their underground tunnels. Depending upon which side wins the tug, seeds from either the beech or the maple tree will be said to sprout and replace the fallen white pine.

You might mention to the children that it's also likely that other seeds from the pine tree's many pinecones may have already drifted out into the wind. These could have been carried away by the breezes or stored away by forgetful squirrels. In either case, such seeds may have already sprouted along the forest edge. Even as the old tree falls, they might be already lifting their branches skyward - continuing in new places the genetic legacy and life of the old pine tree.

The actual game begins with the choosing of two children to represent the pine tree. They face one another and join uplifted hands ('branches') to make an arch. One of the two represents the side of the tree where chipmunks carrying maple seeds like to gather. The other represents the side of the pine that's favored by chipmunks collecting beech seeds. Aside from the 'tree' trunk halves themselves, no one except the teacher / facilitator should know which of the pair is associated with which seeds.

The rest of the children are asked to imagine that they are chipmunks who've been collecting tree seeds for food on a fine afternoon. A few moments might be devoted to describing the relative merits of beech nuts versus maple samaras as dinner delicacies for chipmunks. Alternately, the two mature trees (beech and maple) might be described, and their varied virtues / characteristics could be listed and compared. Each chipmunk should silently decide which seeds they'll prefer - a choice that they'll only reveal when they're finally captured, and the pine asks for an answer.

The chipmunks now proceed in a circling line through the split trunk of the white pine. Singing, they duck beneath the pine's archway. The teacher (or someone else with good reading skills) helps them with the lyrics which are sung to the tune of London Bridge. Every so often, the uplifted pine 'branches' fall down - according to the whim of the children who are pretending to be the tree - or because the singing has reached the refrain of "Little Chipmunks." The fallen 'branches' entrap whichever chipmunk was passing through, gently

catching him or her between outstretched arms. The captured chipmunk must then declare (in a whispered conference with the tree children) whether he or she was carrying maple or beech seeds. The captured chipmunk is then sent off to join the bearers of that particular kind of seed. They form a line behind the half of the tree designated for their species, and continue to participate by singing the verses.

When all of the chipmunks have been caught and lined up on either side of the two tree children, a tug of war is conducted. A marker (such as a long plant stem, a delicate stick, or a length of yarn, etc.) is placed on the ground at the original site of the pine. This becomes the center point for the contest. Two other markers are placed equidistant on either side of the center point, perhaps a yard away for younger children. Students link themselves together into a long line using either clasped hands or by grabbing hold of a long rope which has a knot in its center (positioned over the center marker). In the latter case, the students grasp the rope starting at two points directly above those ground markers which are some three feet from the center. At a shouted signal of "GROW!" – the youngsters in each team start to pull in unison, trying their best to drag the opposite team across one of the two outside markers.

Time and attention permitting, for the sake of more learning, the signal to "GROW" can be encased in suspense-filled sentences such as "The great white pine tree has crashed thunderously to the ground and suddenly there's more water and light and finally the maple and beech seeds are able to s-p-r-o-u-t a…n…d GROW!" At this point each side begins pulling. When one of children in one of the teams is actually pulled across a side marker (one toe over the line suffices), then the other group has won. This team, whether it represents the maple or the beech seeds, can now regard itself as the Old White Pine's glorious successor!

Possible Lyrics for "Old White Pine and Little Chipmunk"

Old White Pine is falling down, falling down, falling down.
Old White Pine is falling down, Little Chipmunk.

T'was struck by lightning years ago, years ago, years ago.
T'was struck by lightning years ago, years ago, Little Chipmunk.

That split a branch off years ago, years ago, years ago.
That split a branch off years ago, Little Chipmunk.

Where bark was torn, the fungi grew, fungi grew, fungi grew.
Where bark was torn, the fungi grew, Little Chipmunk.

They ate the xylem by and by, by and by, by and by.
They ate the xylem by and by, by and by, Little Chipmunk.

The ants moved in and tunneled too, tunneled too, tunneled too.
The ants moved in and tunneled too, Little Chipmunk.

Bark beetles carved some galleries, galleries, galleries.
Bark beetles carved some galleries, Little Chipmunk.

Woodpecker ate them one, two three; one, two three; one, two three.
Woodpecker ate them one, two, three, Little Chipmunk.

And then he drilled a cavity nest, cavity nest, cavity nest.
And then he drilled a cavity nest, Little Chipmunk.

Woodpeckers raised their family, family, family.
Woodpeckers raised their family, Little Chipmunk.

When they were grown, they flew away, flew away, flew away.
When they were grown, they flew away, Little Chipmunk.

When these moved out, red squirrel moved in, red squirrel moved in,
red squirrel moved in.
When these moved out, red squirrel moved in, Little Chipmunk.

When she ran out, a bat flew in, a bat in, a bat flew in.
When she ran out, a bat flew in, Little Chipmunk.

When he flew off, an owl peeked in, an owl peeked in, an owl peeked in.
When he flew off, an owl peeked in, Little Chipmunk.

Then all last week the wind blew hard, the wind blew hard, the wind blew hard.
Then all last week the wind blew hard, Little Chipmunk.

And that is when the tree did fall, the tree did fall, the tree did fall.
And that is when the tree did fall, Little Chipmunk.

Invertebrate Animals, especially Insects

7 - An Insect's Life Cycle Activity

a singing, impersonating game

Ages: 4 to 7

Performance Expectations:
Students will be able to describe the life cycle of an insect with complete metamorphosis.

NGSS Disciplinary Core Ideas: LS1.A, B, C, D; LS2.A, B, C, D; LS3.A; LS4.C

NGSS Practices: 2. Using models

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function; 7. Stability and Change

Lyrics for I'm a Little Insect

(with suggested actions)

I'm a little insect egg
Hidden on a tree. (Curl up, and make yourself as small as possible)
My mother placed me near these leaves.
They'll be a feast for me. (Smile broadly as if thinking of good food)

Now I stretch and now I hatch. (Act out the words)
I'm a larva with many feet. (Lightly stamp feet many times)
I'm a fat, pale, little worm-like thing,
And don't I love to eat? (Smile; chomp your jaws back and forth rapidly)

I eat, I grow, I split my skin. (Keep chomping and pretend to get bigger, and then pretend to rip open your shirt or more accurately, exoskeleton)

I eat and grow some more. (Stand on tip-toes, pretending to grow even larger)

But now it's best for me to rest

As a pupa on the forest floor. (Press hands together resting them against the side of your face as if you're about to fall asleep. Sink drowsily to the floor as if for a nap)

But now I've changed and again I hatch. (Stretch and stand)

I have wings - and I can fly. (Flap arms while standing in place)

Time to find a mate and lay some eggs

In a new place, and so, Good-Bye! (Wave your 'wings' good-bye and take fligh by swooping about the room. All the children flap around a bit)

8 - Buzzing Bumblebee Circle Game

a singing, choosing circle song building verbal knowledge and related to local flowering plants

Ages: 3 to 7

Performance Expectations:

Students will learn about some of the wonderful, mutually beneficial relationships that have coevolved between wild bumblebees and certain wildflowers of the Northeastern Forests.

NGSS Disciplinary Core Ideas: LS1.A, B, C, D; LS2.A, B, C; LS3.A; LS4.D

NGSS Practices: 2. Using models

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 4. Systems and System Models; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function

Overview:

This is a simple circle game for young students. It can provide a pleasant conclusion to a classroom lesson about plants and the amazing (and mutually beneficial!) partnerships they have with various pollinating animals (coevolution). It can be used to conclude a field trip that has emphasized the beautiful wildflowers of fields, forests or wetlands. It could also be used after a general nature discovery hike or a program on insects. This particular version is set in a Northeastern forest with blooming spring ephemerals. Prior to the walk, I mention to then children that they should try to remember the names of the flowering plants we see because these plants are their actual **neighbors**, and it's respectful to know your neighbors' names. Then I add that if they can learn the plants' names, they will also be able to better play a Bumblebee Game at trails' end. In other words, I use the game as an incentive for them to acquire a working knowledge of the common names of local plants. I've found that even if the children don't recall all the names from the walk itself, singing the words out loud and listening to a brief

description of each particular flower when they're playing the concluding game (when that name is offered as one of a set of choices) reinforces students' awareness of their region's flowering plants. This activity also teaches children, in a dramatic and embodied way, about the vital connection between flowers and bees – a classic example of Mutualism and Coevolution.

To play, the children form a circle, joining hands. The premise is that the youngsters are pretending to be a forest of blooming plants - or a blossominggarden, field, or wetland, etc. One child is selected to be the bumblebee. While the circle of children sings the first two verses, the bumblebee child skips around the perimeter or (for more coordinated, cooperative players) weaves his or her way in and out through the blossoming meadow or forest formed by their classmate's joined and uplifted hands. Bumblebee is encouraged to buzz and stretch her wings / arms out behind her back during the traveling. If the bee is weaving, he or she ducks in and out of the circle by passing under the archways formed by the joined hands. Remind Bumblebee not to skip any arches – and realize that younger students often find this action / this pattern very challenging at first.

At the end of the verse "What flower will she choose today," Bumblebee stops and chooses someone to be the flower. The facilitator asks the chosen child what particular kind / species of flower they'd like to become (mention to the youngsters, if they're old enough, that they should name a flower that grows wild in their region, or ideally, one that they have observed on the recently completed field trip or walk through the school garden.) Once the flower's identity has been established, Bumblebee takes this 'flower pollen' child by the hand. Having now gathered the pollen, Bumblebee leads him or her around the circle dipping once again under the arches formed by the other children's uplifted arms – or more simply, the pair just circles the perimeter. As an accompaniment to the bee and flower pollen's journey, the 'forest' or 'meadow' children sing a verse that repeats the name of the chosen flower. Try to encourage them to sing as melodiously as possible!

At the end of the chant, it can be fun to count (out loud, as a group) how many arches the bumblebee and flower pollen pair have passed. This not only introduces math into this early learning activity, but it also provides an opportunity for the pairs to compete to be the team who visits the most flowers (i.e. travels through the greatest number of arches, or circles, past the greatest number of students) before the singing stops. When the verses are finished, the child who represented flower pollen may select the next Bumblebee. He or she then rejoins the circle, together with the former bee, and the newly chosen Bumblebee begins his or her travels.

Basic Lyrics for "The Buzzing Bumblebee" Game

Here comes a roving bumblebee
On a fresh May (June, July…) morning.
Here comes a buzzing bumblebee
For Nectar sweet and Pollen.

What flower will she (or he) choose today
On this fresh May (June, July…) morning?
What flower will she (or he) choose today
For nectar sweet and pollen?

A Bluet she will choose today
On a fresh May morning.
A Bluet she will choose today
For nectar sweet and pollen.

A few other flower possibilities for the Northeast Forestlands:

A Violet, Mayflower, Lady Slipper, Hepatica, Wood Anemone, Starflower, Trillium, Blueberry, Polygala, Bloodroot, a Bluet, etc.

9 - The Foraging Bee's Spring Adventures

a 'Progress towards a Goal' team game of chance

Ages: 6 to 12

Performance Expectations:

Students will acquire many insights into the complexities of honey bees' lives. They will be able to describe in words (or for the youngest: pictures) some features of a foraging bee's daily activities. They will be able to identify the partnership between bees and flowering plants as an example of a very old, coevolved, mutually beneficial relationship. They will begin learning about the more recent, coevolved relationship between humans beings and "domesticated" honey bees. They'll also see how this beneficial partnership can be disrupted by the actions of uninformed, unaware humans. Playing this game should enable children to envision and describe with greater detail and compassion, the intricate ecosystems within which bees and other living beings (such as us people) all interact.

NGSS Disciplinary Core Ideas: LS1.A, B, C, D; LS2.A, B, C, D; LS4.C, D; ESS2.D; ESS3.C, D

NGSS Practices: 2. Using models; 7. Engaging in Argument from Evidence; 8. Communicating Information

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 3. Scale, Proportion, and Quantity; 4. Systems and System Models; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function; 7. Stability and Change

Materials:

- Trimmed copies of the **Sample Chance Cards for Foraging Bees**

Overview:

This is a team game of chance. It allows the children to work in groups and to move, act, and imagine as well as listen. The procedure is simple: There are

two or more teams who are referred to as "hives" of bees. Each hive is trying to fill all of their available honeycomb cells with pollen and honey. By doing this, they will help ensure that they'll have enough food stored for everyone to eat during the winter. The first "hive" of bees to reach the designated finish line is the first to successfully provision their waxy cells. As they move towards or away from the prearranged finish line (according to the directions on the Chance Cards), each group of bees should be encouraged to buzz, flap their wings, and react in bee-like ways to the vagaries of fortune and fate.

For all games of this type, it's very effective for the sake of learning to have the youngsters brainstorm additional event scenarios. In this case, additional events might be devised after the students have played the game once or twice and have observed or researched more details about bees' actual daily existence. Simply write the new events - and their consequences - on cards and add these to the deck.

Sample Chance Card**s for Foraging Bees**

Lots of wonderful fresh clover flowers blooming nearby

FORWARD 4

A large crab spider is hiding in the petals! Danger!

BACK 3

A cold day (below 55 degrees Fahrenheit). It's too chilly for your flight muscles to work effectively. Shelter at home in the hive - no flights today Hail damages your newly sprouted stems

BACK 1

A bee wasp nearby. Fly away to escape

BACK 3

A disease-causing parasite, the microscopic, amoeba-like *Nosema apis* has invaded your chyle-stomach. Luckily, you're very healthy in general, and your immune system is able to fight off the invaders - lose a turn while you're resting and recovering

Sunny day

FORWARD 4

A cherry tree is in blossom. Help carry pollen from flower to flower (ensuring a good crop of cherries) while gathering plenty of nectar and pollen for your family as well

FORWARD 2

Rainy day - can't fly

STAY IN PLACE

Not too breezy; a good day for flying

FORWARD 3

Flower colors are very bright, and you spot them quickly

FORWARD 2

Not enough rain, so very little nectar is being produced. You have to fly to many flowers in order to collect just a small amount

BACK 1

Avoid a prowling digger wasp (*Philanthus*)

BACK 2

The flowers smell delicious in the clean air, and you can detect their fragrance easily

FORWARD 3

Insecticides that were sprayed nearby have poisoned your queen. This is a disaster! The whole hive is out of the game!

A nice nature preserve nearby is filled with native flowers

FORWARD 5

Blooming lupines

FORWARD 3

A bee louse (actually a type of tiny fly) is crawling around on your fuzz. It will try to steal honey later on. What a nuisance!

BACK 1

Weather conditions are good. Nearby plants have produced many nectar-filled blossoms

FORWARD 4

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continued – Sample Chance Cards for Foraging Bees

Brisk winds make it difficult for you to fly

BACK 2

Many flowers are bloom -ing closely together. This allows you to gather lots of pollen without having to fly long distances

FORWARD 3

Toxic sprays for mosquitoes injure or kill some of your hive's best pollen collectors

BACK 4

More flowers are blooming in a nearby park

FORWARD 2

Toxic chemicals have been applied to plants in a garden center. They make you sick

BACK 1

A flower garden nearby is filled with nectar and pollen-filled blossoms

FORWARD 3

Other insects have already gathered most of the nectar and pollen

BACK 1

A mockingbird (who's searching for food for its young) chases after you!

BACK 1

You find a pathway edged with blossoming lavender: Yumm!

FORWARD 3

Fruit trees and flowers are blooming in many yards **FORWARD 2**	**You find organically-grown backyard gardens filled with blooming green beans, squash blossoms, and sunflower plants** **FORWARD 2**	**Pink peach blossoms are providing your hive with lots of protein-rich pollen and energy-filled nectar** **FORWARD 3**
People have allowed their lawns to become blooming perennial meadows – not mere stretches of sterile, mono-cropped grass. Many flowers are blooming in these meadow lawns **FORWARD 4**	**Nectar-filled Joe-Pye Weed is blooming in the wetlands** **FORWARD 2**	**A dragonfly almost catches you** **BACK 2**
An industrially-produced chemical treatment is being squirted on a lawn. It sickens you and your sisters as you fly past **BACK 3**	**A bear knocks over your hive, but your beekeeper with her dogs chases him away** **BACK 3**	**A huge shopping mall and highway is built between you and the best foraging spots** **BACK 4**

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Clear skies today and plentiful recent rains have prompted many flowers to blossom. Enjoy!

FORWARD 2

You've had a restorative nap in the hive. Refreshed, you gather a good amount of nectar

FORWARD 2

A sunny day without too much wind

FORWARD 3

Mites are weakening you as they sip your blood and introduce viruses

BACK 3

Your human beekeeper is both caring and knowledgeable

FORWARD 3

There are many 'wild' areas near your hive providing a healthy variety of nectar and pollen sources

FORWARD 3

A family has planted apple trees, lavender, and native plants such as asters, wild bergamot, Joe Pye weed, and blueberries. There's plenty of food for your family throughout the growing season

FORWARD 4

Asphalt parking lots and big box stores have been built on what was once a diversified dairy farm with pastures and a small forest

BACK 4

Purple bergamot, filled with delicious nectar, waves in the sunshine, silhouetted against the blue sky

FORWARD 2

You carefully observe another field bee's 'round dance' and sample the pollen she's just brought in. Scoot out of the hive to collect more of this nearby food source

FORWARD 2

Serious Problems and a few Positive Events that are probably Best for Older Students

You accidentally ingest (eat) some Imidacloprid – a neonicitinoid pesticide that was sprayed on corn and has drifted onto flowers. This could cause your home colony to "collapse" depending upon how much you and your sisters have consumed!

BACK 4

and lose the next turn too!

Good laws are drafted (passed and enforced!) so that genetically modified plants with BT genes can't be grown in open fields. This legislation protects you from contact with these plants' toxic pollen

FORWARD 4

You discover sap-covered buds of balsam poplar and collect this sticky resin for use back at the hive. Other bees will mix it with beeswax to turn it into Propolis. This will serve as a useful antimicrobial and glue to fill in small gaps in the hive structure

FORWARD 3

Drifting fumes from cars, factories, trucks, and daily mosquito sprays, confuse and sicken the field bees, including you. You just aren't able to collect as much pollen or nectar as usual

FORWARD ONLY 1

Inside the hive, you watch intently another field bee's "waggle" or "figure 8' dance. She does this dance after returning from a successful collecting trip. Using your memory of the information you gleaned from her dance movements, and your own observation of the sun's position in the sky outside, you leave your hive, making a 'beeline' towards this abundant but somewhat distant source of delicious food. (For a quick visual summary of this communication process, try https://www.youtube.com/watch?v=-7ijI-g4jHg) or this longer video https://www.youtube.com/watch?v=bFDGPgXtK-U

FORWARD 4

The apple trees bloom too early (a side effect of global warming?). When the blossoms are fully open, the weather changes. It becomes too cold for you to fly. None of the bees in your hive can collect nectar and help pollinate the apples. You lose the harvest of apple nectar and pollen – and the neighboring people lose most of the year's potential apple crop

BACK 2

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Clovers and violets are blooming in an herbicide-free, mixed perennial, Lionel Smith style sward (a recent English alternative to the all-grass lawn). You harvest plenty of nectar and pollen this morning!

FORWARD 3

Crowded highways and the emissions from trucks and cars (which obscure the fragrance of blooming plants) are creating dangerous and puzzling conditions. This makes it difficult for you to find food in the nearby parks and return safely to the hive

BACK 2

It cooled down very quickly in the late afternoon while you were out foraging. It was too cold and windy to fly back home before night. Shelter and sleep (not too well) in a purple New England aster blossom

BACK 1

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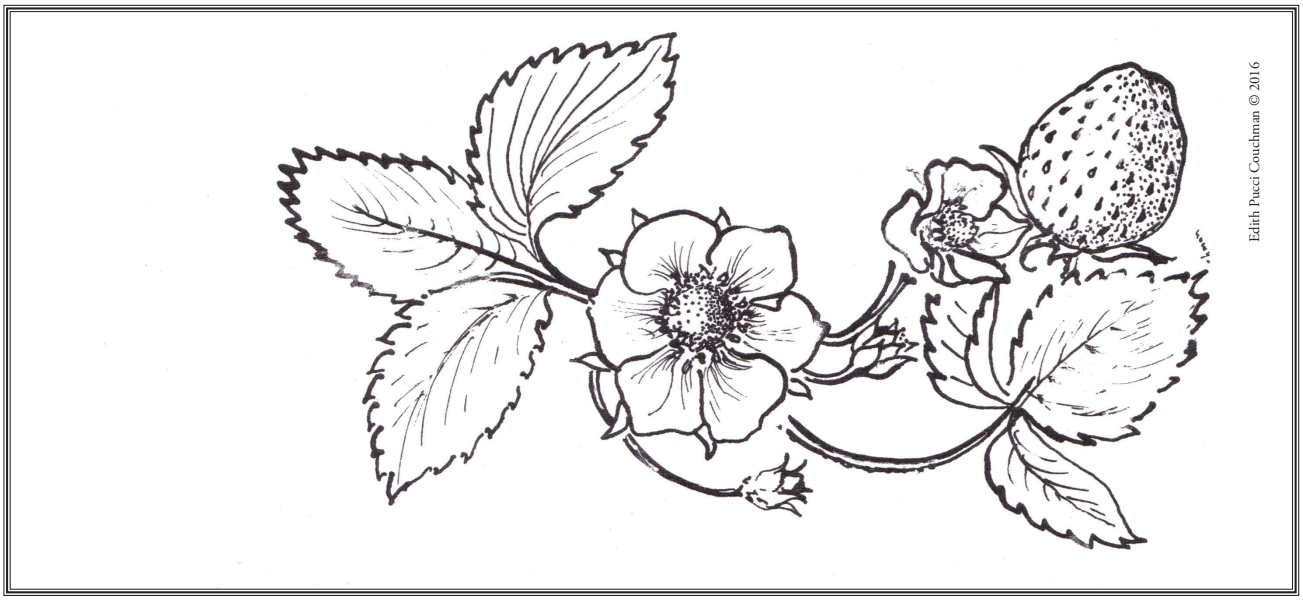
9.1 Honey Bee and Strawberry Name Tags



10 - Blossoms and Pollinators

an example of the basic format for
'Associative Learning through Team Relays'

Ages: 9 to 12

Performance Expectations:

Students will learn about coevolved plant and pollinator forms and functions. They'll begin to understand that certain flower shapes, fragrances, products, and colors have developed in ways that enhance coordination and interaction between specific plants and the mobile animals who assist them with pollination. They'll develop an appreciation for these delicate and ongoing partnerships that have been woven over the course of millions of years. When the youngsters run the relay race which is based upon this information, they'll exercise their muscles, social skills, and knowledge of these vital and mutually beneficial relationships.

NGSS Disciplinary Core Ideas: LS1.A, B, C, D; LS2.A, B, D; LS3.A, B; LS4.A, B, C, D

NGSS Practices: 2. Using models

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 3. Scale, Proportion, and Quantity; 4. Systems and System Models; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function

Materials:

- **Pollinator Cards**
  Students (or the teacher) can quickly construct these by writing pollinator names on index cards. Use a different index card color for each team. A list of some common pollinators follows. A more thought-provoking, engaging, and versatile set of cards can be crafted by adding student drawings (or attaching images) of the pollinators to the cards. Illustrations of a few suggested pollinators are included on the activity page **10.1 A Few Common Pollinators** found at the end of this section.

- **Large Flower Posters or 3 D Models**

You or your students could write descriptions of each flower type on a heavy sheet of poster-sized cardstock, matt board, or cardboard. Basic written texts can be found in the Flower Poster - Text Description paragraph at the end of this section. The posters work best if they can be propped up for the game, but that's not absolutely necessary.

- **Pencil and a piece of Paper for tallying the results.**
  Not absolutely essential. The children usually count up the results out loud during the debriefing.
- **(Optional) Paper Plates, Sheets of Construction Paper, reusable Woven Rattan Paper Plate Holders** These can be placed in front of the flower posters to collect the tossed pollinator cards. Alternately, grass or the school floor will do.

Additional Material Notes:

Constructing the flower posters, as individuals or teams, is a very effective way for children to become more aware of the adaptive value of different flower colors and forms for both interspecific communication and pollinator access. If they design the flower posters themselves, the youngsters will have more opportunities to reflect upon and engage with actual examples of the plant and animal adaptations that embody the abstract concept of Coevolution.

At this point, it's important to point out that, ideally, the posters should not be limited solely to words. After all, how do most living creatures perceive their surroundings; do they read labels? Of course not. With this in mind, it's both fun and worthwhile for the students to include visual images of the flower types being described. Students can collect photographs or illustrations from gardening catalogs, nature magazines, or websites and paste these onto the appropriate poster. Alternately, they can use these images as references as they create their own free-hand drawings for this purpose.

The youngsters will need to strategize how to present the information so that the relay racers, with their pollinator cards, are able to recognize their flower destinations quickly. What if they were to draw especially big flowers instead of small ones? To spark more complex reasoning, you could ask students to consider the energy and material costs that a plant would contend with if it really did produce huge blossoms. What trade-offs might be involved?

Advanced students, presented with this poster-building challenge, might decide that a particularly spectacular way to make the flower types conspicuous would be to create brilliantly colored, three-dimensional paper flowers – imitating, not just illustrating nature. They could hone their 3D building skills by crafting sculptural paper models of the flower forms using the appropriate colors of tissue paper and / or found objects. The finished 3D flowers would serve not only as destinations for the pollinator cards in the relay race but also as examples of Project Based Learning. When paired with the pollinator cards, they could be exhibited at the school or Environmental Center. They could also be documented and posted electronically so that the students' knowledge and creativity could be shared with other youngsters, families, and the larger learning community.

Yet another option is to forgo the student-made flat posters and original 3D sculptures. Instead, you could invest in a collection of good quality silk flowers that exemplify the various

forms and colors. While expensive, these can be used for many years in conjunction with the written labels - or without the written text (to incentivize attentive listening and remembering). I've taken both routes myself and found the silk flowers to be particularly useful when presenting Pollination Partnerships not as a multi-day unit of study with a class, but as one time field trip or as an activity within the context of a festival. To enhance the aesthetics, I also purchased a number of matching pottery vases to hold the various bouquets. The entire collection can be stored in a pretty box along with sets of the pollinator cards and woven rattan plate holders. This way it's very easy to carry the entire ensemble to the playing field, hall, or classroom.

Overview:

This game cultivates children's appreciation for the amazing phenomenon of Coevolution. The cooperative interactions between plants and animals that have evolved across millions of years have resulted in so many extraordinary and often beautiful adaptations in terms of morphology, color signaling, food production, and even fragrance. Learning about these long-term, mutualistic associations provides a healthy counterweight to the over-emphasis on competition and predatory relationships (food chains, for example) that is prevalent in many science texts and much early twenty-first century culture - despite recent paradigm-shifting discoveries such as Endosymbiosis. Pollination partnerships (and dispersal partnerships too) offer a good foundation for understanding Coevolution. This is in part because pollination and dispersal are macroscopic biological phenomena that are close at hand. Coevolution can easily be observed whenever the youngsters watch a butterfly or bee visiting a flower in a garden. It can even be experienced by the children themselves, in an ancient and heart-felt way, when they feel a sense of awe and attraction to the loveliness of a single flower or the magnificence of a fruit tree in full bloom.

Blossoms and Pollinators is a game best played after a comprehensive lesson on the correlations between certain flower types and specific pollinators. Through trips to the school garden, readings, discussions, and videos, students should have already acquired a sturdy awareness of these associations. They should understand that mutually beneficial partnerships that have coevolved across millions of years have produced complementary adaptations between both the pollinators and the flowering plants. And although this is a complicated topic, I've found that it usually fascinates the youngsters. The game then offers them a pleasant means to reinforce and apply their learning while also running a fast-paced relay race with

their friends. Because there is an intellectual component to the game, as well as a motor dimension, this is an activity that gives children with different aptitudes opportunities to shine. It demonstrates that people with varied gifts often benefit from working together. The game can be adapted for indoor settings by adding a difficult sort of movement to the sorting process (such as crossing the space to the flowers by hopping on one foot or carrying the pollinator card balanced on a book or a big wooden spoon). While such challenges can substitute for the fast run across open ground, the outdoors race is optimal because it affords both vigorous exercise and time in fresh air.

The game begins with the formation of two teams who each line up in a specific order. As mentioned earlier, there are the two-color coded stacks of pollinator cards, identical in terms of pollinators but with different background colors to distinguish the choices made by each team. A single set of flower cards, posters, or models should be displayed in a row or half circle arrangement some distance from the starting line. This playing area can be described as the Meadow, Garden, or Blooming Wetland, etc. Emphasize to the youngsters that the object of the game is for each team to deliver their pollinator cards to the appropriate blossom poster (or model) in this habitat as quickly as possible. Students need to place their team's card in front of the flower that seems best adapted to their particular pollinator. (Again, I often use woven reed picnic plate holders situated in front of each flower poster or model as the collection sites.) Only one youngster from each team is able to cross the space at any given point in time. That student must drop off their pollinator card at the correct 'flower' and then race back to tag the next team member so that that person can have a turn.

To begin the game, the teacher or student referee shuffles each of the two stacks of pollinator cards. An equal number of cards (all of the same backing color for a given team) are placed face-down in front of each set of players. At a signal, the person at the front of each team's line flips over the top pollinator card. He or she must then decide independently (or as the result of group consultation) which flower would be best for this particular kind of pollinator. The individual dashes over to the flowers and places the pollinator card in front of the most suitable bloom. He or she then runs back to tag the next person in line. This person flips over the next pollinator card and repeats the procedure. This continues until all the pollinator cards have been carried to the flowers (or flower cards) in the playing field.

The first team to place all their pollinators with their respective flowers is awarded two extra points (or however many points may have been allocated to reward speed). Depending upon the group, the teacher / referee chooses to allow the slower team to finish placing its stack of pollinators at this time, or alternately, calls an end to the placement portion of the game. If some students find racing difficult, just find a different task for them. Maybe they could coordinate the arrangement of runners in the line, or supervise the placement of cards by the flower posters, etc.

To determine the actual winner, both teams now walk over to the blossom area to tally the results. The entire class, with the assistance of the teacher / referee, systematically analyzes and discusses the accuracy of the blossom and pollinator pairings. Using the color code to determine which team made which pairings, teams are awarded points for each correctly placed pollinator. No points are earned for incorrect pairings. Thus, if a team has been careless or hasn't learned which pollinators are generally associated with which flowers, that team will find itself falling behind even though it might have contained the fastest runners.

The scorekeeper (another potential task for a someone who didn't run) records the number of correct pairings and adds the two (or more) extra points earned for speed to the total of the fastest team. The team with the most points wins. This debriefing / tallying phase, with its attendant conversations, can be very effective in helping students remember and better understand the associations between certain kinds of pollinators and certain forms of flowering plants.

A Basic Card Set for Blossoms & Pollinators Game for the NE Forestland

Pollinators:

Hummingbird
Wind
Butterfly
Bumblebee
Fly
Beetle
Moth
Domesticated European Honey Bee
Human Being

Flower Forms (Text Descriptions with Key to the General Pairings):

(Please note that there are many exceptions to the associations listed here and also many other amazing coevolved partnerships that we did not have space to include.)

No colorful petals! Huge amounts of pollen on exposed dangling surfaces. **Wind**
(This category can be omitted, if you choose to focus only on living pollinators.)

Large bright red, pink, yellow, or orange ray flowers surrounding flat, sturdy centers filled with nectar and pollen-rich disk flowers. The center of the flower forms a big landing pad for visiting pollinators. **Butterflies**

Brilliant red or orange flowers drooping down from arching stems. These flowers have plenty of sweet nectar stored in long, deep, spur-like tubes. Whoever visits these has a low likelihood of conflict / competition with bees. The blossoms have almost no fragrance. **Hummingbirds**

Complicated, sweetly fragrant blue flowers with pollen and nectar hidden inside strong protective, bonnet-like petals. These often have nectar guides leading to their centers. **Bumblebees**

Rather foul smelling, tiny white flowers often clustered in large groups. This make them easier for pollinators to see from a distance. These flowers have lots of pollen and tiny drops of nectar that are readily accessible in their shallow centers. **Flies**

The center of this flower is encircled by big, tough, often white, pale pink or yellow petals. It's not very fragrant, however it does have lots of pollen very obviously displayed in its large, open center. **Beetles**

White or lightly colored blossoms with deep nectar tubes. These have a very sweet scent and often open only at night. **Moths**

Sweet smelling blue and yellow flowers with distinct nectar guides leading to somewhat hidden stores of pollen and nectar. **Domesticated European Honey Bee**s

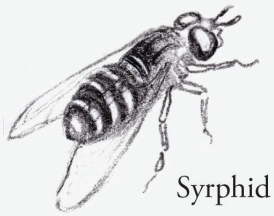
Any of the above flower types. **Human Being**

*Note that the Human Being Card in the Pollinator set is a bit like a 'wild' card - It can be matched with any flower. Typically, humans - especially gardeners, farmers, and botanists - will try to encourage the pollination and propagation of any plant that produces materials that they value. These gifts from plants can include beautiful blossoms, perfumes, nutritious fruits, seeds, vegetables, textile fibers (such as linen or cotton), building materials (such as pine, oak or bamboo), and other useful substances such as oils and medicines, and much more. Keeping hives of domesticated pollinators such as honeybees near their farms and gardens is one way that some people ensure that their insect pollinated plants continue producing abundant crops – in addition to new generations of seeds. Some other important farming techniques that foster the relationships between traditional pollinators and plants include: agroecological methods such as planting a variety of crops within a given area and keeping (and protecting) areas such as hedgerows, stream banks, and woodlots near cultivated lands. These serve as refugia not only for pollinators but also for other beneficial insects. In addition to conserving wildlands, farmers and gardeners who care about pollinators avoid toxic synthetic pesticides and GMO crops, both of which can be lethal not just to crop pests but also to pollinators and sometimes humans! Buying foods and textiles produced by organic methods and without GMO's is a very practical way for all of us to help maintain the health of essential and ancient plant and pollinator partnerships.

Older groups can research the actual names of the specific flowering plants in their area whose

blossoms represent the general types. They can then make replicas of these or list them on their cards / posters. At an even more advanced level, students can create different plant and pollinator sets for distinctive habitats in their region such as the flowering plants and pollinators of an old growth forest, an open field, a bog, a salt marsh, etc. They could even research coevolved flowers and pollinators found in distant biomes such as the Neotropical rainforests, Australian deserts, etc. Imagine constructing games that feature these species. Are some of the adaptive pairings that they've encountered in the NE Forestlands similar to those found in other ecosystems? Here's an opportunity to talk about Convergent Evolution.

10.1 A Few Common Pollinators

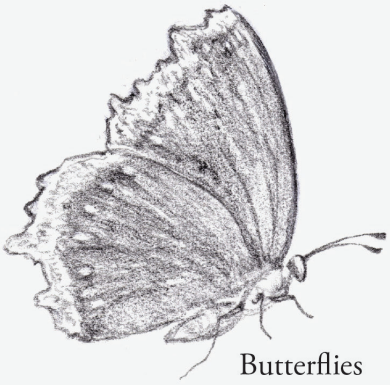


Syrphid Flies

Many Types of Bees including
Native Bumble Bees, Solitary Bees,
and European Honey Bees

Bee Flies

Wind



Butterflies

Moths

Wasps

Hummingbirds

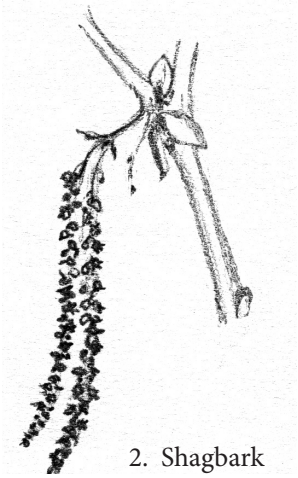
Some species of Beetles

Edith Pucci Couchman © 2016

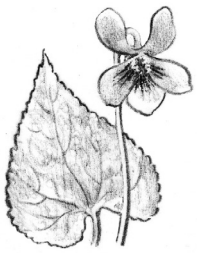
10.2 Guess the Pollinators

1. Nicotiana,
Nicotiana alata
(White, very fragrant - especially in the evening)

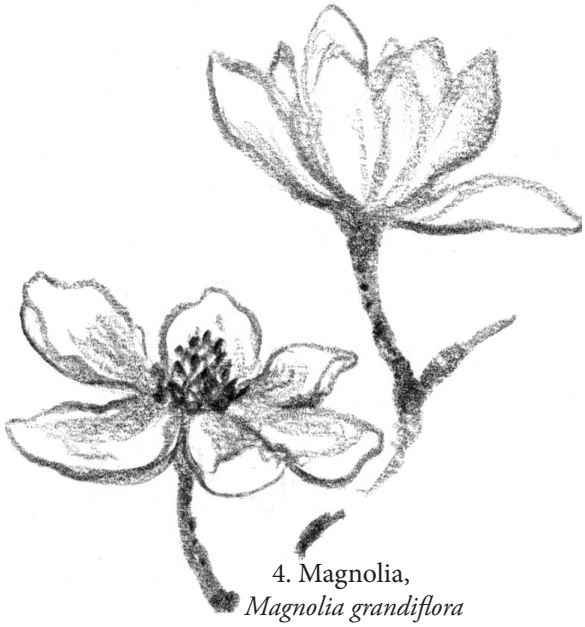
Plants have evolved these blossoms over the course of more than 130 million years! From your observations and studies, can you guess which pollinators might be especially well suited to help with pollen exchange for each of of these species? For clues, refer to the flowers' visual form / shape, the words in parentheses, or the Word Bank. Write the name (or draw a picture) of the appropriate pollinator next to each flower. Be prepared to provide reasons for your selections.



2. Shagbark Hickory,
Carya ovata
(Green catkins)



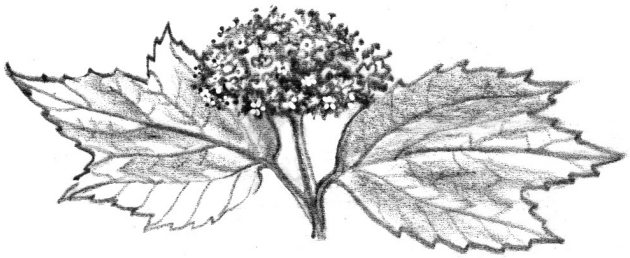
3. Common Blue Violet,
Viola sororia
(Purplish-blue)



4. Magnolia,
Magnolia grandiflora
(White with abundant pollen)

5. Wild Columbine,
Aquilegia canadensis
(Reddish-orange petals)

6. Coneflower,
Echinacea purpurea
(Reddish-pink)



7. Mapleleaf Viburnum,
Viburnum acerifolia
(White, with a rather unpleasant scent)

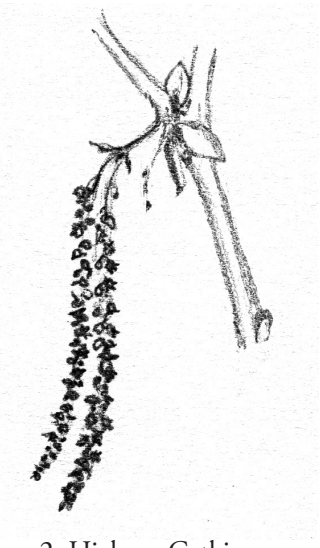
Word Bank of Some Possible Pollinators:
Butterflies, Moths, Flies, Hummingbirds, Beetles, Wind, Native Bees

10.2 Guess the Pollinators

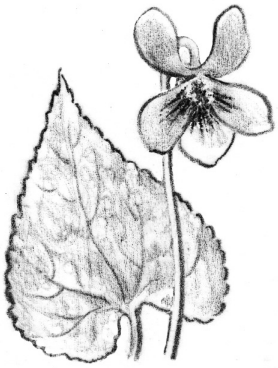
(with Answer Key)

Plants have evolved these blossoms over the course of more than 130 million years! From your observations and studies, can you guess which pollinators might be especially well suited to help with pollen exchange for each of of these species? For clues, refer to the flowers' visual form /shape, the words in parentheses, and the Word Bank. Write the name (or draw a picture) of the appropriate pollinator next to each flower. Be prepared to provide your reasons for your selections.

1. Nicotiana
(White, very fragrant)



2. Hickory Catkins
(Green)

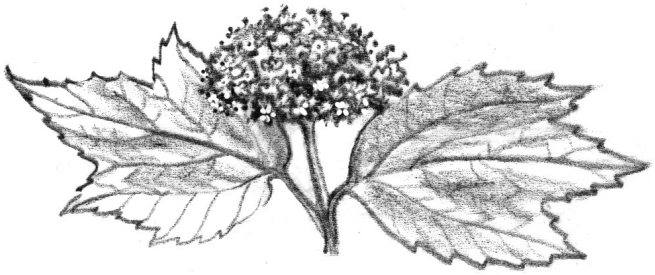


3. Violet
(Purplish-blue)

4. Magnolia
(Sturdy flowers with abundant pollen)

5. Wild Columbine
(Reddish-orange petals)

3. Coneflower
(Reddish-pink)



7. Maple-leaf Viburnum
(White, a rather unpleasant scent)

Word Bank of Some Possible Pollinators:
Butterflies, Moths, Flies, Hummingbirds, Beetles, Wind, Honeybees

Answers: 1. Moths; 2. Wind; 3. Honeybees; 4. Beetles; 5. Hummingbirds; 6. Butterflies; 7. Flies\

10.3 Flowers and their Pollination Partners

Learning about "Form Following Function," Symbiosis, and Coevolution

Please draw a picture of each flower type (or cut out and paste on a photograph of a flower that exemplifies each general form). Next, write the name and / or draw a pollinator with whom this flower might have coevolved. Check the Word Bank for clues ~

1. Brilliant red, pink, or orange flowers drooping down from arching stems. These blossoms have plenty of sweet nectar stored in long, deep, spur-like tubes. They have almost no fragrance, yet their bright colors make them easy to find.

2. Red, pink, orange, or yellow blossoms actually composed of several different kinds of smaller flowers clumped together. The blossom (such as that of a Black-eyed Susan) might include a center of tiny disk flowers rich with nectar and pollen. These could be surrounded by long, colorful ray flowers that act as advertising banners. The ray flowers radiate out from the center - like sunlight from the sun. Such blooms typically possess little scent but their densely packed centers serve as strong landing pads for visiting pollinators. The family name for these plants is Asteraceae (from the Latin word for stars).

3. Huge amounts of pollen are exposed on dangling surfaces. No colorful petals! (Hints: These flowers have not evolved to attract the eyes of animals - and petals would just be in the way...)

4. The centers of these flowers are often encircled by big, tough whitish petals. They're not very fragrant, however they do have lots of pollen obviously displayed in their large bowl-like middles. The insects who pollinate these blooms are rather greedy and ineffective as compared to highly specialized pollinators such as bees.

5. These blooms have a very sweet and strong scent and often open only at night. They feature white or other light colored blossoms with deep nectar tubes well suited for hovering pollinators.

6. Complicated, sweetly fragrant, bluish flowers are favorites, but other colors serve too - including white, yellow, and ultraviolet (which is invisible to us humans). Sometimes the pollen and nectar supplies are hidden inside strong protective, bonnet-like petals. The petals may also be marked with distinctly colored nectar guides.

7. These small, whitish flowers have nectar and pollen supplies that are easily accessible to small insects with short, sponge like mouth parts. Often, they have scents that are unpleasant to people.

Word Bank: Bumble Bee, Butterfly, Wind, Moth, Flies, Beetles, Hummingbirds

11 - The Last Wasp of Autumn

a stationary circle game with a race

Ages: 6 to 10

Performance Expectations:
Students will better understand the truly difficult conditions that wasps face at the end of the growing season. They will be able to list at least three of the many dangers that the mothers of this year's wasps have had to overcome in order to survive the winter and produce this current generation.

NGSS Disciplinary Core Ideas: LS1.C, D; LS2.A, B, C; LS4.B, C; ESS2.D

NGSS Practices: 2. Using models

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 4. Systems and System Models; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function; 7. Stability and Change

Materials:

- Trimmed Copies of **'Possible Dangers for a Wasp'** Cards

Overview:

Winter is an especially stressful time for cold-blooded creatures such as insects. Most adult insects simply die as the temperatures drop below freezing. They leave behind their miniature, young forms (eggs, larvae, or nymphs) who are able to survive the cold in a sort of suspended animation. These eggs, larvae or nymphs will begin growing and maturing again in the spring. Examples of well-known insects who have this sort of life pattern are most crickets, most grasshoppers, and many beetles. A few adult insects, such as monarch butterflies, red admiral butterflies, and green darner dragonflies migrate south to warmer climates. Others, such as ants and honey bees, manage to endure the winter by working together in large family groups to

store food and build shelters (often underground or in hollow trees). A few other insects, such as young queen wasps, bumblebees, and mourning cloak butterflies survive the winter as adults – that is, if they are skillful and lucky enough to find a safe hiding place. In the following game, we look at the adventures of a bald-faced wasp, a common species in the Northern Forestlands.

This little insect will test her strength against some of the many dangers that such animals confront during the final days of autumn. Our wasp is trying to become one of the fortunate few who does find a safe shelter for winter, and can emerge in the spring to start a family.

To begin the game, everyone receives a card inscribed with one of the following 'Dangers' – or other equally truthful perils that might confront a wasp in late autumn. The teacher has a second set of these same cards or just a list enumerating each of the Dangers. Students form a large circle with a space between people equal to two arm's length. Youngsters can stand without joining hands, but they should remember that when they're part of the circle, they represent well-rooted trees - in other words they should stay in one place! One person is chosen to be the 'Wasp.'

The Danger of each round is selected from the cards or list by the teacher (or student volunteer) and announced. Students check their cards, and the person who holds the Danger mentioned takes a few steps out from the circle. Wasp walks over to that student and stands back to back with them. As needed, there's a brief description or discussion regarding this particular peril. The gap that's been created in the circle will form both the start and finish of the contest that's about to take place. Explain that, at the signal, both players should race off in **opposite directions** around the circle, and the first one reaching the gap will be the winner. Students can agree to take on the added challenge, exercise, and fun of running in and out between the 'trees' as they go around the circle - although this procedure does slow things down. Give a warning against collisions. Then, either the teacher or a designated student can officially begin the race by calling out, "Ready, set, Autumn Equinox" – or simply, "Go!" The players charge off. If Wasp reaches the destination first, then Wasp is considered safe, and has the honor of choosing the next Wasp. Alternately, if Danger arrives first, then Wasp is considered conquered, and Danger selects the next round's Wasp.

‘Possible Dangers for a Wasp’ Cards

There's no food because you’re in an area where people have no gardens or wild areas near their apartments and businesses.s

You’ve flown into a city’s financial district. There are no flowers or fruit to eat!

A car is speeding in your direction.

A hungry Skunk has found you resting on a log.

You’re in a city and you can find no logs or trees with loose bark where you can hide.

There's no food for you because the plants you’d usually visit have been killed by frost.

It’s too cold for you to fly.

It’s too rainy to fly but you haven’t found a place to shelter yet…

A hungry Mockingbird chases after you.

A hungry Raccoon spots you resting on a stone when you're already sluggish from cold.

A Bullfrog tries to catch you as you attempt to land near the edge of a pond.

A large, migrating Green Darner Dragonfly tries to nab you for lunch.

A person who is afraid of wasps tries to swat you.

A person who is overly afraid of wasps (because he knows that you can sting, and that a few people are very allergic to the chemicals in your sting) tries to spray you with very toxic insecticides.

A Robber Fly chases after you.

A person tries to poison you with sprays. She doesn't understand that wasps are very helpful and important because you and your family eat plant-devouring insects such as tent caterpillars.

You accidentally fly into a building through an open door. It's difficult to find your way out.

You're entangled in the web of a big Yellow Garden Spider *(Argiope aurantia)*.

© 2020 Edith Pucci Couchman

Lethal aerial sprays for Mosquitoes drift towards you.

You're in an open trash bin, happily sipping what's left from some sugary drinks. Suddenly, the whole bin is lifted and tipped into a large dump truck.

A Summer Tanager, late for its annual migration south, tries to catch you.

A Praying Mantis notices you on the branch of a spruce tree.

You're still flying at dusk and are chased by a Little Brown Bat.

An Eastern Phoebe spots you while you're trying to drink nectar from some asters.

While you're dozing at night on a tree trunk, a hungry Mouse discovers you.

An Eastern Kingbird darts off a branch to chase you.

It's suddenly windy and you have trouble finding a safe place to shelter.

12 - Mosquito in the Woods

(Alternate casts of characters: Black Fly, Dragonfly,
Bat, Mouse, Owl, Phoebe, or Tree Swallow),
a singing, choosing and racing circle game about food webs

Ages: 5 to 10

Performance Expectations:

Students will become very aware of the trophic connection between two particular species. Depending upon the creatures chosen for the game, students may learn to appreciate the benefits that certain secondary consumers / carnivores confer upon us humans as they go about catching their prey. The children will gain a stronger understanding of the forest food web, and they'll realize that some creatures who are very annoying to us people are essential for the nourishment of other species who happen to be human favorites. This includes the mosquitos and black flies who serve as dinner for woodland birds and fish such as trout. The students might learn that some animals who sometimes seem frightening (such as bats or dragonflies) are actually benefiting us people as they devour pesky insects. Youngsters may also become more conscious of parental care among non-human beings as they play those games with verses about owls, phoebes or tree swallows.

NGSS Disciplinary Core Ideas: LS1.A, B, C, D; LS2.A, B, C, D; LS4.B, C, D

NGSS Practices: 2. Using models

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function; 7. Stability and Change

Overview:

This is a simple singing circle game that can serve as a lively, upbeat conclusion to many types of lessons. I've used this game following field trips focused on insects, birds, or various night creatures, as well as after classes studying parental care. It can be easily revised to model specific predator and prey relationships such as those between

brown bats and moths, dragonflies and mosquitoes, owls and mice, etc. just by changing the main characters in the song. It's been particularly well received after field trips where we've all been exasperated by annoying insects.

In its **black fly or mosquito** versions, the game serves as a competive and yet sociable complement to verbal and visual instruction about these formidable inhabitants of this biome. Prior to the game, we learn about their life cycles. I use a poster that shows their developmental phases. I highlight their similarities (including their aquatic egg, larvae and pupae stages, and the fact that both the female mosquitoes and the female black flies require a blood meal in order produce their eggs). I also point out some of their differences. Many of these are related to their adaptations to different types of watery environments. Black flies tend to live in well-oxygenated, fast flowing streams in the early phases of their life, while mosquito eggs, larvae and pupae are well adapted to stagnant aquatic settings. I mention mosquitoes' role in transporting certain disease-causing organisms, and also describe a few strategic defenses that humans can take to avoid becoming the lunch bar for these creatures. I point out the advantages of long-sleeved shirts, pants, and wide-brimmed hats, and the downsides to various synthetic repellents or insecticides. I describe the natural controls to these insects (some of whom the children will impersonate during the game). I also explain their positive contributions to the ecosystem (Yes, you knew there were some!): the swarms of blackflies and mosquitoes in the Northeastern Forests form a vital link within forest food chains. They provide necessary protein for various, important fish as well as nourishment for the developing nestlings of many songbirds. Particularly in the case of songbirds, flying insects are a crucial component in the diet of the babies. By feeding their nestlings high-protein flying insects (such as mosquitoes and black flies), as well as caterpillars and other insect larvae, parent birds can help ensure that their little ones grow up quickly and have strong muscles. This insect feast helps fortify the young birds for their difficult journey south when they migrate in late summer and early autumn to their families' winter territories.

After students have listened to all this didactic information, they're usually more than ready for a chance to relax, race around, and attend to their own personal social agenda. This game offers a structure for them to achieve these goals even as it reinforces their ecological understandings.

Here's the game's basic form:

Youngsters join hands and form a circle. They create arches with their upraised arms. In this configuration, they represent the trees of the forest. One child is selected to be a type of bird who relishes blackflies. This could be a **phoebe** or a **tree swallow** for example. This bird child then weaves in and out of the 'tree branches' (progressing in an orderly, graceful way around the forest / circle). Alternately, he or she can merely skip or run around the outside of the forest circle while the other students sing the words which are found on the following page:

Basic Lyrics for 'Mosquito in the Woods'

There's a Mosquito in these woods, (Alternate line: Black Fly)

Middle of June, middle of June. (Alternate lines: Middle of the Day or Middle of July)

There's a Mosquito in these woods,

Middle of June, so hot - oh.

There's a Mosquito in these woods,

'Loves to drink the people's blood.

Flip your tail and flap your wings,

Feed it to your babies.

As the singing concludes, the bird / phoebe child selects another person to be the mosquito. This is accomplished simply by having the bird child tap the new mosquito on the shoulder. Now the mosquito and phoebe both stand outside of the circle, pointing in opposite directions. At a signal – such as the word "FLY," both charge off, racing around the outside of the circle. The first one to return to the empty starting space has won. If it's phoebe, then phoebe has caught the mosquito - and phoebe's babies will have a tasty feast; if it's mosquito, then mosquito has eluded capture. The winning creature earns the opportunity to appoint one of his or her friends to be the next phoebe.

For a more physically challenging, somewhat slower race, have the two contestants weave in and out through the forest 'branches'- without skipping any - as they rush back to the starting point.

For a **bat** version of this game, change the second line to *"Middle of the night, middle of the night."* Change the last two lines to *"Make a squeak and flap your wings. Catch him if you can – oh."*

For a **dragonfly** version, change the last lines to *"Dart and Dive, Dart and Dive, Catch her if you can – oh."*

Please check **Section 22** in this collection for the **Mouse and Owl** versions of this activity, plus illustrations of a few of the mice and owls of this bioregion.

Vertebrate Animals

13 - Little Frog Jumping

a jump rope chant and physical challenge focused on rhythmic coordination

Ages: 3 to 6

Performance Expectations:

Students will take turns pretending to be a jumping frog with the result that, by the end of the game, most of the children will be able to say that 1) frogs like to live near water and 2) jumping is one of the ways that they tend to move (in addition to swimming). Depending upon the commentary that you and the other participants provide, the children may also be able to note the similarities and differences between their feet and legs, those of frogs, and the resulting functional capacities. The students will build their jumping and singing skills even as they exercise their imaginations and acting ability. They will be developing the executive skills required to play a game with simple rules. They will be coordinating arm and hand motions with another child in order to create the rhythmic motions of the rope. At the same time, they will be expanding their empathy with frogs.

NGSS Disciplinary Core Ideas: LS1.A; LS3.A, B; LS4.C

NGSS Practices: 2. Using models

NGSS Crosscutting Concepts: 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function

Materials:

- **a jump rope**

Overview:

This is a project especially suitable for four- to six-year-olds. Two children create rhythmic 'low water' swings with a rope. (The rope only goes back and forth; it does not circle all the way up and around.) A third child jumps. Please appreciate that even moving the rope back and forth is a very challenging task of physical

and social coordination for the very young. Similarly, the jumper has to work to calibrate his / her muscles in order to respond to the visual cues from the rope and the tempo expressed in the chant that the others are saying / singing. Some youngsters find the collaborative and performance elements of this game a bit overwhelming and have to overcome this obstacle as well.

And by the way, the jump rope can - and I think should - be a beautiful thing. I like to have the children use a satin-like, multicolored cord originally designed for Christmas decorating. The children, including all those who are waiting in line, sing the words described below while the jumping child (who's pretending to be a frog) jumps back and forth over the pretty rope / 'stream.'

Lyric for "Little Frog" Jump Rope Game'

Little stream flowing,

Little frog going,

Jump, Jump,

Jump, Splash!

(Jump out and give the next child a turn)

Once most of the children can do three 'jumps' in a row, switch to counting the jumps – i.e. jump 1, jump 2, jump 3, jump 4... until the frog child misses 'the stream bank' and steps on the rope. At this point, everyone says: 'SPLASH,' and the next child takes a turn. The children can work individually to increase the total number of jumps that represents their personal best. Alternatively, they could compete among themselves to see who can jump the most, second most, etc.

(Another fine frog activity, this one focused on frogs' and kids' vocalizations, is Jenepher Lingelbach's Spring Serenade (Hands-On Nature, 1986). The creation of this simple 'frog orchestra' with a facilitating conductor is usually much enjoyed by youngsters, even nine- and ten-year-olds. Lang Elliot's audio CD for the beautifully illustrated A Guide to Wildlife Sounds, (Stackpole, 2005) is excellent for this project - and many others as well. Also recommended is Elliot's book The Frogs and Toads of North America: A Comprehensive Guide to Their Identification, Behavior, and Calls, another well-designed combination of CD, text, and full color photographs created by Elliot, H. Carl Gerhard, and Carlos Davidson (Houghton Mifflin Harcourt, 2009). If time or funds are a constraint, you could also access Mr. Elliot's website for free recordings of a number of key species: https://musicofnature.com/calls-of-frogs-and-toads-of-the-northeast/)

14 - Lily Pond Hop

'Musical Chairs' for Amphibians, *a game of chance and impersonation*

Ages: 4 to 9

Performance Expectations:
Students will be developing social and emotional learning skills (executive function skills) as they play this frog variation of an old but exciting and challenging traditional children's game. They will become more aware of other species' use of sound to communicate. They may even develop more compassion for the frogs in nearby ponds as they imagine what it might be
to live a life like theirs.

NGSS Disciplinary Core Ideas: LS1.A, C, D; LS2.A, B, D; LS4.C

NGSS Practices: 2. Using models

NGSS Crosscutting Concepts: 2. Cause and Effect: Mechanism and Explanation; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function; 7. Stability and Change

Materials:

- **Recordings of Frog Calls from a CD or online**
  (see Lily Pond Hop for a few suggestions)
- **Green Construction Papers (or more elaborately trimmed felt pieces)**
  to represent lily pads

Overview:

This is simply a frog version of musical chairs. A CD of real frog calls provides the melodies that start and stop the participants' movements. Reusable, green felt 'pond lily leaves / pads' crafted beforehand substitute for the chairs. If time is limited, you can simply use sheets of 9" by 12" green construction paper.

However, it's just much more charming to have the papers trimmed into oval, notched lily pads. In this regard, if your students need a rainy-day activity, let them design or color suitable leaves for this game (after researching the shapes and leaf vein patterns of various pond lilies or lotuses). The cutting and coloring phase of this project can be done while listening to (and learning) frog sounds. For actual playing, if using paper, laminate and trim the resulting leaves. When you're playing indoors, allow the youngsters to remove their shoes before the game so the lily pads will last longer. This will also better enable them to have the fun of pretending that they have very flexible, webbed frog feet. If you're

playing this during a field trip, make certain that you have access to frog sounds on your cell phone, and feel free to use real stones, small sticks, or a specific type of leaf (that the children collect along the trail) to represent the lily pads.

The scenario for the game is the following: the children imagine that they are some type of frog hopping about in a beautiful pond. The only problem is that there is a pickerel (a type of frog-eating fish) swimming around in the water - and the pickerel is hungry. Reassure the youngsters that the frogs are safe as long as they are perched on a pond lily leaf / lily pad. Unfortunately, there is one less lily pad on the pond than there are frogs! Whenever frog sounds can be heard, everything is fine. The other frogs are calling and singing. As long as these sounds can be heard, the children who are pretending to be frogs should simply leap from lily pad to lily pad. (Arranging the leaves in a looping, vaguely circular path helps facilitate this process). When the frog sounds stop, this is a signal that the pickerel is nearby and on the prowl. All the frogs should immediately hop onto a leaf for safety. The one frog who can't find a lily pad should leap to the sidelines (the bank of the pond). That frog is now safe onshore. However, he or she will need to wait there for the rest of this game. Another leaf is removed, and play resumes. The game is over when there is only one frog left on the very last lily pad. This last, brave, and fortunate frog is hailed as the King or Queen of the Pond.

15 - Frog Fortunes

another example of the basic format for a
*'Progress towards a Goal' Game**

Ages: 6 to 12

Performance Expectations:

By playing this game, students will gain a better factual and empathetic understanding of the complexities and relationships that shape a frog's existence / world. They'll also appreciate in greater detail how the activities of us humans intersect with frogs' ancient and ongoing efforts to survive.

Students will NGSS Disciplinary Core Ideas: PS1.A, B; PS3.C, D; LS1.A, B, C, D; LS2.A, B, C, D; LS3.B; LS4.B, C, D

NGSS Practices: 2. Using models; 8. Communicating Information

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 3. Scale, Proportion, and Quantity; 4. Systems and System Models; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function; 7. Stability and Change

Materials:

- **Frog Fortune Cards**

Overview:

Here is a frog game that works well for even older children. Following their studies of various frogs and their characteristics, students form teams representing favorite species. Three to four frog teams work well, or if it's a small or impatient class, two will suffice. The species assortment that I like includes: green frogs, bullfrogs, wood frogs, and spring peepers. Setting up the teams can be an opportunity for you to highlight significant features of each species' life. You can also teach an approximation of each frog's call -

*This was previously published in *Green Teacher Magazine*, June 2011. Subscribers to *Green Teacher* can access this and hundreds of other environmental science resources, including webinars, on their excellent website: Greenteacher.com

green frog: banjo-like “twang;” bullfrog: “jug-a-rum;” wood frog: “quack;” spring peeper: a high pitched, sustained “peep.” These calls become each team's ‘cheer’ and using these sounds, the children can joke around and build team spirit. As the game begins, each team represents a species of frogs newly awakened from hibernation. The frogs are traveling towards a peaceful ‘pond’ (the designated finish line). There, the frogs will feast on mosquitoes and various small invertebrates and produce the next generation of froglets. Progress towards the breeding pond is determined by readings from a set of randomly arranged Frog Fortune Cards. These cards describe some of the hazards and helpful events that might shape real frogs' travels. The moderator draws a card for each team of frogs in turn and the frogs follow the card’s instructions – hopping forward or backwards (as a team / species) the appropriate number of hops. The first team to reach the pond successfully is deemed victorious.

Frog Fortune Cards

Find an Earthworm

FORWARD 3 HOPS

Blackflies for lunch

FORWARD 2 HOPS

Cold weather. Since you're an ectotherm, your muscles (and your metabolism in general) won't work well if it's too cold outside

LOSE A TURN

Meet a hungry Garter Snake

BACK 3 HOPS

Devour several small Slugs

FORWARD 2 HOPS

Highway

BACK 5 HOPS

Warm, rainy day

FORWARD 3 HOPS

Catch a Fly

FORWARD 2 HOPS

Encounter a Skunk!

BACK 2 HOPS

Find a tasty Caterpillar

FORWARD 3 HOPS

Encounter a menacing Housecat

BACK 1 HOP

Catch a slow Clouded Sulfur Butterfly

FORWARD 3 HOPS

Mean children tossing sticks

BACK 2 HOPS

Catch a Mayfly

FORWARD 1 HOP

Cross a golf course as people operate huge lawn mowing machines

BACK 3 HOPS

Find a nice clump of tall wildflowers. Hide among their leaves during the hottest part of the day. Because you've sheltered here, no enemy can find you, and your skin will notdry out

FORWARD 3 HOPS

Catch a Dragonfly that wasn't paying attention

FORWARD 2 HOPS

Munch on a Cranefly

FORWARD 2 HOPS

Bulldozers have filled in a favorite pond that you used to visit. It's been replaced with a shopping mall **BACK 6 HOPS**	Bask in the sun for a while to improve your health (taking care not to dry out your skin!) **FORWARD 2 HOPS**	Race to escape from a Dog **BACKWARDS 2 HOPS**
Gobble up a Rove Beetle that you find in the weeds **FORWARD 3 HOPS**	Catch a 'Sowbug' (a terrestrial isopod, a.k.a. 'Pillbug') **FORWARD 2 HOPS**	Capture a small Moth **FORWARD 3 HOPS**
Hear other Frogs calling **FORWARD 4 HOPS**	Enjoy the morning dew. It keeps your skin moist, and this is important because you breathe in oxygen through a thin layer of water on your skin **FORWARD 3 HOPS**	Toxic material gets on your skin from pesticides that were applied to nearby lawns or fields. You become very sick for a while. **BACK 5 HOPS**

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continued – Frog Fortune Cards

Cross a field that has lately been treated with a variety of toxic chemicals (such as Glyphosate) that are often used as weed killers / herbicides in large, industrialized agricultural operations

BACK 4 HOPS

Gobble up a Wolf Spider

FORWARD 3 HOPS

Find a Cabbage Looper Caterpillar

FORWARD 2 HOPS

Catch a tasty Moth

FORWARD 2 HOPS

Catch several Gnats

FORWARD 2 HOPS

Capture a Lightening Beetle

FORWARD 3 HOPS

Encounter a large lawn with grass that's clipped short (exposing you to danger from hawks flying overhead – as well as the drying sun)

BACKWARDS 2 HOPS

Avoid a Raccoon by jumping into a nearby stream

LOSE A TURN

A lovely, rainy night for travelling

FORWARD 5 HOPS

Avoid a person trying to capture you for sale as food, a pet, or a dissection specimen

BACK 2 HOPS

Capture a Red-Banded Leafhopper

FORWARD 2 HOPS

Because of human-caused climate change, it's too hot and dry. You're having trouble keeping cool, moist, and fed. You don't feel like traveling.

BACK 2 HOPS

When you were a little tadpole growingup, excess nitrogen fertilizer running off from a careless farming operation, a nearby golf course, or suburban lawns led to an increase in the quantity of algae in your pond. Because there was all this extra algae, more large snails came to live there and feast on these small green protists. Some of the snails were carrying parasitic trematode larvae. The parasitic larvae infected you! Because your immune system was already stressed - from various toxic pesticides that had also drained into the water, you couldn't fight off the trematodes very well. They invaded your leg bud and caused so much damage that you were only able to grow one back leg instead of two!

BACK 4 HOPS SLOWLY

You've been exposed to the very deadly Chytrid fungus. It was accidentally brought to this continent when non-native, infected clawed toads (being kept for pharmaceutical research and / or as pets) were released into the wild. These clawed toads were somewhat immune to the fungus, but most native North American amphibians (like you) are not. Luckily you have some helpful bacteria, called *Janthinobacterium lividum*, living on your skin. They will help you to fight the fungus - but even so, you're somewhat weakened.

BACK 3 HOPS

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You are easily tired because you received too much UVB radiation as a little egg in the pond. This happened, in part, because human-made chemicals such as CFCs thinned the ozone layer of the atmosphere. (This is the layer that usually filters out a lot of the damaging UVB rays in sunlight.) On the bright side – maybe this is not the best choice of words – at least you survived; many of your siblings never made it to the tadpole stage!

BACK 5 HOPS

Chlorothalonil, a fungicide often used in industrialized agriculture, ran off the fields and into the wetland where you were living as a little tadpole. While most of your brothers and sisters died from contact with this fungicide, you survived in a weakened condition.

BACK 3 HOPS

Herbicides (such as Atrazine) used in conventional, industrialized agriculture contaminated the water where you were living when you were a tadpole. The hormone levels in your body have been disrupted and now that you're a grown-up frog, you have both male and female characteristics. You may not be able to reproduce even if you make it to the pond.

BACK 6 HOPS

Estrogen-mimicking chemicals from inadequately treated city and suburban wastewater have washed into the water where you are living. This has affected your development in a very negative way.

BACK 4 HOPS

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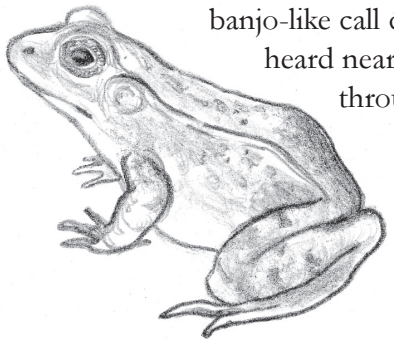
Overview:

As an activity, Frog Fortunes tends to be rather controlled (except for the unpredictable sequence of event cards). This rather structured quality can be an advantage, particularly when you are dealing with new students (such as a group visiting a nature center for the day) or with youngsters who are being a bit obstreperous. At any rate, you can make the game more enjoyable - and not merely didactic - by emphasizing its competitive, team-bonding dimensions and the imaginative possibilities of pretending to be a frog. Urge the various frog species to chorus proudly prior to the reading of their Fortune Cards (as in J. Lingelbach's Spring Serenade activity described earlier in **Lily Pond Hop**). Read the cards themselves in a bombastic, theatrical manner. Encourage the students to make astonishing (yet fair) leaps forward. Capture the interest of the more athletic individuals by allowing each team to move forward to the point that was reached by the team's very best hopper. When one team finally arrives at the 'pond of destiny.' conclude the game with a multi-species celebration, featuring supportive frog vocalizations - not just from the winners but also from those teams who didn't quite reach the goal. Elaborate a bit on the vicissitudes of luck and fortune and use this game as a teachable moment to discuss the randomness of life and the importance of good sportsmanship.

15.1 - A Few Common North American Amphibians

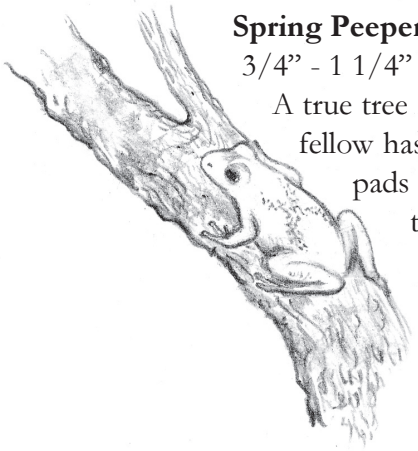
A Few Common North American Amphibians

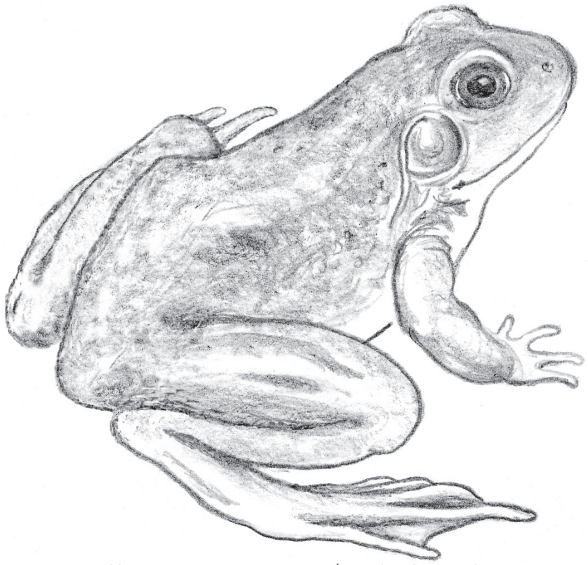
Green Frog 2”- 4” in length.
This frog’s one-note, banjo-like call can be heard near wetlands throughout the summer.



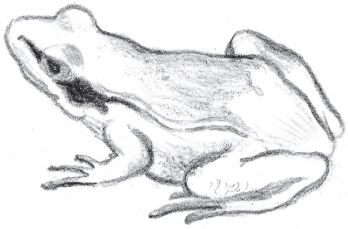
American Toad
2” - 4” in length.
The swollen glands and bumps on toad’s skin contain distasteful substances that help ward off hungry predators.

Spring Peeper
3/4” - 1 1/4” in length.
A true tree frog, this little fellow has special pads on his toes that help him cling to vegetation.





Wood Frog
3/4” - 2” in length.
This black-masked frog overwinters under the leaves in the forest. Wood Frogs can actually freeze and still survive!



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Bull Frog 4” - 7 1/2” in length.
The largest native North American frog, some spend two years in the tadpole stage before maturing into adults.

16 - Blue Jay, Blue Jay in the Forest

(Can be adapted to celebrate other flying creatures such as Butterflies, Katydids, Dragonflies, etc.*), a singing, choosing circle game to build students' verbal knowledge and vocabulary related to common bird species or flying forest creatures in general*

Ages: 3 to 7

Performance Expectations:
Children will increase their awareness of the names and attributes of various regional birds (or other animals who can fly) even as they build their singing and social skills and enhance their physical coordination.

NGSS Disciplinary Core Ideas: PS1.A, B, C; LS1.A, B, C, D; LS2.A, B

NGSS Practices: Using models; 8. Communicating Information

NGSS Crosscutting Concepts: 1. Patterns; 5. Energy and Matter: Flows, Cycles, and Conservation

Materials:

None needed!

Overview:

This is a variation of the old game "Blue Bird, Blue Bird through my Window." The first version we'll describe is focused solely on birds. It's a very simple game that's suitable even for three-year-olds. The youngsters form a circle linking hands. Invite them to imagine that they represent trees and suggest that they now have become a mighty forest. Their lifted arms and joined hands are the great branches of the forest trees.

One child is selected to be the 'Blue Jay.' This youngster pretends to be a vigorous bird who weaves his / her way around the circle, ducking under the 'branches' of the graceful trees. As this child flies beneath the branches of every tree, the forest children **sing**:

Blue Jay, Blue Jay through the forest,

Blue Jay, Blue Jay through the forest,

Blue Jay, Blue Jay through the forest,

Oh Blue Jay, are you tired?

At this point the now exhausted Blue Jay chooses another youngster to be the next bird. This child must announce which species of bird he or she wishes to represent. (As needed, the teacher and / or students can help the child with this decision by supplying names and interesting characteristics of various birds who live in this particular habitat.) The new bird-child is encouraged to impersonate their selected bird by acting out typical behaviors or vocalizations during his / her circuit through the 'forest.' During this flight, the other youngsters sing a version of the chant that features the new bird's name. Thus, the song could become:

Ruffed Grouse, Ruffed Grouse through the forest, etc…

Barred Owl, Barred Owl through the forest, etc…

Chickadee, Chickadee through the forest, etc…

Hermit Thrush, Hermit Thrush through the forest, etc.…

This game lends itself to many variations. After a field trip on Flying Creatures, young children could be asked to select any flying creature – not just a bird – for the journey through the forest. In such a situation, the flying creature might be a dragonfly, a flying squirrel, a katydid, a fritillary butterfly, a brown bat, etc. Additionally, for a very large group, there could be several birds – a family! – winging their way through the forest during the singing of each verse.

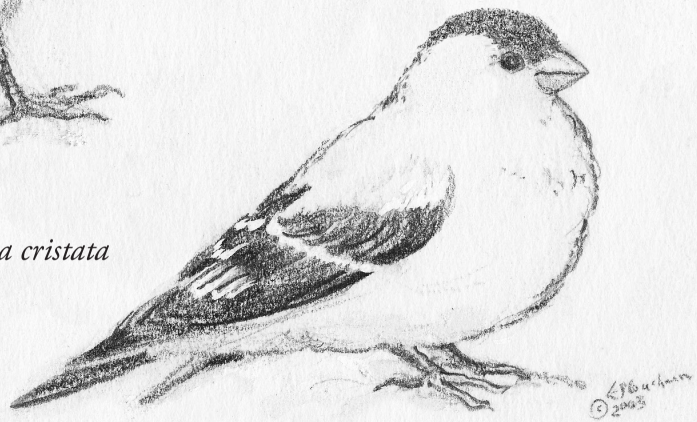
And while the game / chant may be rather repetitive, it does work well for younger students who are usually intrigued, not only by the coordinated singing and the new animal names to learn, but also by the physical challenge of progressing around the circle while ducking under archways formed by classmates' arms. In which regard, as mentioned earlier, for the very youngest children or children who've never tried arch-type circle games, there's always the option of having the 'blue jay' or other 'creature' just skip around the perimeter - rather than weaving in and out.

First Birds - Primary Colors

Red, Yellow, and Blue are the colors of these three birds.
Which color goes with which bird?

All three will sometimes visit backyard feeders.

Blue Jay
Cyanocitta cristata



American Goldfinch
Spinus Tristis

Northern Cardinal
Cardinalis cardinalis

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17 - Cardinal Weaves a Basket

a singing circle game featuring choices and simple tossing skills

Ages: 4 to 7

Performance Expectations:
Children will be able to say (and remember!) that cardinals are birds who build nests (special homes) in which they raise their families. They'll know that the cardinals collect plant materials such as vines and twigs in order to construct / weave their bowl-like shelters in shrubs or trees. Depending upon the learning goals you have for your students, the names of many other birds from the Northeastern Forestland can be substituted in the lyrics in place of 'Cardinal.' In this situation, the youngsters can learn new bird names (perhaps relevant to recent outdoor observations), and these names can become part of their memory trove.

NGSS Disciplinary Core Ideas: PS1.A, B, C; LS1.A, B, C, D; LS2.A

NGSS Practices: 2. Using models; 8. Communicating Information

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation

Materials:

- A 6 – 8" piece of **natural jute twine, yarn, or soft grape vine** (or some other pliant plant stem) that can be tossed in the air and caught (without danger of injury to anyone's eyes).

Overview:

This is a variation of a very old game - adapted for a very young group. Its level of difficulty is close to that of 'Blue Bird, Blue Bird,' – in other words, it's relatively simple - once students are accustomed to forming the ring. It's also a peaceful, rhythmic game focused on singing, choosing, a toss and catch challenge, and one child's simple progression around the circle.

Select one student to be the Cardinal. This child will now be the carrier of the length of twine or grapevine. Ask the other children to create a ring by holding hands and lifting up their arms to form arches. Invite them to pretend that they've become a circle of beautiful trees in the summertime forest. Encourage them to sing the words to the following song as the Cardinal child begins traveling around their circle, weaving in and out between every two students, ducking his / her head to pass beneath the "tree branch" arches. The student who is acting as the cardinal will gradually learn how to progress around the circle gracefully without missing any of the spaces between the 'trees.' For the youngest children, omit this complication, and just let the cardinal child try to travel completely around the ring (the circle's perimeter) back to his or her original starting point

Here is the basic song - with explanations for the teacher added after each line. I use the traditional "a tisket a tasket" melody.

A tisket, a tasket,

The Cardinal weaves a basket (Explain that 'basket' is just a word used to describe the woven nest that the Cardinals are creating from twigs, vines, and other plant materials. It will become a home the parent birds' eggs and the young that will hatch from those eggs. The cardinals' babies will grow within the nest's safe boundaries until they're able to see well, develop feathers, fly, and find their own food.)

He brought his love a little vine (The cardinal child continues carrying that short length of jute or grapevine while traveling around the ring of children.)

But on the way s/he dropped it.

(So, the story is that the first cardinal was going to help his or her mate build a nest, but the vine was accidentally dropped. No worries! The first cardinal will find another vine somewhere else. And after all, this isn't a total loss. On the contrary, the vine has been dropped behind another child (whom Cardinal selected). This child will step out of the circle and pretend to be a bird. Will this bird be able to use the vine for their nest? Let's see what happens…)

He dropped it, he dropped it,

On his way he dropped it.

Another Cardinal picked it up

And in the air s /he tossed it. (The selected player tosses the jute above his or her head and tries to catch it in the air. If successful, this player becomes the new Cardinal who will now run or skip around the circle during the singing. He or she will be the one to choose the next youngster for the tossing challenge. If the player is not able to catch the tossed vine, that child will still have, as a consolation prize, the privilege of selecting the next Cardinal. The child selected in this way does not have to go through the tossing challenge, but instead, carries the vine and starts circling the ring of players when the singing resumes.)

18 - Berry in the Beak

a singing choosing, circle game with a race that highlights coevolution and seed dispersal

Ages: 6 to 12

Performance Expectations:
Children will develop an enhanced appreciation for the coevolved, mutualistic relationships that exist between many birds and fruit-bearing plants in the Northeastern Woodlands. They will be able to cite Dispersal in addition to Pollination as important examples of Coevolved Interspecific Cooperation or Mutualism. They will be able to name several factors (both abiotic and biotic) that determine whether or not dispersed seeds actually germinate and grow to maturity. Students in groups that play the more elaborate version of the game (with the bright red cloth) should be able to describe color change as one of the many ways (in addition to taste and fragrance) that plants signal to animals when seeds are ready to be dispersed.

NGSS Disciplinary Core Ideas: PS1.A, B, C; LS1.A, B, C, D; LS2.A, B;

NGSS Practices: 2. Using models; 7. Engaging in Argument from Evidence; 8. Communicating Information

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function

Materials:

- **Some object to symbolize the fruit and the seeds it contains.** This could be a small ball, or a more 'realistic,' large paper cutout depicting some sort of berry that contains precious seeds. You could also use a trimmed and colored copy of the Raspberry Disk illustration that you'll find at the end of this section. Another version of the game, also described here, requires slightly different materials to represent a cherry.

This can be a very lively and fast-paced activity. To begin, the children form the ring by joining

Overview:

The coevolution of adaptations for seed dispersal between flowering plants and various birds and mammals has led to a host of beautiful phenomena – from delicious fruits to fragrant, colorful berries to color vision! Here's a game that helps children begin to appreciate, from an early age, the mutually beneficial relationships between hungry birds and rooted green plants who have seeds to disperse.

hands. One child is designated as the Bird. This person moves outside the circle, and is presented with the big paper berry containing the imaginary seeds. While carrying this precious burden (lunch for the bird and the Future for the plants), Bird circles the now moving ring of singing children, travelling in the opposite direction to their direction of rotation. (Once the children understand how to move as a group, the singing portion of this game is lengthy enough that you can model (and they can learn) an interesting step pattern, such as the grape vine step, to amplify the learning and fun.) At the end of the song, the circle stops, and Bird drops the paper berry between two children. These two will represent the competing forces that help determine whether or not a seed becomes a well-sprouted plant. The child on the left symbolizes the Helpful Conditions that the little seed needs. He or she represents: soft fertile ground, water, adequate drainage, sunshine, no predators, etc. The child on the right represents a fierce seed predator – in this case: Hungry Mouse. These two will now compete in a speedy race around the circle, traveling in opposite directions, to see which can return to the starting place first (i. e. to the gap in the circle where the seed was dropped and the race began). Another student is selected to shout out: "Ready, Set, Go!" When that child gives the signal, both Hungry Mouse and Helpful Conditions race off - in opposite directions. The first to complete the course and return to the gap in the circle is the winner. Bird can stand watch as the referee. Depending upon the speed of Helpful Conditions or Hungry Mouse, the seed either sprouts or is eaten. (Mice are notorious seed predators, not dispersers.) The winner of the race earns the privilege of selecting the next bird.

Lyrics for "Berry in its Beak" Singing Circle Game

Berry in its beak and the bird flies on…
Seed in the berry, where will it go?
Spat out from aloft, or dropped in a plop-
Will it ever find a good place to grow?

Seed on the ground and the bird flies on…
Did it land on a rock or on soft, moist ground?
Is there too much water, or too little sun?
Will it be eaten by a mouse on the run?

For a more dramatic version of this game, one that emphasizes the way that the edible portion of a fruit serves as an energy-filled, calorie-rich reward for the seed disperser, try "Cherry in the Beak." Change the chant accordingly. The cherry seed, which is safely stored inside the hard-shelled pit, can be represented by a plain brown, laminated paper circle or brown ball (a small coconut?) wrapped in a brilliant red or purple piece of fabric. The fabric symbolizes the ripe edible portion of the cherry itself. When the singing ends during each round, Bird stops behind the two chosen children and ostentatiously pulls the cloth off the seed, and pretends to gobble up this delicious outer covering. Bird then tosses the pit (seed) onto the ground between the two competitors, and the game proceeds exactly as it did in the original game.

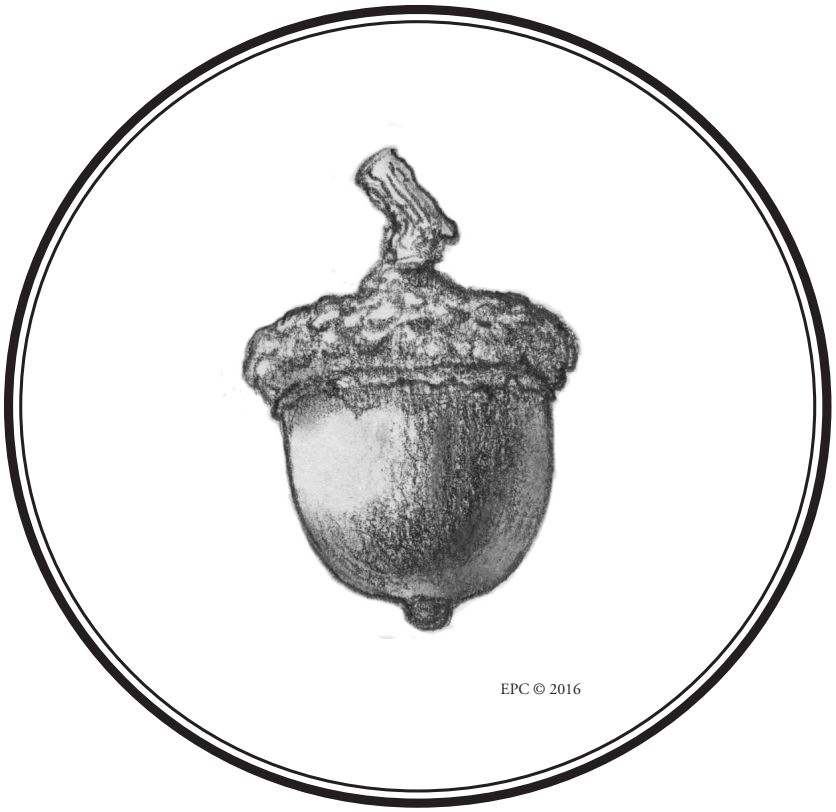
By adding this complication, you're providing an opportunity to talk about (and celebrate in play) the fascinating phenomenon of color change in fruits and the role that visual signals play in communicating to dispersing animals. Sometimes called Pre-ripening Fruit Flagging (also related to the fascinating phenomenon of Foliar Flagging) – certain color changes attract the attention of fruit-eating birds or mammals. As such, they offer fine examples of coevolution between stationary plants and mobile creatures. Over millions of years of natural selection, such changes have become intensified and refined so that beyond being a byproduct of chemical activities within the plant, they serve as advertisements - actual symbols and signifiers - that can be tracked by a variety of beings (including us humans) who have also coevolved color vision (another interesting story). Responding to the plants' visual call, these moving animals can help distribute the plants' seeds - after they've feasted on the calorie-rich outer portions of the fruit. The seeds themselves, which typically have a tough outer coat, are spat out or pass through the animals' digestive systems. In this way, the seeds, large or small, are transported to new locations. Some plants have coevolved so closely with their dispersing animals that their seeds won't even germinate / sprout unless the seed coats have been softened by a journey through an animal's gut!

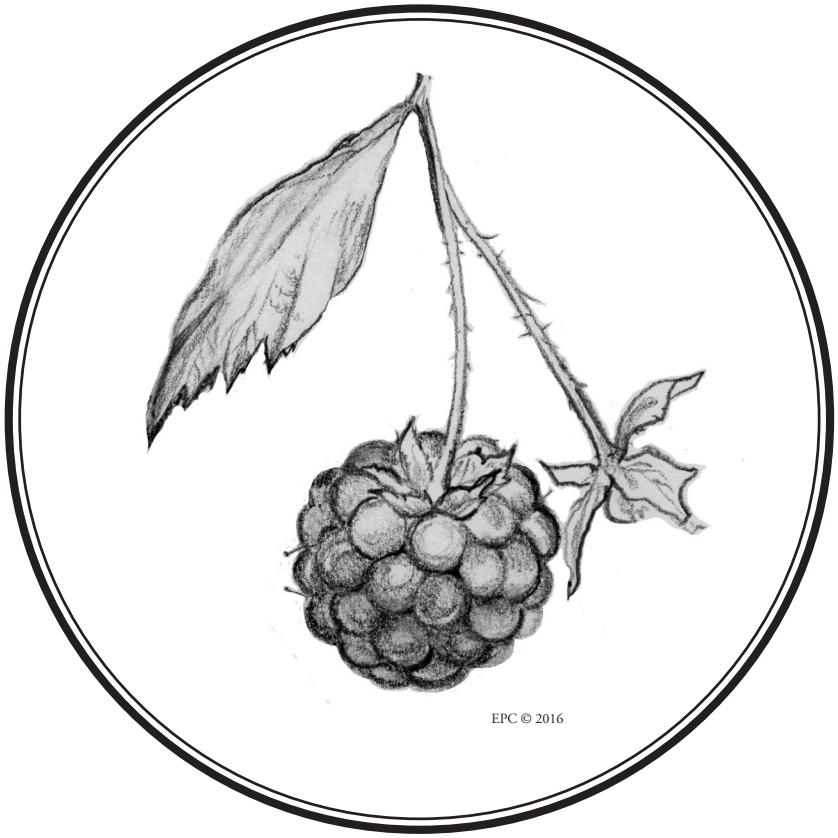
Visual signals of color change, along with taste

and olfactory cues, and the calorically-rewarding energy treat of edible fruit flesh (which will truly nourish the helpful animal disperser) are all lovely examples of subtle forms of interspecific communication and partnership. The tasty fruit tissue produced by plants reinforces / incentivizes interactions with dispersing animals. This has parallels to the way nectar produced in flowers compensates pollinators for their efforts. These mutually beneficial interactions are lucidly explained in Gordon Kricher's marvelous book: *Ecology of Eastern Forests, a Peterson Field Guide*. For more details, check that book's "Summer in Nature" chapter for the section titled "Patterns of Fruit and Seed Dispersal."

In closing, I hope that you'll be able to convey to your youngsters a sense of the importance and ubiquity of such coevolved relationships. Cooperative interactions such as the ones they are learning about here, as well as competitive ones, contribute powerfully to the beauty, diversity, and abundance of Life on this teeming planet.

18.1 Acorn and Raspberry Disk Illustrations





19 - The Hawk in the Nest

a singing, choosing, and acting circle game about energy flow and food chains
(Previously published in Green Teacher Magazine, Dec. 2009)

Ages: 5 to 10

Performance Expectations:
Students will be able to construct a reasonable forest food chain working in reverse from a Broad-winged Hawk. Older students will be able to state in words that energy from the sun (sunlight / electromagnetic waves) absorbed by photosynthesizing green plants powers most food webs - most life! - here on planet Earth.

NGSS Disciplinary Core Ideas: PS3.A, B, D; PS4.B; LS1.C; LS2.A, B, C; LS4.B, C; ESS1.B

NGSS Practices: 2. Using models; 8. Communicating Information

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 4. Systems and System Models; 5. Energy and Matter: Flows, Cycles, and Conservation; 7. Stability and Change

Materials:

None needed

Overview:

Circle games are a tried and true way for a group of people to have fun together. Here's a version of 'The Farmer in the Dell' that can help children understand how energy flows through a community of living beings. It's a singing and choosing game that builds students' knowledge about food chains within a given habitat.

Here are the basics. Let the players know that this game is somewhat similar to 'The Farmer in the Dell.' The melody of the song is identical – it's just that the words are different. To begin, the youngsters join hands and form a large circle. One person is selected to be the Hawk. The Hawk is of course a top predator in some of the many food chains in the Northeastern United States. Since Broad-Winged Hawks, with their short, highly maneuverable wings, are especially well suited for life in this region's forests, and since they raise their families there, let's assume that this Hawk is actually a member of the Broad-Winged species.

The designated Hawk moves into the circle's center where s / he stands or swoops about being very hawk-like while the rest of children (with hands still linked) begin to travel to the left singing, *"The Hawk in the nest, the Hawk in the nest, high-ho the forest oh, the Hawk in the nest."* At the next line, *"The Hawk takes the -,"* everyone stops circling and listens as Hawk announces what (or rather who) s/he is having for supper. If needed, the teacher prompts, "Which creature would a hawk choose – a mouse, a squirrel, a careless sparrow, or perhaps a chipmunk?" Any creature a real hawk in the forest might use for food (for itself or its babies) can be named. Students forming the circle can call out menu suggestions to Hawk. When Hawk has finally made up his / her mind, the choice is named.

At this point, the other students offer their best impersonations of the critter mentioned, and Hawk chooses one of them, leading that youngster out of the ring into the center. In this case, let's imagine Hawk has chosen Deer Mouse – a small white-footed rodent who's very common in forests. Everyone would sing, *"The Hawk takes the Deer Mouse. The Hawk takes the Deer Mouse. High-ho the forest oh, the Hawk takes the Deer Mouse."* The student chosen to be the Deer Mouse continues squeaking and skittering about in the center; in other words, acting very mouse-like, while the Hawk continues acting like a hawk.

Next, the people circling sing *"The Deer Mouse takes the -?"* and it's time for Deer Mouse to tell what his / her favorite snack might be. At this point, youngsters almost invariably call out "Cheese." I then explain that today we're building a forest food chain, and we are trying to think about what forest animals eat when there are no humans around. We might discuss the possibility that a careless camper has left behind a cheese sandwich, but students are encouraged to focus their attention on the many items that forest mice might include in their diet - without human intervention. Given this scenario, let's suppose that today Deer Mouse chooses a crunchy June Beetle. Now the students circle again singing, *"The Deer Mouse takes the Beetle, the Deer Mouse takes the Beetle, high-ho the forest oh, the Deer Mouse takes the Beetle."* Deer Mouse goes out to the circling students and chooses one child to be the June Beetle, bringing him or her into the circle's center. Now that everyone knows the game pretty well, someone else might call out (or you, as the teacher, might ask), 'Beetle, what are you going to eat?" And Beetle might reply, "an Oak Leaf." Everyone would then sing, *"The Beetle takes the Oak Leaf. The Beetle takes the Oak Leaf. High-ho the forest oh, the Beetle takes the Oak Leaf,"* while Beetle delicately pulls an 'Oak Leaf' from out of the line of circling singers.

Now it's time for 'Oak Leaf" to choose some plant food. This is an essential feature to the game and a key lesson to transmit: whenever a plant or a plant part such as a berry, leaf, fruit, or seed is mentioned, then that plant must select the Sun as its food source. After all, the Sun, our nearest star, provides almost all of the electromagnetic energy that daily pours out across our earth. As such, the Sun is the source that initially powers almost all of the food chains and biological energy transfers that are occurring on this planet. (Please note, I am not describing this as

an ultimate source.) Plants and the cyanobacteria are the key links in this process of biological energy transfer since they are the main living things who are able to absorb the Sun's energy and store it in the form of the chemical energy bonds of food molecules (such as sugars or starches / carbohydrates or oils). They not only make their own food from sunlight, but they form the foundation for most of the subsequent food / energy webs or chains on earth. Therefore, whether the child in the center represents an Acorn, a Milkweed Blossom, or a Grape, he or she will still choose the Sun as their source of energy. Moreover, all of these tasty morsels are parts of plants, so in the next sung verse, folks could either name the precise plant structure that's being eaten or generalize and say simply *"The Plant takes the Sun. The Plant takes the Sun. High-ho the forest oh, the Plant takes the Sun,"* and the Plant / Oak Leaf proceeds to choose someone for that role.

This should be done with great fanfare. After all, as mentioned before, the Sun is the main energy source for almost all the food chains on the planet and our closest star. It is a place where nuclear fusion and fission are constantly occurring, transforming Sun's matter into energy and releasing vast quantities of light and other types of radiation into space. As the teacher explains this, the children can try to somehow communicate this amazing phenomenon through their gestures, facial expressions, and bodily attitudes. The Plant's task is now to select one of these radiant beings to represent the Sun. That child is pulled gingerly into the center. All of the other food chain creatures, including Plant, are warned that because the Sun is so powerful and so full of energy, they must immediately hurry out of the center to escape from being scorched / obliterated. The food chain children break back into the circling ring and the circle expands to avoid the Sun's radiation. Sometimes, I mention that too much of an initially good thing can cause problems. For example, sunlight sustains all life here on earth, but too much sunlight can cause people to develop skin cancer! Other times I might comment that the distant Sun is really a big nuclear fusion and fission reactor and this distant Sun is probably the safest and best place to house nuclear energy. In any case, after the commotion of the escaping food chain creatures has been resolved, and the circle has been enlarged and renewed, the game finishes with the youngsters skipping around the Sun singing. *"The Sun helps feed us all. The Sun helps feed us all. High-ho the forest oh, the sun helps feed us all."*

And now after giving special thanks to all of the food chain creatures for their hard work and to the Sun for being such a good star, the explainer / teacher urges Sun to choose the next person to be the Hawk. And so the game continues…

Of course, there are thousands and thousands of other possible food chains that could be realistically constructed for a forest habitat. Challenge the group: How many different chains can they create? How long a food chain can they build – and fit in their circle? What about a different top predator, perhaps an owl or a bobcat or a red fox?

And now that the youngsters know the basics of the game, they can use their imagination to think of other habitats with other food chains. For example, a game for a wetland habitat might begin with the phrase: *"The Heron in the marsh, the Heron in the marsh. High-ho, the wetlands–oh, the Heron in the marsh."* A possible sequence for a food chain in the marsh might involve the Heron capturing a Blacksnake who might take a Bullfrog who might take a Shiner who might take tiny floating green plants such as Duckweed or protists such as Algae who in turn would take the Sun. Alternately, they could try *"The Black Bass in the pond … high-ho, freshwater–oh" or "The Sea Star in the tide pool … high–ho, the rocky shore."* Consider the possibilities.

And of course, if the children are studying other bioregions, it can be worthwhile to create new versions of this game. There could be *"The 'Gator in the swamp…"* for a southern wetland or the *"The Buffalo on the prairie…"* for a grasslands biome. For the neotropical rainforest, you could have *"The Jaguar in the ferns…"* or for the African savannahs, *"The Lion in the grass…"*

Finally, for any of these scenarios, please emphasize that the game can be especially enjoyable if the youngsters pretend to transform into the creatures that they are representing - by using their voices and / or gestures. Can't you just see the Green Frog hopping, the Milk Snake slithering, or the Heron stalking?

Circle games - the fun is almost never ending…

20 - When the Beavers Build their Dam

a singing, choosing, and acting circle game with a guessing component about wetland creatures

Ages: 4 to 10

Performance Expectations:

Older Students will learn about beavers' roles as members of a keystone species. They will be able to state that keystone species tend to alter their environment in such a way that biodiversity is markedly enhanced. All students will be able to explain verbally that large ponds and wetlands are created when beavers build their dams and, in effect, transform and flood what were previously dense forests traversed by freely flowing streams. Students will be able to name some of the many plants and animals who flourish in the ponds, marshlands, and swamps that are created by these large, intelligent, and very family-oriented rodents.

NGSS Disciplinary Core Ideas: LS1.A; LS2.A, D; LS4.C

NGSS Practices: 2. Using models

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 3. Scale, Proportion, and Quantity; 4. Systems and System Models; 6. Structure and Function; 7. Stability and Change

Overview:

Here's another circle game that's especially well-suited for 4- to 10-year-olds. It attempts to focus children's thoughts on the inhabitants of wetlands – in an active, embodied, and amusing way. It's best played outdoors, ideally, in an environmental center near real wetlands or in a school yard. It can also be adapted for an indoors setting. For an older group, you could substitute chanting for singing and drop the moving circle – unless, of course, the youngsters are accustomed to / comfortable with this form. (That said, you could even transform this activity into a simple, chanted Creature Charades with a seated audience and a succession of individuals dramatizing and answering questions about the beings they're personifying).

Returning to the ideal situation, following a field trip, film, story, and / or discussion about beavers that has included the concept of keystone species, students are all asked to think carefully and deeply about the life of one wetland animal or plant – other than a beaver– that they personally might like to be. Explain that they will soon be playing a game in which some people will act out the behaviors and appearance of their chosen creature while others will try their best to guess who they are.

Here's how the game begins. The children take hands and form themselves into a large circle. They now represent a beaver pond with its surrounding edge of cattails, aspens, alders, and willows. Two children are invited to act as the Beavers. Using their imaginations, they transform themselves and swim about inside the "pond." At the same time, the other students take hands and begin to walk, skip, or vine-step to the left so that the circle starts to revolve. They sing this brief song two or three times:

Lyrics for "When the Beaver Build their Dam

When the beavers build their dam,
They make themselves a home.
Other creatures like it too,
So they are not alone…

As the waters start to rise
The Pine Trees start to go.
Frogs and Turtles splash right in,
Cattails (alt. version - Sedges) begin to grow

At this point, the circle stops abruptly, and the children drop hands. The second Beaver selected chooses a child from the circle. He or she "swims" over and leads the newly chosen student into the very center. (This will make more sense as you read further.)

Now the youngster in the center has an opportunity to impersonate the plant or animal that they had imagined at the very beginning of the game. They're encouraged to act as much like their particular creature as possible - in the way that they're standing, swimming, hopping, making sounds, etc. While they're trying their best to convey by their behavior a bit of the spirit of the creature portrayed, the other children provide them with a human voice by singing:

If you ask me questions three,
I'll tell you who I am.
I'm a living creature
'Likes to live near beaver
dams.

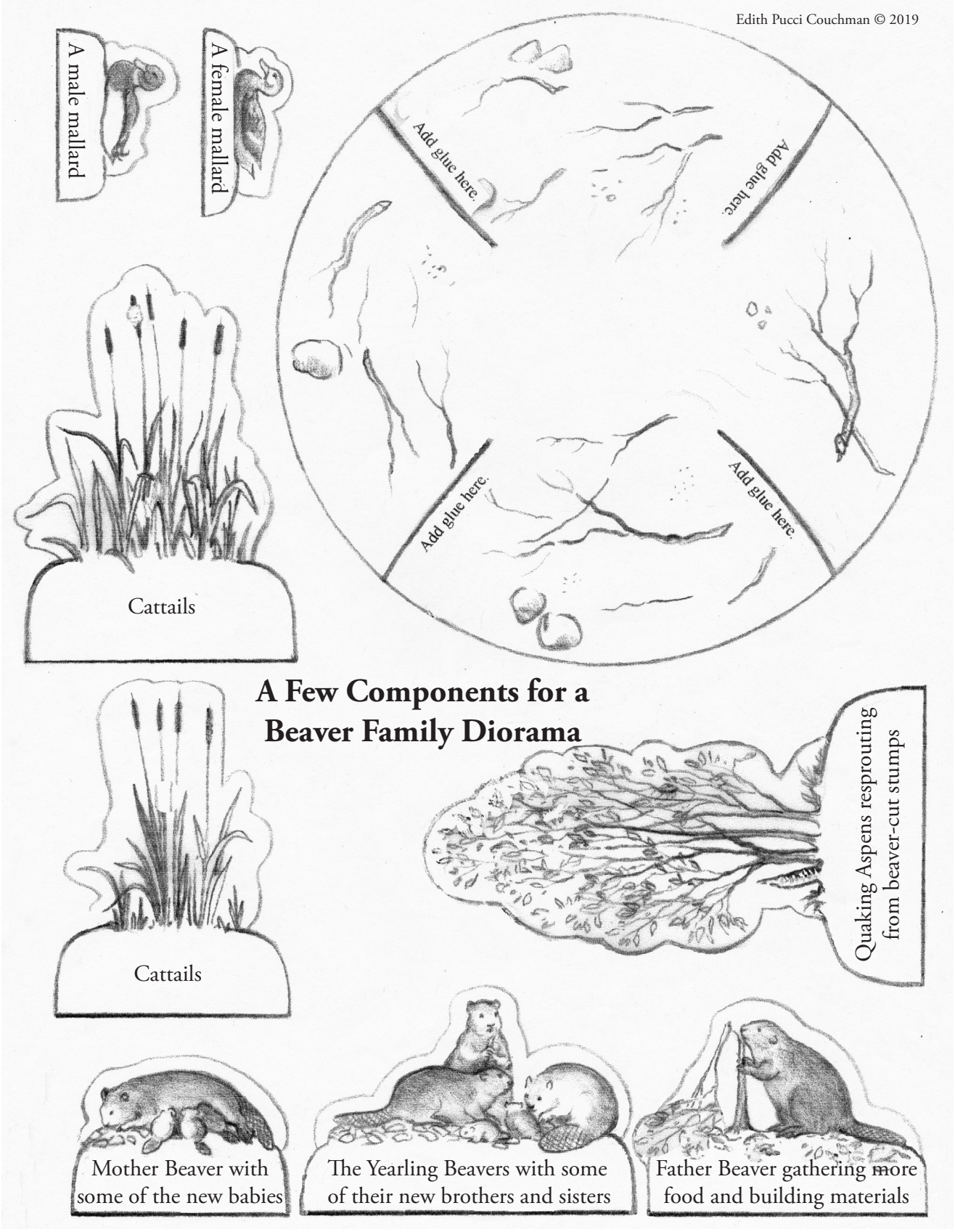
At this point, the children forming the circle take turns trying to guess what animal (or plant) the child in the center is representing. They do this by posing questions that can be answered by the creature with "yes" or "no" answers. The first child to guess correctly which creature is being represented becomes the first Beaver in the next round. He or she also has the privilege of selecting another child to become the second Beaver. The original pair of Beavers rejoins the ring of youngsters. If no one guesses correctly,the creature from the center (or the teacher) should select the first Beaver for the next round's beaver pair.

As you might notice, this final section is merely a version of "Twenty Questions." Feel free to change the number of queries in the verses to other configurations such as 'questions five' or 'questions ten.' And during the actual game, you might even need to extend the interrogations. Consider what's most effective for your group! Sometimes, if the class is too large, you might add extra Beavers (With a particularly large assembly, I've allowed four to swim about. After all, beaver babies stay with their parents for two years, helping both with dam building and care of their new siblings). Alternately, set up two separate circles (with a student or aide to coordinate) so that more children will have the opportunity to both choose their friends and dramatize (and empathize with) wetland species. It's very memorable and rewarding for most youngsters, during their turn, to literally become the center of attention. That said, if students are feeling shy and do not want to become one of the characters, by all means, make certain that they can opt out and remain part of the outer ring.

This game can be used to teach many questioning strategies. The younger cohorts will be most impressed by the visual display (the acting) and since their responses are very intuitive, fast, and concrete, they often go directly to names, asking excitedly "*Are you a turtle?"* or *"Are you a deer?"* Older children are more likely to offer questions such as *"Can you fly?"* or "*Do you have fur?*" From the oldest groups, we can expect some more layered, analytical questioning. To better ensure that this happens with students 9 or above, model a sample series of queries beforehand. For example, demonstrate a strategy for determining scale at the outset by asking, "*Are you larger than a house cat?"* You could also help them focus on salient differences defining various scientific classification schemes. For example, a question such as *"Do you make your own food from non-living things [by means of photosynthesis]?"* quickly splits the plants from the animals. *"Are you an animal with a backbone / vertebral column?*" reinforces fifth graders newly won scientific vocabulary and knowledge of animal phylogeny. For more advanced students, you might encourage the use of compound questions. For example: *"Are you an animal with feathers?"* neatly distinguishes birds from all the rest. *"Do you take care of your babies and feed them milk?"* directs the focus towards wetland mammals. A three-part question such as *"Do you have bones, cold-blood, and produce shelled eggs?"* quickly establishes that a student's four-footed pose represents a reptile (such as a turtle) – and not an amphibian (such as a salamander) or a mammal.

In sum, as you can see, this pantomime game can be readily played by older, more verbally-informed youngsters or by very young students who prefer the direct drama of imaginative, gestural, and auditory imitations. The key point is that it offers another pathway for enhancing students' appreciation and understanding of our varied wetland kin - even as they're enjoying time with their friends.

18.1 Components for a Diorama about Beavers and the Niches they Create



21 - Northeastern Animal Steps

a simple, impersonating game about movement (best suited for small groups of individuals - not teams)

Ages: 3 to 10

Performance Expectations:
Students will have a better sense and understanding of the different ways that animals in this bioregion move from place to place. They'll be able to associate various forestland species with characteristic modes of locomotion. They'll try out new ways of coordinating their muscles to move, even as they learn new vocabulary to describe such actions.

NGSS Disciplinary Core Ideas: PS2.A; LS1.A; LS3.B; LS4.C, D

NGSS Practices: 2. Using models

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 6. Structure and Function

Materials:

- **Animal Steps Cards**

Overview:

This activity gives very young children a chance to empathize with other living beings' modes of travel even as they compete and cooperate with one another in a friendly, sociable way.

Once you've duplicated and cut out the cards, there are many ways to play the game. With a small number of children, define a playing field (outdoors ideally, or indoors - even in a small room or hallway). Explain that each student will take a card and pretend to be the creature the card describes. They will then move from the starting line towards the defined goal, acting out their chosen creature's way of moving, accomplishing the designated number of jumps, hops, etc. After each turn, they must stay in place until everyone else takes a turn.

Then, they'll draw yet another card, become yet another creature, and complete a different set of motions. The child who reaches the 'finish line' first becomes the King or Queen of the Forest - for that round.

You can also play this game in teams. Divide your larger class into two or three groups - or however many are convenient. For very young, energetic youngsters, two teams are sometimes best because there's less waiting time between team actions. You might decide to name the teams after a few of the region's major trees, such as black oaks, shagbark hickories, red maples, white pines, beeches, etc. These are the large plants who form our region's wonderful forests - forests that shelter and feed so many other kinds of living things – including the animals the children will pretend to be! Play the game as described above, except that all the youngsters in a team have an opportunity to act out the motions prescribed on the card that one of their group has selected. (They line up side by side and advance as a unit.) To simplify play, once they've all made their moves, you can have the children advance to the farthest point reached by one of the teammates (provided that the youngster reached his / her spot fairly). The first team to cross the finish line receives an honorable title such as "Guardians of the Forest."

Imagine being some other sort of living creature and being able to move as they do!

21.1 - Animal Steps Cards

2
Bobcat pounces

3
Butterfly flaps
(a "butterfly flap" is a large swooping jump accompanied with a flap of the arms)

2
Atlantic Salmon leaps
(big jumps)

3
Skunk waddles forward
(squint and waddle forward three steps with hands touching ground: stamp your back feet and smile smugly)

2
Spotted Turtle steps forward
(with hands and feet on ground, lurch slowly forward two full steps)

1
Hoverfly hover!
Move your arms rapidly but travel neither forward or backwards

2
Ruffed Grouse bursts
(Jump up and leap forward)

2
Crayfish scoots backwards!

1
Caterpillar spin
(stay in same place but spin around)

2
Short-tailed Weasel slinks
(silent bounds)

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2
Snake slithers
(go forward two times your body length)

1
Earthworm crawl
(one body length forward – squirm)

4
Millipede ripples forward
(shaking slightly, move forward 4 small steps)

4
Centipede ripples forward
(shaking noticeably, move forward quickly with 4 big steps)

1
Snail glide
(slide 1 foot as far forward as possible; bring the other foot up even with the first)

3
Grasshopper jumps

2
Cottontail Rabbit hops

4
Chipmunk scampers
(four quick tiny steps)

3
Porcupine waddles forward

2
Blue Jay hops
(flap your wings!)

1
Flying Squirrel glide
(eyes opened wide, arms outstretched, make one large leap)

2
Toad hops

2
Jumping Mouse leaps
(2 big jumps)

1
Beaver step forward
(clap your hands like a tail slapping the water)

0
An Opossum playing dead
(no movement)

3
Coyote bounds
(running jumps)

3
Deer leaps
(huge jumps)

2
Sowbug / Pillbug rolls
(2 somersaults)

4
Dragonfly darts
(2 forward, 1 backwards, and 1 to the side!)

2
Owl swoops forward

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3
Canada Geese flights forward
(flap your arms, leap, and honk!)

4
Moth flits
(flap your arms and make four zig zag hops forward)

3
Stalking Heron steps forward
(stand on tiptoes, lift feet high, and move very slowly)

2
Whirligig Beetle spins
(step forward while revolving in two completes circles)

2
Bat dives forward
(flap arms and swoop down as if catching a moth)

4
Tiger Beetle charges
(Bend at the waist so your back is fairly horizontal to the ground; hold arms straight-back to represent your hard wing covers / elytra; step forward very quickly')

4
Raccoon ambles forward
(hands touching the ground, move froward four steps)

2
Spiderling floats
(take two graceful leaps forward; pretend you're drifting along as breezes lift your long strand of silk)

4
wavy Goldfinch flights
(bob up and down and chirp as you step forward with outstretched arms)

Encourage students to devise additional cards as they do more research on their neighborhood creatures' varied ways of traveling.

This will improve the game and increase the learning as they share their discoveries with their friends.

22 - There's a Mouse Gnawing in these Woods

a singing, choosing circle game about food webs with an added race

Ages: 5 to 10

Performance Expectations:

The children will strengthen their understanding of the forest food web. They will become very aware of the trophic connections between multiple creatures. They may become more familiar with several species of Northeastern Forestland's mice and owls, and they'll learn about the role that mice play as seed predators and consumers of young saplings. They'll better appreciate the benefits that certain secondary consumers / carnivores confer upon forests (and even us humans) as they go about catching their prey. They may become more conscious of parental care among non-humans. Older children will encounter the scientific term Trophic Cascades. All the children will enhance their social skills and exercise their muscles as they play this active game.

NGSS Disciplinary Core Ideas: LS1.A, B, C, D; LS2.A, B, C, D; LS4.B, C, D

NGSS Practices: 2. Using models

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function; 7. Stability and Change

Overview:

Here's a mammal and bird version of Game 12, "Mosquito in the Woods." It's particularly fun to play during autumn field trips, night programs or indoor winter science classes.

This game is played in the same way as the Mosquito game except that the lyrics are slightly changed to account for the drama's new characters. One child is chosen to be the mother or father owl. The other children become mice and they form a rotating ring (with hands joined - or not). The parent owl swoops around the outside of this ring (travelling in the opposite direction) in search of a mouse to feed to his or her family of nestlings. When the singing ends, the

circling halts, and Owl taps one of the mice on their shoulder, challenging him or her to race for

survival. This mouse steps out of the ring. Sometimes we pretend that the gap that's formed when the mouse steps out of the circle has been suddenly transformed into a mouse hole, the doorway to the mouse's home. At the designated signal, Owl and Mice race off in opposite directions around the circle of children. The first to arrive at the mouse hole is the winner – either Owl has captured food for his or her babies, or Mouse has escaped into the safety of the tunnels. The fastest moving child now has the honor of selecting the next Owl.

For most groups of students, it's worthwhile mentioning that mice are part of the Rodent Order of the Mammal Class. In Latin, 'Rodere' means gnawing or chewing - which is exactly what mice do. Explain that having too many mice in a forest can make it hard for certain woody plants / trees to replace themselves. This is because the mice tend to devour seeds and gnaw saplings. Over the course of thousands of years of evolution, a healthy balance has developed between mouse populations, owls, and newly sprouted trees. Owls (and many other creatures who eat mice) find safe homes in the forest's many trees. At the same time they keep the mice numbers from becoming excessive because they hunt them for food. Nesting in trees helps the owls to survive, and the owls (by eating mice) help the trees to flourish. There is a kind of mutually beneficial partnership here between the trees who shelter the owls and the owls who protect the trees. A dynamic equilibrium is in effect within the forest ecosystem.

For an older group, you might reference the concept of **"trophic cascade."** This is the scientific term used to describe this same ecological phenomenon whereby one creature - at a certain level of a food chain – indirectly assists another creature two or more Trophic Levels away, by keeping that creature's predators in check. Thus, Barred Owls help maintain the overall population of Sugar Maples in the forest because they reduce the number of White-Footed Mice scurrying about. Without the owls, there would be too many mice gobbling up the maple seeds and maple seedlings!

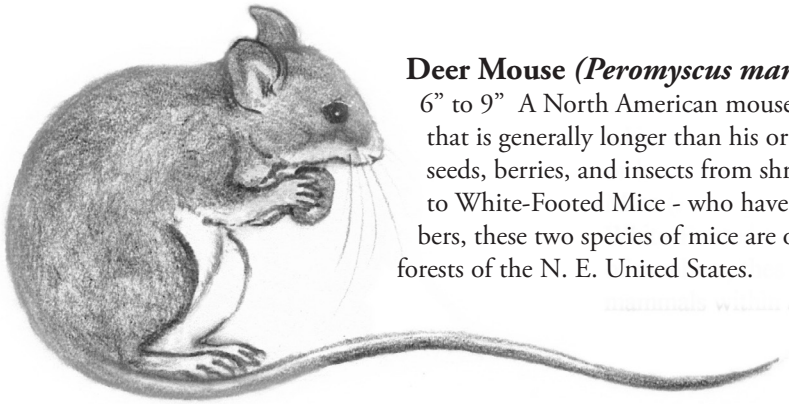
Here's the song for this version of the game:

There's a Mouse Gnawing in these Woods

There's a mouse gnawing in these woods,
Middle of the night, middle of the night.
There's a mouse gnawing in these woods,
Middle of the night so dark – oh.

There's a mouse gnawing in the woods
To your babies, he'd taste good.
Swoop and dive on silent wings,
Catch him if you can – oh.

A Few Common Mice



Deer Mouse ***(Peromyscus maniculatus)***
6" to 9" A North American mouse with a white belly, white feet, and a tail that is generally longer than his or her body. They are adept at gathering seeds, berries, and insects from shrubs and trees. They are also very similar to White-Footed Mice - who have slightly shorter tails. In terms of numbers, these two species of mice are often the most common mammals in the forests of the N. E. United States.

House Mouse *(Mus musculus)*
6" - 6 1/2" These mice may have originated in Asia. They are a common mouse that typically lives in human buildings. Unlike most native mice species, they do not have light-colored bellies. Instead, they are usually a solid grey color overall.

Meadow Vole ***(Microtus pennsylvanicus)***
5 1/2" - 8" These are frequenly called 'field mice.' They have very short tails, small ears, and chunky bodies. They eat all sort of vegetable materials, and in turn, are eaten by hawks, foxes, snakes, and coyotes. They travel under the snow in winter utilizing a system of clipped trails and tunnels through the brown grass. Look for these in spring.

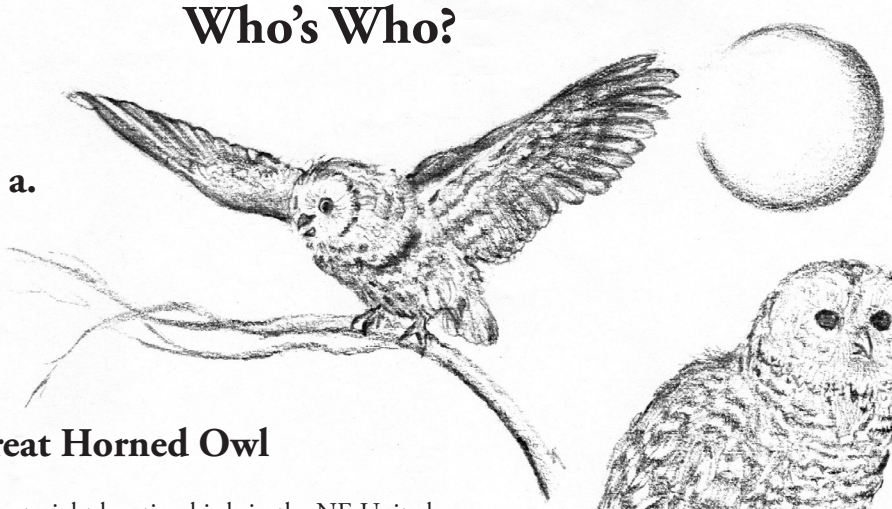
Meadow Jumping Mouse
(Zapus hudsonius)
8" - 10" This fellow eats many insects, seeds, and even underground fungi during the warm seasons of the year. He is also one of the few New England mammals who truly hibernates. Notice his long, bony legs. They're well adapted for leaps of 2 to 3 feet when danger is detected.

Edith Pucci Couchman © 2020

Principle Sources: National Audubon Society's Field Guide to North American Animals and D. and L. Stokes' Guide to Animal Tracking and Behavior.

22.2 - Three Northeastern Owls

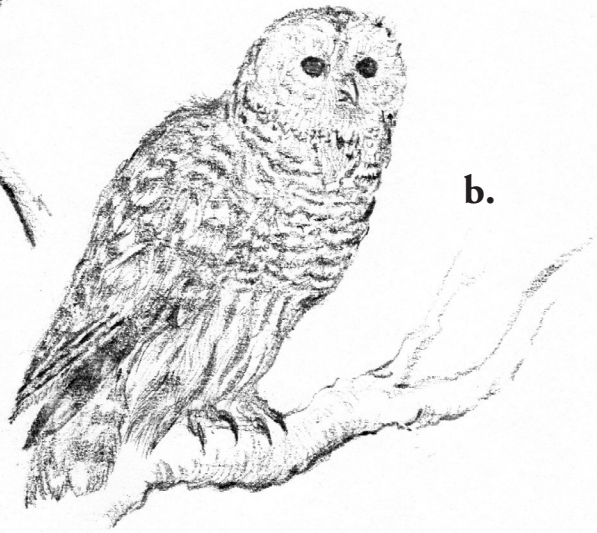
Who's Who?



a.

1. Great Horned Owl

The largest night hunting birds in the NE United States, these powerful 'top carnivores' feed themselves and their families by gathering up rabbits, squirrels, small rodents, skunks, and even other birds such as small owls, grouse, or the occasional roosting crow. They are able to live around human towns and often reuse crows' or hawks' open platform nests as homes for raising their own young.



b.

2. Saw-whet Owl

A tiny owl who likes to live in secluded swamps and forests, this fellow eats insects, small birds, earthworms, and other small animals. He is slighty smaller than the screech owl (who is the most common owl in this area). Saw-whet owls (again like screech owls) usually nest in hollow trees - that is to say, they are cavity nesters.

3. Barred Owl

A medium-sized owl, this is the owl who is most likely to answer an owl-calling human. Her "Who cooks for you - who cooks for you all" call is well known. Barred Owls require a rather large undisturbed area of forest to successfully raise their young They are closely related to the Spotted Owls of the Northwestern United States and like those owls, they too usually nest in hollow trees.

Directions: Write the number for each owl next to the picture that you think represents that species.

Answers: a - 2, b - 3, c - 1

c.

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23 - Mixed Feeding Flocks in January

(or Squirrels and Hickories; Chipmunks and Berries; Rabbits and Clovers; etc.), *a racing and chasing game using the basic format for 'Families, Individuals, or Teams Collecting Resources under Duress.' It models food webs and energy flow*

Ages: 6 to 12

Performance Expectations:

Students will have a deeper appreciation of the challenges facing particular animals everyday as these beings endeavor to find sufficient food and / or avoid dangers. Depending upon which version of the game is being played, they may also begin to understand some of the benefits and drawbacks of being both an individual and a member of a group.

NGSS Disciplinary Core Ideas: LS1.A, C, D; LS2.A, B, C, D; LS4.B, C

NGSS Practices: 2. Using models

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 3. Scale, Proportion, and Quantity; 4. Systems and System Models; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function; 7. Stability and Change

Materials:

- Tokens to represent the food materials being collected. These might be semi-flattened cupcake papers that serve as generic symbols for berries, nuts, or clover, etc. Alternately, you could design more elaborate, laminated cutouts in the shape and color of sunflowers, ripe strawberries, hickories, or acorns, etc. These can also be made extra-large to facilitate collecting and emphasize form. The illustrations of the **raspberry** and **acorn** at the end of 'The Berry in the Beak' (section 18) could also serve this purpose. Other more durable options include painted disks of wood. These might be worth the investment since they can withstand both the wear and tear of being carried, and the occasional wet or windy day on the playing field.

Overview:

This is a variation of tag, and, as such, it is related to Project Wild's "Quick Frozen Critters" game. It provides students with a fine opportunity to use their muscles, their minds, and their emotions: to run, chase, and socialize. Simultaneously, the youngsters learn more about the dilemmas encountered by other animals seeking food. They become more aware of these creatures' day to day ingenuity, and perhaps, develop a greater curiosity regarding their lives. I've used this game as a culminating activity following discussions and hikes focused on winter birds, but the underlying format is amazingly versatile. Tag games such as this, which feature 'individuals, families, or teams collecting resources under duress,' can provide an excellent framework for modeling all sorts of biotic and abiotic interactions within a wealth of biomes. Once children are familiar with the basic structure of the game, they can invent, reconfigure, and play all sorts of variations on this theme to represent the specific relationships and situations that they're studying. Such student-created games can help children both appreciate and speculate about the fascinating variables that operate within every trophic chain and ecosystem. Devising such games strengthens their capacity to integrate objective information into imaginative, self-determined, self-regulated, socialized play. The games themselves accustom them to interacting with their world (including their peers) in dynamic, responsive, and intelligent ways.

The Mixed Foraging Flocks section in the Autumn and Winter chapter of John Kricher's *Ecology of Eastern Forests (a Peterson Field Guide*, Houghton Mifflin, 1998) provides the basic factual framework for the game that I'll describe here.

To begin, I briefly explain to the youngsters how a **variety** of bird species actually flock together as they search for food and safety in the wintry Northeastern Woods. The nuclear species of these Mixed Foraging Flocks are typically local birds such as Titmice and Chickadees (both in the Paridae family of songbirds). They live in the forests year-round so they know their territory well. They also tend to be rather vocal and aggressive. These birds serve as the leaders, scouts, and sentinels for the group. They sound the alarm with special calls when danger is detected, and the other birds react appropriately to the signals, either freezing or exiting the area when they hear such warnings. This is a fine example of interspecific communication https://www.earth.com/news/mixed-species-foraging-flocks/. Species that join Mixed Foraging Flocks include Northern Juncos, Nuthatches, Downy and Hairy Woodpeckers, Golden Crowned Kinglets, Brown Creepers, and several more. Significantly, these diverse birds often have very distinct ways of dividing / partitioning the precious food resources of the forest. Some are adapted to seeking insects hidden on tree trunks, while others concentrate on the main or outermost branches of trees. Others prefer the seeds that can be discovered on the forest floor. Some (especially the Northern Juncos) are summertime residents of the Boreal Forest or Tundra. By migrating to the midcontinental NE Forestlands, they may be benefitting from the milder weather here as well as more abundant food and shelter.

To better convey this information and engage student's attention, I usually hold up laminated 9" by 12" photographs of each of the bird species. As I do this, I talk briefly about their particular ways of life and their adaptations for finding food. Both before and after recounting these brief stories, I invite students to select a favorite species from the roster, explaining that during the game they can pretend to be this kind of bird. At its heart, this choosing process provides them with motivation for listening more closely, and ideally, prompts them to identify with – and remember better – at least **one species** among the many whose attributes are described. The challenge of the game will be to collect enough food to survive the cold. And while the youngsters might be competing among themselves in this task, I also ask them to consider why it might be beneficial for them to also be part of this larger flock, especially during the dark cold days of winter.

The next step is to establish the spatial boundaries for the playing field and to designate a safety / shelter zone. To reflect the realities of a Mixed Forest Foraging Flock, a particular landmark could be called the 'hemlock shelter' or the 'conifer grove.' A second space within the playing field will be referred to as the 'feeding area.' The game will differ depending upon whether the children decide that all the food is concentrated in one spot (as in a human's backyard bird feeder) or if it's scattered about more widely - as is usually the case in 'wild' feeding zones that are less influenced by people. Children are then shown the materials that will represent the food supply. As mentioned, semi-flattened cupcake papers work well to symbolize food - which might include delicacies such as hibernating insects, spiders, insect eggs and / or plant seeds. Volunteers designated as 'Nature's Bounty' take up the task of scattering the food tokens around the feeding area.

When this is done, remind the younger students that the object of the game is for them to race out to the feeding site, gather food, and return safely to their shelter. Essentially, they need to obtain enough food / calories to allow them to fly back to safety. These calories are also needed to fuel the birds' internal 'furnaces' / their inner metabolism so that they won't freeze during the long, foodless night. (Here's a chance to reinforce students' awareness of the difficulties caused by sixteen hours of chilly darkness and the demands of Endothermy.) Youngsters can play this game several times, gathering tokens until all have been collected and everyone has flown back to the safety of the 'conifer grove.' Once there, they should count the food items that they've retrieved to determine which individual bird will be the fattest at the end of the day – i.e. which one has been able to gather the most food calories as compared to the others in the flock. If the group is very young, this might be the extent of the game.

For older students, the game can and should be much more complex. Now they must also confront the challenge of avoiding Dangers while seeking food. One or two children should volunteer for these roles. The youngsters themselves brainstorm who and what the dangers might be. There are threats that are abiotic and others that stem from living creatures. Perhaps there is not enough good shelter due to recent logging activity or road construction by people. Living Dangers might be predators looking for food. They might include Sharp-Shinned Hawks, prowling Housecats, or a hungry Fox, etc. When a Danger tags a Bird, that bird student must freeze in place for the rest of the round. Some classes like to include a Wildlife Rehabilitator who can rescue tagged birds simply by tapping / unfreezing them (more details about this are included in the explanation of the 'Parental Care' game). Depending upon the number of people playing, at least one or two students should volunteer to impersonate Dangers.

At the starting signal (which could be **"Go!"** or

a more contextually rich and dramatic phrase such as: "After the long, cold night, you awaken as the dim winter sun **Rises**!"), the mixed foraging flock flies out from the safety zone towards the feeding area. The predators, by agreement, start from the middle of the field or from a distant area far removed from the boundaries. They race in (or slyly slink about) attempting to catch as many birds as possible by tagging them. Members of the flock may use both vocal and visual signals / cues to warn one another about the predators. When all the food has been gathered, or an imaginary ice storm causes the teacher to call, "Halt," all the birds must return to the safety zone of hemlocks or other conifers.

At this point, the flock and predators debrief about the events of the game. Here are a few sample questions which the teacher or students might pose: Did it help sometimes to see where other birds were finding food? Which birds escaped the predators but returned without enough food to survive? What is the food situation of the predators? What warning signals worked – why or why not? Do birds in our region use visual signals? (Besides the obvious meaning conveyed by a startled bird suddenly lifting into flight, the teacher might comment that Northern Juncos in particular have highly contrasting white outer tail feathers that flash when the birds fly up from the ground.) What social purpose might warning signals serve? How might the Junco's tail feathers parallel the grey and white tail of this biome's prominent herbivore – the White-tailed Deer? (Older students) How do these similarities relate to Convergent Evolution? Other questions: Did your fellow birds help or hinder your escapes; your feeding? How and why? What escape strategies did you develop? What worked? What didn't? Did you actively call to your neighbors when danger appeared? Why or why not? How could a bird from one species learn to react to the calls of another species? Are there any experiments you could devise, or research that you could do that might help you answer one or more of these questions?

For even older students, this game could be used to explore the fact that different food items contain different quantities of energy (calories) stored in the form of chemical bonds. Using this fact, more advanced students could construct ever more realistic / difficult game scenarios using colored 'food items' and assigning different caloric value to different colors. Players could be required to obtain a certain minimum number of calories during each game (or over a number of games) to avoid starvation / disqualification. Looking at food as energy, as well as material for growth and repair, is a useful perspective to cultivate. Students might find it surprising to hear that some studies have suggested that a chickadee will thrive nicely on the energy stored in 7 or 8 sunflower seeds during a warm summer day. In contrast, that same bird would need to eat 50- to 150 sunflower seeds on a winter day - just to be able to maintain its normal body temperature.[i] In discussing this situation, it might be mentioned that some berries and nuts are higher in carbohydrate and lower in protein than others, so beyond the variations in the caloric value of some food resources, there are also important differences in the nutritional value of different foods. There are also risks / costs associated with obtaining these calories. For example, a red squirrel can obtain many more calories by choosing a Shagbark Hickory nut rather than a Red Oak's tannin-filled acorn. However, the hickory nut's shell and husk make obtaining the actual food more difficult than simply nipping through the relatively thin shell of an acorn. Similarly, there could be a discussion about the fact that the energy / food requirements for active, warm-blooded animals like birds change tremendously depending not only upon temperature, but also upon physiological, morphological and behavioral adaptations such as: whether they can shiver, huddle with others,

insulate their body from the wind, find a cavity nest, keep water from their skin, or temporarily lower their temperature (by becoming torpid). These are the sort of insights and science content that can be incorporated into different rounds of the game in terms of Dangers to avoid.

As suggested earlier, this game can be readily adapted to illustrate numerous other ecosystem interactions featuring very different species. For example, after a talk about squirrels with kindergarten youngsters, my students have played a version of this game called "Squirrels and Hickories." In this variation, most children become either grey, red, or flying squirrels. They decide which species they'll represent after reviewing the distinctive characteristics of each of these arboreal North American rodents. The remaining students impersonate carnivores who might try to catch a foraging squirrel – carnivores such as Fishers, Broad-winged Hawks, Gray Foxes, or Great Horned Owls, etc. We discuss whether the food they'll be seeking should be hickory nuts, acorns, tree buds, or mushrooms, etc. and why. Students can be supplied materials and time for crafting props for the games they're about to play. They can explore concepts such as caching vs. dispersed storing in regard to the ever-present problem of seed robbers. They could devise a game about camouflage and color changescolor changes in mature or immature oak seeds by crafting both green and brown acorns. They can then note which are gathered most often in a given game and ask themselves why.

To recap, tag games comprise a traditional form of activity that lends itself exceptionally well to many topics in environmental education. When customized to recreate a particular schema of biological relationships, the games can build a sense of empathy and familiarity with the species being studied. At the same time, they can transmit and reinforce scientifically accurate knowledge. Such games develop students' physical skills and provide exercise within emotionally-charged, information rich contexts. Academically and viscerally, they provide students with opportunities to experience for themselves the complex relationships and feedback loops that arise between multiple variables within a system (without the need for calculus or other forms of advanced math). They provide teachers with occasions to highlight these phenomena as well as to model questioning strategies and unravel misunderstandings. Such important clarifications and extensions can take place during the research, arguing, and brainstorming that accompany both the initial construction of the game and the vitally important post-game reflection. Among older elementary students especially, these games can provide an engaging forum for serious thinking and debate about specific situations and factors in the natural world as well as interpersonal expectations and responsibilities.

As a final note, it is important to acknowledge that tag games – which could also be described as 'peer chasing games' - are part of the innate behavioral repertoire of many mammals besides human beings. As such, they allow youngsters of many species to express and develop their peer to peer social relationships. As everyone knows, youngsters (human and otherwise) enjoy chasing after each other, and will do this spontaneously just for the fun of it. It is my opinion that good socialization – including educational practice - builds constructively whenever possible upon just such precious, ancient, and inborn behavioral tendencies.

With that in mind (and in our hearts), I think that we, as parents, community members, and teachers, need to be wary of commercial electronic games that seek to commandeer our children's priceless attention, imagination, and time. (Too often they snare children's attention with competitive and violent diversions /

scenarios that are at best counterproductive to the emergence of a compassionate and well-informed citizenry.) Too much disembodied "screen time" not only distracts, but can also hollow out and stunt many vital, incipient social skills and capacities. It can tangle young generations insidiously and almost unconsciously into passive roles within an industrialized culture of unsustainable values and motives.)

Instead, let's do what we can to see to it that our boys and girls play active, real games in real life with real friends. Let them play under blue skies on meadows and fields ringed with handsome trees as part of their humane, imaginative, and biologically-relevant public education. (Why restrict such marvelous environments and exciting events to the domain of competitive sports and athletic departments alone?) As parents and teachers, let's extricate our children from the confines of concrete 'classrooms.' Let's provision them with more hybrid, outdoor experiences that they themselves can shape – that will, hopefully, weave together laughter, sociability, physical exercise, and knowledge. When such factors join, they can help nourish within the children an informed sense of both belonging to and grateful responsibility towards the precious biosphere. And the youngsters' emotional response to this non-aversive 'education' will extend most immediately towards the biosphere's human subsets: to the children's beloved families, communities, and societies. There will be less resentment and frustration 'in the air' because the older generations will no longer be subjecting the young to an overly competitive, dehumanizing, and mechanistic, educational process.

And after all, what are the key outcomes that we expect from education? Don't we need it to be an enlightening and inspiring experience - a springboard to deeper compassion, and interconnectedness, as well as capacities to contribute to the common good? By offering activities that are more deeply infused and intentionally crafted with both the arts (in the case of this game, with drama) and long-lensed science, we can develop educational practices that are ever more consonant with our evolutionary heritage. Such learning activities can help nourish young people's joyful growth towards wisdom, creativity, and caring.

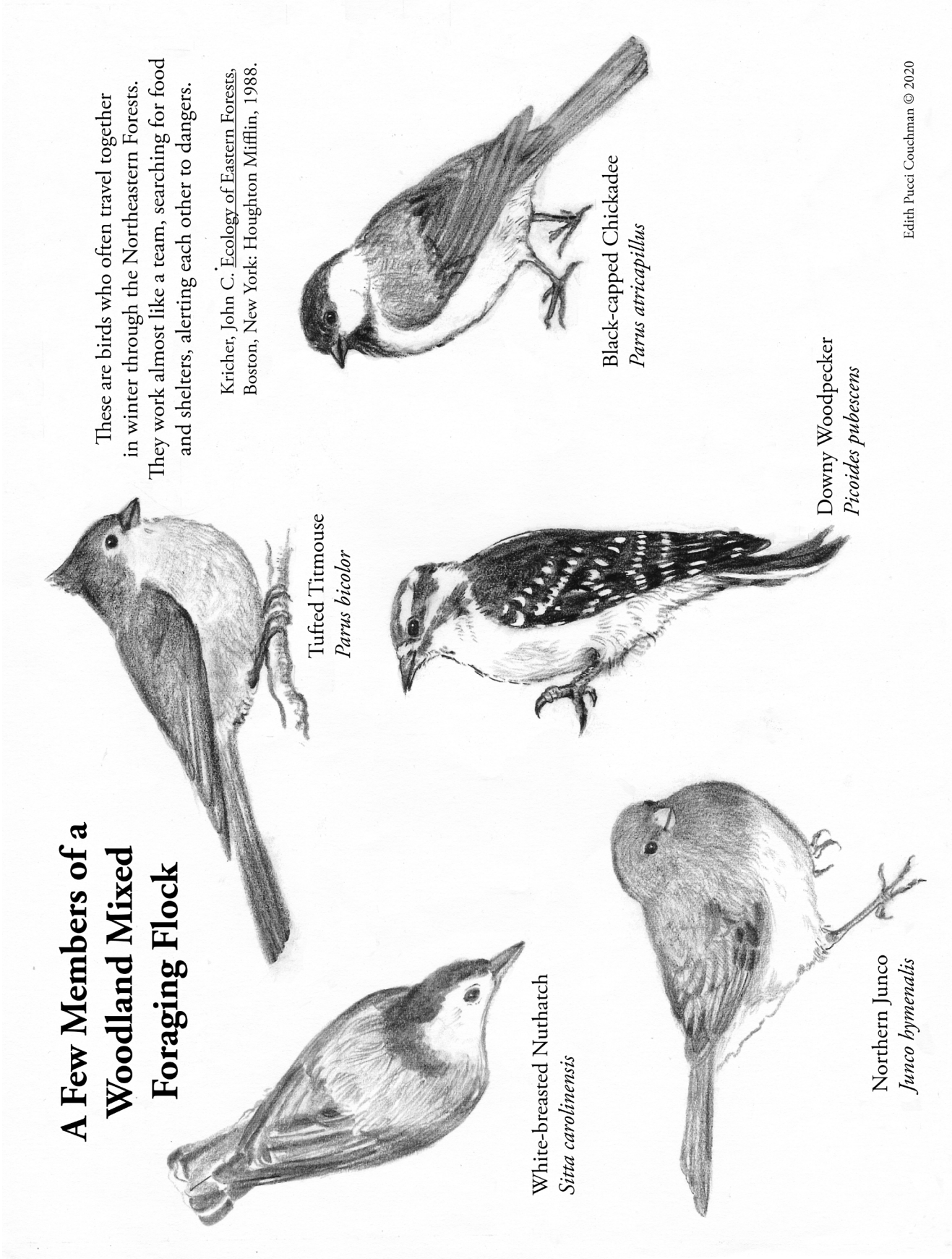
A

Adapt this game to highlight the food gathering patterns of creatures that your youngsters find particularly interesting - on the trail or around their school...

[i] https://www.google.com/search?q=food+Vs+Safety+chickadees&rlz=1C5ACMJ_enUS520US520&oq=food+Vs+Safety+chickadees&aqs=chrome..69i57j

https://www.nwf.org/Magazines/National-Wildlife/1991/Little-Dynamo

23.1 - A Few Members of a Woodland Mixed Foraging Flock



23.2 - Squirrels and Hickories (an illustrated information page)

Edith Pucci Couchman
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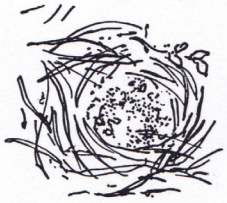
Drey - a leafy summer home hat both Gray and Red Squirrels often build.

A tree hole home - a favorite dwelling for Gray and Red Squirrels, especially in winter. Sometimes Red Squirrels nest underground or in dens among human-made rock walls.

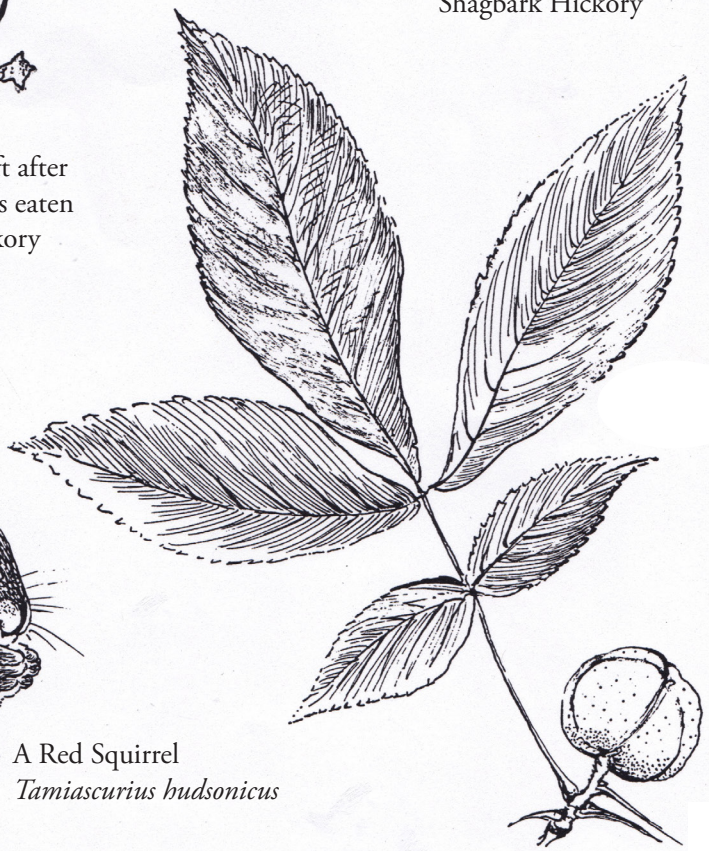
A sprouting hickory nut

A close-up view of the distinctive bark of a mature Shagbark Hickory

Shattered shells left after a Gray Squirrel has eaten the nutritious hickory seed kernels



A dig-hole from a Gray Squirrel who has either retreived or buried a nut. (Red Squirrels usually store many nuts or pine seeds together in big piles known as caches.)



A Red Squirrel
Tamiascurius hudsonicus

A Shagbark Hickory nut in its partially gnawed husk

A Shagbark Hickory leaf (with its characteristic five leaflets) and a Shagbark Hickory nut still encased in its aromatic green husk.

 © 2020 Edith Pucci Couchman

23.3 - Squirrels and Hickories (for very young students)

Edith Pucci Couchman © 2019

Here is a Red Squirrel, *tamiasciurus hudsonicus*, and several parts of a tree called Shagbark Hickory, *Carya ovata*. You can observe the plant's five-part leaf and the tough green husk which is enclosing the actual hickory nut.

Please use your good judgement and growing artistic skills to add color to these black and white ink drawings. Then cut the creatures out, as best you can, and use them as collage elements for your project. Have fun!

24 - Life Circles (Life Cycles) Game)

a singing, choosing circle game that builds verbal vocabulary pertaining to the English names for different stages in the lives of common animals and a few plants

Ages: 4 to 8

Performance Expectations:
Children will become more knowledgeable about the complex life cycles of many organisms. They will expand their vocabulary and ability to communicate more precisely about these life stages. They will enhance their cooperative social skills and their capacity to sing and move in a coordinated way within a group

NGSS Disciplinary Core Ideas: LS1.B; LS2.B, C; LS3.A; LS4.C, D; ESS2.D

NGSS Practices: 2. Using models; 7. Engaging in Argument from Evidence; 8. Communicating Information

NGSS Crosscutting Concepts: 1. Patterns; 7. Stability and Change

Materials:

- **Life Circles Cards**
- **a ball for tossing**

Overview:

The following is a game for very young children that builds social skills (such as cooperation and choosing) together with motor skills (coordinated movements, singing and catching a ball). At the same time, it also helps the youngsters to build their knowledge of English vocabulary words that serve to distinguish juvenile creatures from adults.

When we step back to consider the very profound differences that exist between young multicellular creatures and their mature forms, both in terms of appearance and behavioral capacities, it's not surprising that many human

languages use at least two very distinct words to describe the young of a species and another for these same beings when they are mature. Often there are even more than two words that can be used to describe the varied phases within a particular species' life cycle.

In explaining this game, you can mention to the children that sometimes all these words can make simple processes and things seem very complicated.

All of the young creatures that we'll be talking about today, with their very unique names, are just the immature forms of various adult creatures. With time and good fortune; with food and a relatively stable environment, and in many cases, with extended care from parent, parents and / or family, community, or society, these immature beings will grow to become the adults of the next generation. These adults, in turn, will be able to produce the subsequent cohort of young who in turn will pass along new combinations of their genetic material (DNA) and culture when they in turn produce more young. This is how species keep going forward through time, adapting, and changing while the older adults of each generation eventually die and pass away. This phenomenon / pattern is one in which we humans take part. (What do we call a young human? - an infant, a baby, a toddler, a child, or an adolescent, etc. What do we call a grown-up human? an adult, a man, or a woman, etc.) It is a lovely, if somewhat bittersweet, life circle or life cycle (to use the scientific term) that recurs throughout nature, especially among multicellular creatures.

And here at this point, almost paradoxically, we can grasp how scientific language combined with scientific insights can actually help us to see and share more clearly a beautiful and simple Big Picture of Life on Earth. Despite all the complicated words, it's just a case of immature forms becoming adults who produce more immature forms who grow into adults, and so on and so on. This game introduces this process to human youngsters and also begins to let them know that sometimes several words can have the same meaning, and / or that one thing (one animal or plant in this case) can have multiple names.

Through this simple round dance, even little children can begin to better appreciate this pattern within which their lives unfold, a marvelous pattern which connects them (and us all) to so many other living beings, past, present, and future, and to which we ourselves contribute! (Older students will eventually learn in their science classes or from their families, that the genetic material that makes us human goes back all the way to the first living bacteria of 3.5 billion years ago. It has just been elaborated and at times simplified and passed along across all these many eons. Essentially, we do indeed share common ancestry and genetic sequences with all of earth's living beings. We are in fact relatives and kin to all of this planet's amazing life forms!)

To play the game, someone first needs to create a deck of creature cards. Write or paste onto index cards (or some other papers) the English word pairs used to describe the juvenile and adult life forms of a variety of creatures. A list of some of these is included at this section's conclusion. On the reverse side of each card, attach pictures (photographs or drawings) of the young and adult forms of the species signified by the words on the front.

Making the cards can become a student project. Simply provide nature magazines for cutting, or printouts from the internet for trimming. Have students paste the picture pairs that they've selected onto the back of the appropriate card. Naturally, for preliterate children, you'll make certain, with spoken words, that each child knows which creatures, at which life stages,

they should seek. These very young children do not need to write the names on the other side of the cards, although perhaps this consulting and writing could be a task for older 'buddy' students - or for those peers who are already reading. (Older 'buddies' could even create a deck of hand-illustrated life cycle cards as a class project to present to a younger group of students.)

The children can also increase the level of difficulty / challenge of this game by adding more unfamiliar animals. Insects, especially freshwater species, and ocean creatures such as mollusks and coelenterates often have very amazing immature and adult forms with intriguing Latin or Greek derived names which could be shared - along with words' original meanings - with the students. (Children at this age are so adept at acquiring new vocabulary!)

The game itself begins as a circle. The children hold hands and move clockwise singing the eight lines of the descriptive song. The moderator (a teacher and / or a well-informed or literate student) stands in the middle next to the cards. At the end of the brief lyric, the circling children halt and drop hands. At this point, the moderator tosses a ball towards one child on the perimeter who must catch that ball without stepping from their spot in the circle. This challenge met, the youngster walks into the center to draw a card. (If the child misses, then the rotating and singing is repeated, or this tossing challenge is deemed too difficult and the teacher or moderator simply calls a student out of the circle to try to translate one of the pictures.) He or she then identifies the adult creature on the card and states which English word names this animal in its immature form. If the student can identify the word used for both stages correctly, that student stays in the center of the ring and tosses the ball – after the verses have been sung again and the circling children have had a chance to move. In effect, this child has the reward of choosing who will be the next contestant to guess. The moderator remains in the center throughout the game to toss the ball - in case someone can't name the two stages, and to make certain that the drawing of the cards from the center pile proceeds correctly and fairly.

Lyrics for 'Life Circles' Game

In Spring, Life's circles come around.
The grass, renewed, springs from the ground.
A time for growth and for rebirth.
Redwings return, the frogs leap forth.

What were you then, what are you now?
The little calf's a bull or cow.
What are you now, what were you then?
The chick's a rooster or a hen…

Sample Cards for Life Circles

Use illustrations showing the immature and the adult form on one side of the cards The names can be printed and glued or hand-written on the other side.

Kitten / Cat

Puppy / Dog

Lamb / Sheep

Foal / Horse

Chick / Chicken

Duckling / Duck

Kid / Goat

Kit / Fox

Gosling / Geese

Piglet / Pig

Child / Adult Human

Tadpole / Frog

Larva / Adult Bee

Caterpillar / Butterfly

Kitten / Bobcat

Pup / Coyote

Fawn / Deer

Duckling /Duck

Eaglet / Eagle

Cub / Bear

Porcupette / Porcupine

Caterpillar / Moth

Nymph / Dragonfly

Bunny / Rabbit

Hellgrammite / Dobsonfly

Maggot / Fly

Grub / Beetle

Wriggler / Mosquito

Sapling / Oak Tree

Seedling / Tomato Plant

(Add your own!)

25 - Sorting: Winter Adaptations; True or False, Habitats, etc.,

another example of 'Associative Learning through Team Relays' as in "10. Blossoms and Pollinators"

Ages: 6 to 12

Performance Expectations:

By playing this racing game, children's ability to correctly associate certain elements with particular categories / sets will be tested and strengthened. They will have an opportunity for physical exercise and fun - even as they sharpen their memory with the classification challenge. Their social skills will be expanded as they practice supporting their team while simultaneously competing against other sets of students.

NGSS Disciplinary Core Ideas: LS1.A, B, C; LS2.A, B, C; LS3.A; LS4.C

NGSS Practices: 2. Using models; 7. Engaging in Argument from Evidence; 8. Communicating Information

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 4. Systems and System Models; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function; 7. Stability and Change

Materials:

The materials required depend upon which version you've chosen to play. If you're trying the Winter Adaptations game, you'll need:

- **Four Winter Adaptations Posters - included at the end of this section (A pdf version of these posters is available at evolvingbeauty.org/winter-adaptations/)**
- **One or more illustrated sets of Common Living Beings of the NE Forestlands. These are <u>not included here</u>, but the directions for designing them follow.**

- **(Optional) Targets** to place in front of the destination / category posters.These could be as simple as pieces of 9" by 12" construction paper or woven rattan paper plate holders (my favorite because they are handmade of natural materials, attractive, light-weight and durable.). Grass is just fine outdoors too. When playing this game indoors, chairs or desks work well, but students can also just toss the cards on the floor as long as it's specified that each card needs to be reasonably close to its particular category poster (for instance, within a handspan or child's foot of distance from the relevant poster).

If you're playing a True and False game, you'll need sets of whatever materials the student are classifying plus:

- **True and False Posters with William Morris Borders – see section end**

The destination / category posters for these two games can be quickly made by photocopying the **Four Winter Adaptations** and the **True and False** categories. Attach them to stand-alone matt boards or cardboard backings. I don't recommend foam core because of its environmental implications. You can also put the category posters in upright acrylic display holders or in 8.5" by 11" soft plastic covers and place them flat on the ground. Again, as in laminating, please consider the negative consequences of using plastic.

For variations of the game, you can also use

- **2 sets of labeled tossable objects** ranging from pine cones to sock balls to popcorn cobs, etc.

Thus, if you're adapting this format to new categories and content, simply draw on your own creativity and that of your students. Craft destination posters and cards (or other tossable objects) that will depict the elements that need to be classified.

One final note in regard to materials, if it's not possible to create a duplicate set of sortable cards (or other materials) you can just make double copies of the category posters. In this circumstance, when playing, place the category posters in locations that are equally distant from the starting place, and divide the single set of sortable items into two equal but randomly divided stacks. The two teams simply run with their cards (or other materials) to their respective destination category posters.

Suggestions for Creating Illustrated Sets of Common Living Beings of the NE Forestlands

While you or your older students can quickly make sortable card sets simply by writing the names of the creatures on index cards of two distinct colors, this process can be much more enjoyable and learning-rich if you also make it an art project. Particularly with younger students, I would recommend the following:

First, provide the children with time to collect a variety of images of the living beings who thrive within a particular ecosystem. These creatures could include plants, animals, fungi, and, if possible, even tiny microorganisms such as protists and bacteria. Magazines such as publications from the National Wildlife Federation contain excellent photographs of the big, multicellular beings of the NE Forestlands. You could also purchase beautiful postcards or calendars featuring wildlife images from outstanding local and regional photographers. Another option is to scan or photograph pictures from books (copyright restrictions permitting) that illustrate common plants and animals of this biome. Additionally, there are abundant on-line resources that can be researched and printed.

Next, trim and glue the chosen images to tougher backing papers. I like using brightly-colored, heavy weight file folders (split in half) as backings to reinforce photographs from publications such

as the National Wildlife Federation's ***Ranger Rick*** or ***Big Backyard*** magazines. I laminate the combined papers. The finished, rather rigid, 9" by 12" posters have worked very well for my classes for over a decade, both on the trails, as visual aids for discussions, as reference materials for drawing, and for these sorting games. Heavy index cards are also fine card backings, if the plan is to create sets that are small in size and readily carried by racing students. That said, the youngsters seem to have fun toting and sorting the bigger images too.

For even more meaningful and lasting learning, students can draw and paint / color their own illustrations of these fellow inhabitants of our particular biome. Please refer to Ron Berger's wonderful video "Austin's Butterfly" for excellent suggestions about ways to accomplish this task kindly, realistically, and with peer collaboration: https://modelsofexcellence.eleducation.org/resources/austins-butterfly

The completed artwork is then scanned and turned into the game cards. However, this is not the limit to this work's utility. It can also function as a component of a Project Based Learning or STEAM assignment or unit especially when the drawings are paired with brief written reports about the lives of the animals being depicted. The illustrations can also form the basis for school, restaurant, community, or online art exhibits; as tools for student-to-student teaching with younger children; as gifts for family members, or as image sources for notecards or fundraising calendars.

In any case, it's ideal to create at least two complete sets of the beings, objects, or elements being sorted. Thus, students should collect or draw two images of all the items featured - although such images needn't be identical. It's essential that the card or poster sets have easily distinguished background colors (patterned papers?) or marks for identifying each team's cards. For the sake of durability, the finished cards might be laminated prior to playing the game. Given that they'll last for years, craft them well!

Overview:

This is a variation of the 'Pollinators and Blossoms' style of relay game. Students study a concept such as Winter Adaptations, Habitats, Plant vs. Animal Cells, Rock Types, or the stacked Layers of a forest, rocky ocean coastline, or lake). Once destination category posters and objects for sorting have been made or assembled, the students form two teams.

Challenge the students to sort their cards, materials, etc. into the appropriate category by racing or hopping across a designated space and tossing each labeled index card, sock ball, etc. into a space in front of the category posters.

I often use woven natural-fiber picnic plate holder as the targets / collection places but objects could just as easily be tossed onto or into paper plates, construction papers, classroom desks or the grass. There just need to be targets and rules - such as the 'creature' being sorted will be placed within the boundaries of its "habitat" (the paper plate or rectangle of construction paper) or will perhaps touch the edge of the particular target poster or be within a particular range of distance. Points are earned for each correct association. Extra points are awarded to the team that sorts its 'beings' first. (I usually award two or three points to this first team in order to honor their speed and coordination.)

One of the game's best attributes reveals itself at the very end: since a combination of knowledge, cooperation, and physical skill determines the winning team, students usually pay close attention during the post-race period when the entire class walks over to the sorting area to assess and debate whether the animals and plants, etc. have been allocated to the correct baskets / targets / categories. The score for each team is tallied. Mistaken pairings do not earn points so the winner of the contest is in doubt until the class has evaluated all the pairings for accuracy - even if one group was much faster in its sorting than the others. This is yet another opportunity to review the natural history information that is being learned, within a context of camaraderie and emotional investment. Games built with this active sorting format can function as lively follow-up activities for many topics involving categories and classification. They can easily be used to add large motor exercise to the intellectual exercise of preparing for approaching tests.

The **Winter Adaptations** version we're highlighting here helps students consolidate their knowledge regarding four general winter adaptations / 'strategies' that living organisms have evolved to survive the cold, dark NE winters. These basic adaptations are:

1. **Migration**
2. **Hibernation / Dormancy**
3. **Dying but Leaving Behind Offspring (as Eggs or Seeds)**
4. **Keeping Active.**

Before the actual game, students investigate which creatures tend to rely on which behavior patterns. They report back and talk with one another about their findings. Once agreement has been reached about the ways that specific beings generally deal with winter conditions, students use the cards they've constructed to play the game. They employ the relay race method described above to sort their creatures according to the principle methods that these beings have evolved to contend with winter challenges. Visual symbols for these adaptations can be found at the end of this section. I've found these illustrations to be very effective for conveying the concepts – even for my very young or dyslexic students.

And of course, games of this type can be used to classify statements into the categories of **True or Fals**e. The **True and False Posters** included at the end of the section feature borders designed by the great 19th century artist and social theorist, William Morris, a historic figure worth bringing to the children's attention. For older students, these True and False Posters are very helpful as destinations for races that review content and concepts prior to a classroom test. Sometimes you can just print the test's true and false statements (or variations of the learning objectives) onto two different colors of paper and trim out the individual sentences. Alternately, let the students do this task. Teams can then run the sorting relay race to review for the pending exam.

For younger, less literate students, the True

and False posters work nicely for lively races premised on simple statements such as: I'm an animal who can fly; I'm a creature who provides active care for my young, or I'm an animal who finds shelter in trees. The youngsters then sort the provided cards / images accordingly.

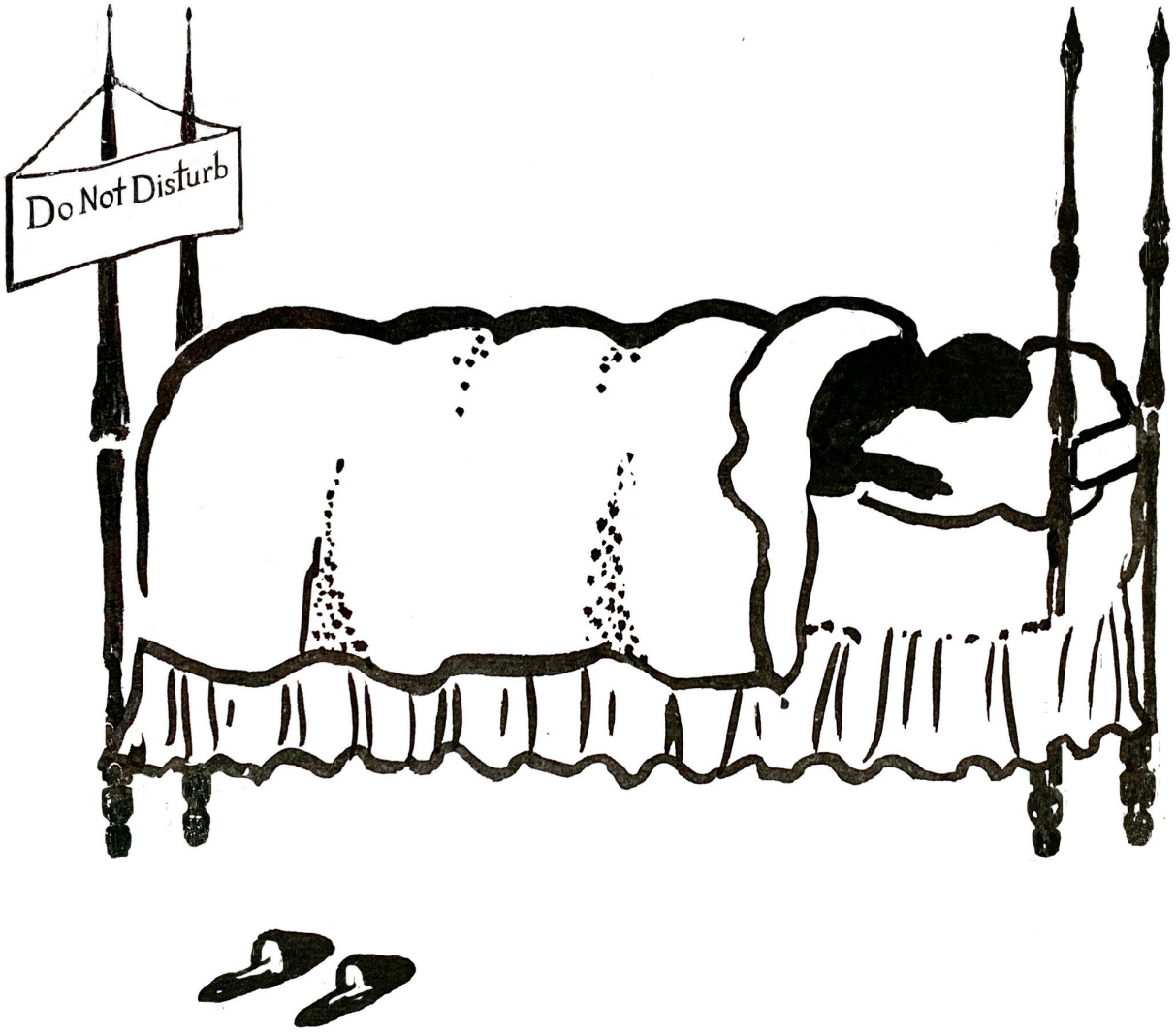
My students also enjoy reviewing true and false information by means of Joseph Cornell's rowdy, challenging, and sociable **"Owls and Crows"** tag game, as described in his book Sharing Nature with Children, 20th Anniversary Edition (DAWN Publications, 1998). It's also summarized online at https://www.sharingnature.com/owls-and-crows.html I consider this team tag game to be one of the most brilliant and versatile teaching techniques that I've ever encountered.

But to return to the sorting games, these provide a pleasant and lively structure in which youngsters can acquire, demonstrate and / or reinforce their knowledge of our complex world while simultaneously exercising their own physical and social skills. Such games can be set up in such a way that they provide serious athletic challenges on a school's playgrounds or a Nature Center's fields. Alternately, in inclement weather, less arduous versions can be played indoors in your school's rooms or corridors (as described earlier in **Blossoms and Pollinators**). The key point is that these teaching formats, these activities, build on the way children naturally and traditionally play. As such, they help keep learning fun. Learning is so vital to our lives as humans, we mustn't let it become an aversive chore! The acquisition of new understandings deserves to be a welcome and rewarding part of everyday life, especially in the lives of our children.

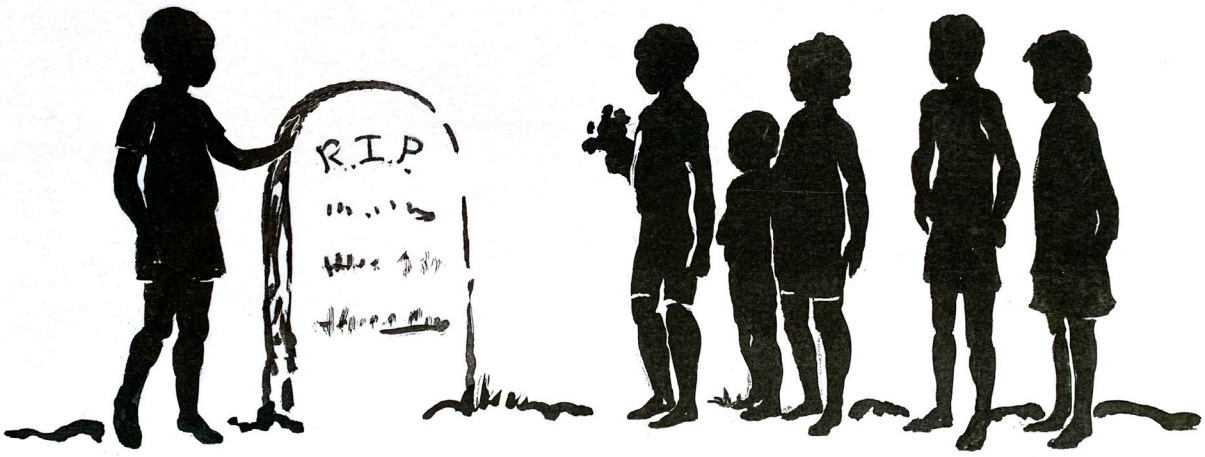
25.1 - Four Winter Adaptations Posters

Migration

Hibernation/ Dormancy



Die but Leave Many Offspring



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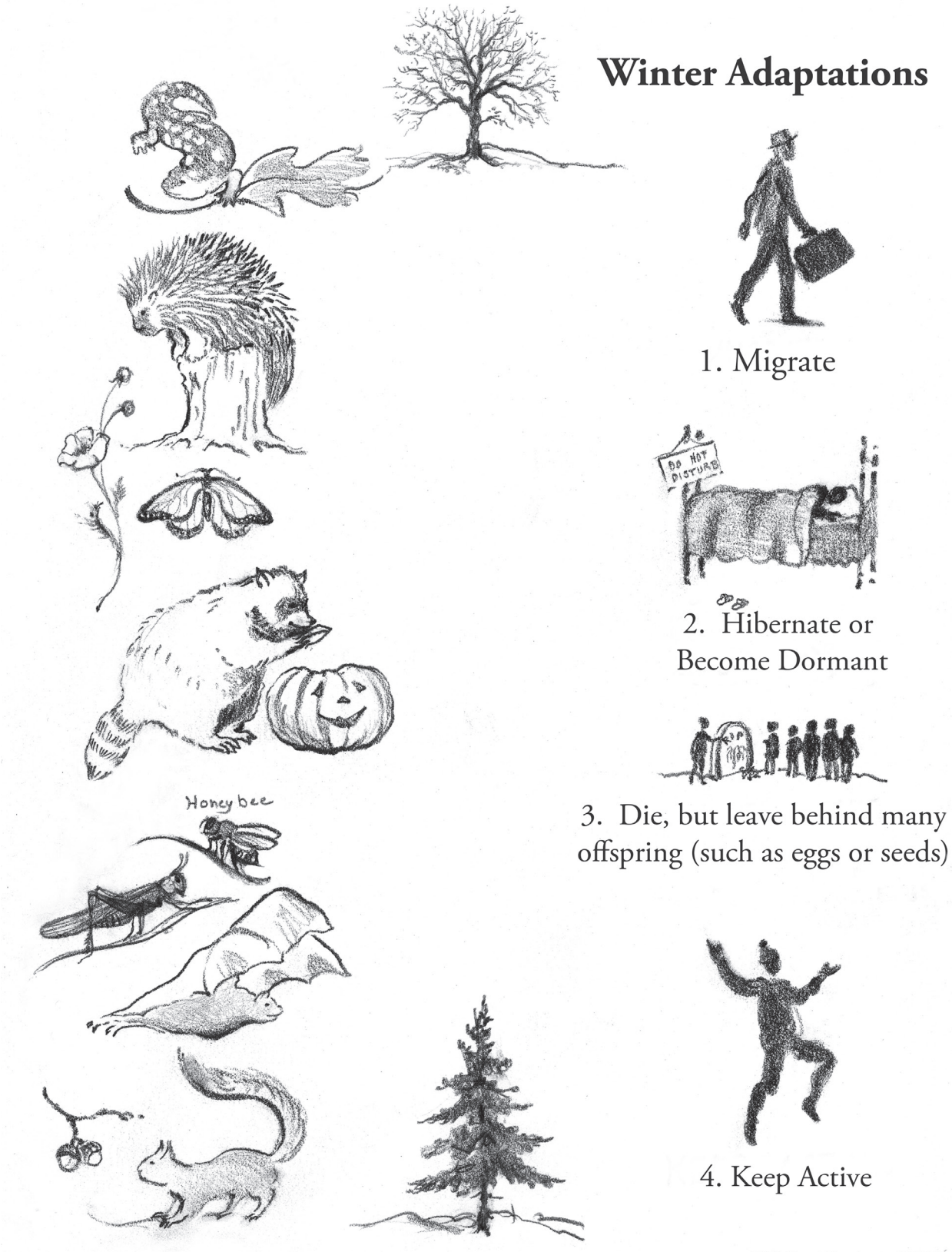
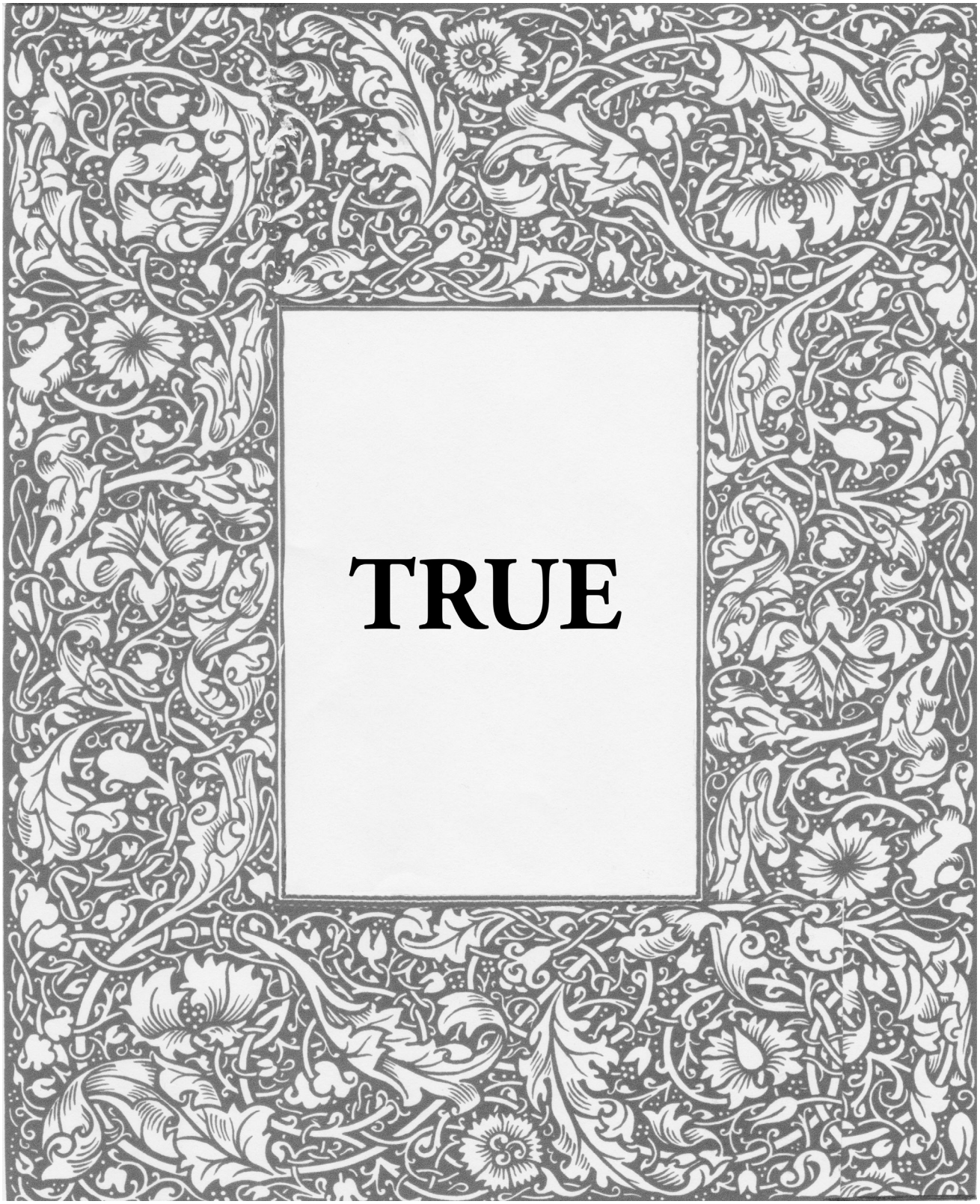
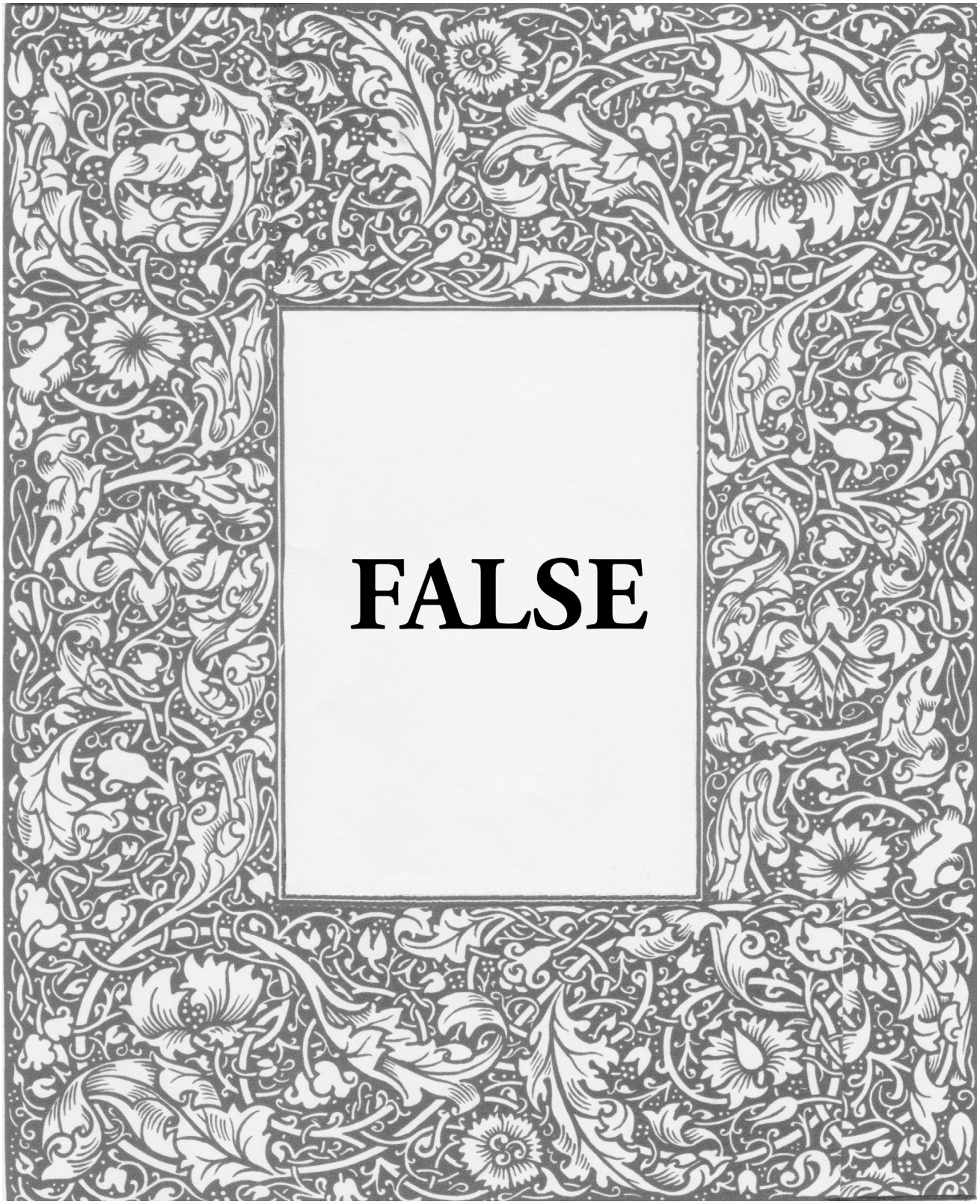
Keep Active

25.2 - Winter Adaptations Activity Page



25.3 - True and False Posters with William Morris Borders




FALSE

26 - Parental or Intergenerational Care Game

another example of the basic format for 'Families, Individuals, or Teams Gathering Resources under Duress' featuring both competitive collecting and tag. (Previously published in Green Teacher Magazine, Sept. 2016, as "An Intergenerational Care Game")

Ages: 6 to 12

Performance Expectations: Students will be able to identify four key components of intergeneration care and to list several of the difficulties / dangers that particular species must overcome in order to actually raise their young to maturity. By reenacting some of life's essential dramas, youngsters will be building both objective knowledge and empathy.

NGSS Disciplinary Core Ideas: LS1.A, B, C, D; LS2.A, B, C, D; LS3.A; LS4.B, C

NGSS Practices: 2. Developing and Using Models

NGSS Crosscutting Concepts: 1. Patterns; 2. Cause and Effect: Mechanism and Explanation; 3. Scale, Proportion, and Quantity; 4. Systems and System Models; 5. Energy and Matter: Flows, Cycles, and Conservation; 6. Structure and Function; 7. Stability and Change

Materials:

- **Parental Care Cards** - copied and trimmed to ensure that there is at least one card

Overview: "

It's not fair! Jordan always wants to be the Baby! It's his turn to be the Parent and go out and look for food!"

This is the sort of impassioned complaint that I often hear when youngsters are in the midst of an Intergenerational Care game. Nevertheless, it's the sort of game that they'll ask to play repeatedly. Is it surprising that this topic vividly captures their imaginations? Given our species' profound immaturity at birth and our abject dependency upon our

elders for food, protection, and training for literally years, doesn't it make sense that children are immensely intrigued by this subject? After all, discussions of parental care address experiences that are at the heart of their day-to-day existence as well as some of their deepest, often unnamed anxieties.

Although it can be a delicate and fraught subject within complex human societies, parental or intergenerational care is also, for many creatures, an epigenetic necessity. In other words, for numerous species, including our own, healthy, prosocial, functioning adults cannot be produced without a succession of interactions with other conspecifics: typically, at the earliest stages, their mothers and family members. Significantly, as a result of the character, range, and sequence of these inputs, varied genetic potentials and paths become activated and sculpted. This in turn leads to an array of developmental unfoldings at the molecular, somatic, psychological, behavioral, and social levels. Thus parental / intergenerational care epitomizes on a macroscopic level, the powerful effects of epigenetic cascades. But beyond this, it also offers a clear and beautiful example of the cooperative processes that have been so integral to biological evolution across the eons. Thus it is a theme that we need to weave directly into our teaching if we, as environmental educators, care about provisioning our students with a truth-filled and energizing understanding of their world.

Acknowledging this, I've found that the following active, running game can be an enjoyable way for children to reflect upon and speculate about important dimensions of intergenerational care. With a few simple adaptations, it can be used by a wide range of presenters working in a variety of settings withyoungsters ages five and above. It can serve as a concluding activity for a nature center field trip, as an option within an afterschool program, or as a lively complement to a text-heavy lesson in the classroom. It can be played in a large space such as a gymnasium or in a wide hallway, but it's definitely best played outdoors in the sunlight. It gives youngsters a chance to race around and have fun with their friends, even as they empathize with, and perhaps consciously consider, the arduous process whereby one generation 'raises' the next.

To play, students are encouraged to pretend that they belong to an animal species that practices parental / intergenerational care. This category includes a vast realm of birds and mammals, and even some reptiles, amphibians, and invertebrates (such as terrestrial isopods, lace bugs, bumblebees, and wolf spiders.) Whatever species is chosen, the object is for each 'family' to help its offspring reach maturity, thereby rolling the life cycle forward. In its simplest form, scattered cards symbolizing the immature beings' needs must be gathered by players impersonating the adults. To add a competitive element, the object of the game is to be the first family to collect a complete set. The searching process challenges children's memories as well as their running and communication skills.

What are the needs of these immature beings? Students are typically very eager to discuss this question, and often their lists coalesce around the

following general categories:

1. **Food** - matter and energy (stored in chemical bonds) that will allow the young creatures to grow well and maintain and repair their bodies.
2. **Shelter** - protection from abiotic threats such as extreme cold or rainstorms
3. **Protection** - active defense from predators and other biotic dangers, both large and small. This includes protection from pesky microbes and / or invertebrates - a service that parents accomplish through essential but often under-appreciated cleaning practices
4. **Training** - a process that includes

(depending upon the species being considered) the demonstration of techniques / methods for obtaining healthy food, avoiding dangers, communicating with visual signals, calls, and / or songs, as well as the modeling / transfer of vital caring, competitive, and / or cooperative social behaviors.

And here, at this point in the conversation, a very interesting phenomenon usually occurs. Some of the youngsters will pipe up to say that we've left out a tremendously important factor - **Love!** And indeed, for complex social animals, such as certain birds and mammals (including us humans), that powerful expression of bonding is probably yet another key ingredient in intergenerational care. I would personally place this amazing extension of territoriality right up there as a component of Training or maybe even in the category of Food as a nutrient - or perhaps as part of Shelter or Protection. For social animals, it is an indispensable ingredient of effective nurture. This is the conclusion drawn by attachment theorists such as John Bowlby[i] and anthropologists / primatologists such as Sarah Hrdy[ii]. Nevertheless, given that contemporary biologists haven't yet been able to confirm whether it is this feeling that humans call 'Love' that motivates, for example, a pair of Red Shouldered Hawks to risk their lives battling a nest-invading Pine Marten, we can't formally include this extraordinary emotion in the pre-printed list. **We recommend, however, that you compensate for this deficiency in reductionist science (and simultaneously honor the wisdom of children) by adding a heart symbol to whichever component card (or cards) you and your students think is best.** It is important and illuminating for young people to hear their teachers acknowledge the limitations of strictly objective, empirical science, as well as the significance of Parental Love. This can also be an occasion to explain that Parental Love, like Life and Consciousness, is a fine example of "Emergence" - and to then define this key concept of 21st century science.

*Emergent property - a feature, such as the texture of a stone, which is only evident at a certain level of organization. In other words, it wouldn't be useful to talk about the texture of a single atom. Yet when many atoms exchange or share electrons, and are thereby organized into molecules, sometimes, new qualities - such as texture, or even a tendency to maintain homeostasis - appear. These can be observed by a human percipient. In other words, such qualities "emerge," at least in reference to the perspective of a conscious, symbol-sharing system / organism such as ourselves. Some of us would consider Life, Love, and Consciousness to be among of the most wondrous of emergent properties.

Once students have agreed to employ the four factors mentioned above, I suggest using photographs of animal families to visually confirm the organizing verbal formulations. You might ask the children to analyze selected images and classify the types of care provided in order to gauge whether or not they've understood the categories. Four basic cards follow this explanatory text. You're welcome

to print and cut out multiple copies of these for your programs. Students can color the cards to better acquaint themselves with the ideas described - and to make the game more beautiful. Alternately, to maximize learning, youngsters could design their own symbolic representations. You could then use all of the resultant cards, or conduct an anonymous vote and print up the four favorites.

Mechanics aside, this explanatory portion of the game provides thoughtful children with a glimpse into some rather advanced ways to verbally and visually conceptualize their personal environments – and the developmental / enculturation process in which they themselves are so thoroughly immersed. By rationally framing and examining the process of 'child' development across species in the non-threatening context of an athletic game and discussion, you are offering your students ideas and analogies that can be potentially relevant as they try to understand their own circumstances. Moreover, you're strengthening their capacity to see and appreciate the continuities that exist among species, and expanding their sense of kinship with other life forms on the planet. In this way, you are helping them gain an awareness that might eventually contribute to their development of a personal Land Ethic as envisioned by Aldo Leopold[iii] or perhaps a strong sense of belonging within the Earth Community (that 'communion of subjects') proposed by Thomas Berry.[iv]

At this point, I would encourage you to enjoy the versatility of the game. Whether you choose Peacocks, Harbor Seals, or American Robins (as in the script available at the end of this section) you'll find that you have a fine opportunity to pass along granular descriptions of intergenerational care to an audience that really will listen. The information is intrinsically more meaningful because youngsters know that they'll be enacting the lives of these struggling beings in the game they're about to play. They will be literally embodying these animals' behaviors, in a process that will cultivate emotions of compassion and empathy even as it reinforces their knowledge of these creatures' lives.

The rules of play are simple. Once the animal's life story has been presented, establish the playing boundaries and ask the students to sort themselves into 'families' of a precise and appropriate size. The newly minted 'families' should assemble along one edge of the playing field while they decide among themselves who will be the adults and who will be the offspring. (For less social angst, assign these roles for the initial rounds). The young then settle into their imaginary nests, dens, burrows, etc. knowing that the game will be played at least two or three times so that everyone will have a turn at being the mobile adults as well as the stationary young. With some fanfare, select several individuals to temporarily serve as the Spirits of Summer and / or Nature's Bounty - or (for the Reductionists out there) Resource Dispensers. These folks will scatter the coveted Care Cards across the field. Clearly explain that the adults can only collect one card at a time and must then deliver it to the nest, den, etc.

At a signal such as "The owlets have hatched and are hungry," the families' adults charge out onto the field in quest of the required inputs. The young begin their clamoring. (Often students seem to relish regressing and pretending that they're greedy babies!) Sometimes 'family members' shout directions and warnings to one another. Sometimes they cheer for their adults or emit piteous cries for food – thereby contributing to the general melee. For certain species, the youngsters make no sounds, – a clever practice since noise might attract the attention of predators. The running and commotion continue until each family has all four of the elements, each delivered to the nest one at a time. The first group to acquire a complete set - and perhaps the second group - should be singled out for

commendations. Everyone is congratulated for working together and for trying their hardest to provide for the new generation. The random role of fortune is cited.

You can also try scenarios in which one parent has to remain in place with the young to brood, incubate, nurse, or generally care for them through a given portion of each round. This arrangement should prompt some thought-provoking questions. For example, should the players change the number / types of cards that need to be found on the field given that one adult is already providing constant temperature (for incubating birds), food (in the form of milk for the nursing mammals), protection, and / or continual training / modeling? Perhaps these services need to be recognized by pre-allocating cards for the work being accomplished at the nest site.

Students could also consider the challenges for creatures, such as white-tailed deer, whose females raise fawns without assistance from the stags. In this instance, only one adult does all the running. A contrasting format describes the lives of species who have care arrangements involving helpers / alloparents. In such cases, as among elephants, beavers, and scrub jays, there will be more than two individuals providing care. These might be grandmothers, older brothers or sisters, aunts, or sometimes even unrelated conspecifics. Given all this diversity in the organization of family life, you will be able to offer children not only an amusing and physically engaging game but even a few potentially comforting examples of the multiple paths that living beings have evolved for raising young and continuing their species through time.

Options for Students Over Age 7: In this regard it's important to keep in mind the vivid imaginations of younger students who are still functioning in what Piaget designates as the pre-operational stage (ages two to age seven or so). The basic scenario set forth so far works well for this group because all of the families and their members survive. It's merely a matter of some reaching maturity faster than others or having more resources than the rest. However, with older, less sensitive, students (third graders and above), you can add more realistic elements.

For example, the group might decide to require four inputs for each and every nestling. The winner of the game becomes the family that fledges the most offspring before all the Care Cards have been claimed. Alternately, you could model the effects of a disease outbreak (one which makes it especially difficult to protect the young from biotic threats) simply by reducing the quantity of protection cards. Play the game and see what happens.

The Most Versatile Option: The most dynamic (and probably most fun) variation introduces a tag feature. Carnivores or other Dangers, alluded to in the cards and actually associated with the species being represented, now become characters in the game. These entities chase the foraging adults who must both gather components and avoid being caught. If the Dangers tag one of the parent runners, this player is lost from the game, temporarily or permanently. For third and fourth graders, I highly recommend that the parent be only temporarily incapacitated. For this purpose, simply add a Veterinarian or Animal Rehabilitator into the mix. The tagged parent freezes in place until being tapped by the student who's playing the healer. For older students (11 and 12-year-olds), a Danger tagging an adult might indicate that the adult has become part of the food chain - and been killed. In such a scenario, the tagged person is sidelined for the rest of the game, and the remaining family members must try to compensate for this disastrous loss.

Debriefing the Game: The discussions following these activities are especially necessary and valuable educationally. They serve as

opportunities for students to translate their experiences into words and to reason about the costs and benefits of various actions / choices and about alternative strategies that might have been tried. This process is especially effective immediately after the game when the youngsters' muscles are tired but their memories are fresh.

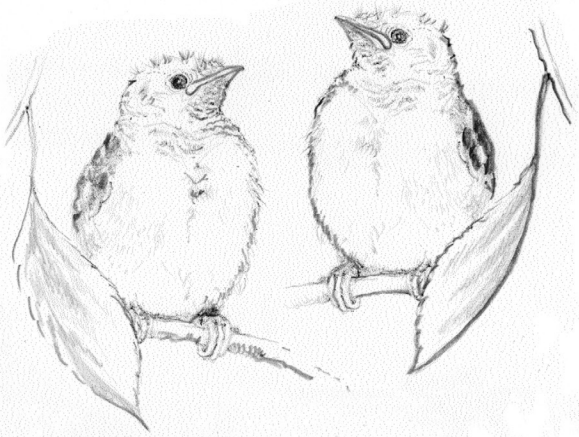
As you can see this is a flexible playing structure that can easily be reconfigured and elaborated to increase its cognitive richness. The premise often evolves into spontaneous dramas of surprising dimension and originality. Playing this game - which has deep roots in traditional hunting and gathering activities as well as racing and chasing behaviors - can lead to serious conversations as well as more heartfelt comprehension regarding the complexities of child-rearing and parental care. Hopefully, it can also help illuminate students' understanding of their own family contexts as these play out within the contemporary panoply of human cultures and classes. It can lead to interesting discussions about the differences between social creatures such as humans and less social beings such as cabbage butterflies or bobcats.

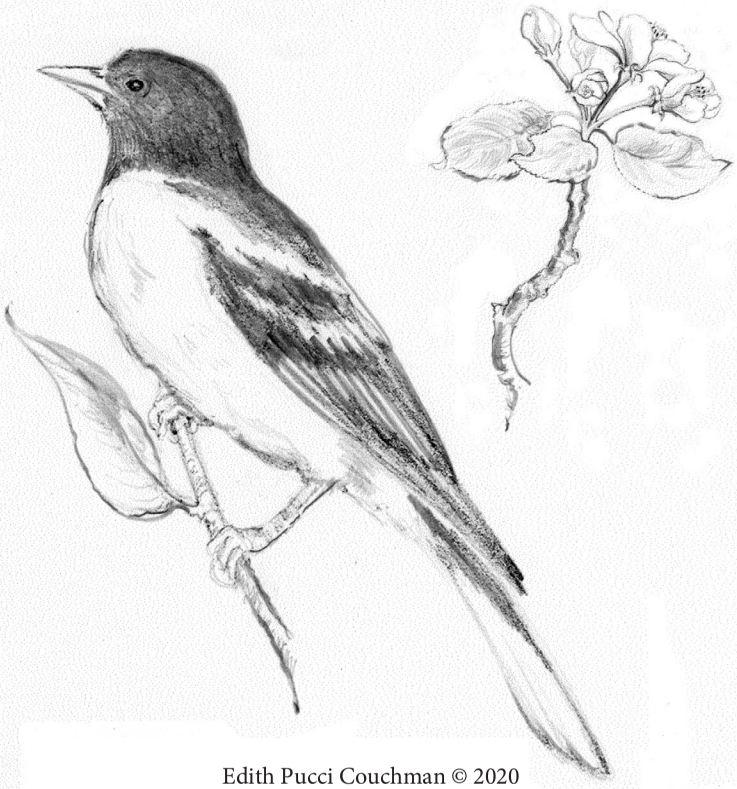
Real Games and the Re-enchantment of Education: I truly believe that if we can reinvest beloved, old, ontologically appropriate forms of play (like the collecting and chasing game described here) with new truths, we can improve the quality, integrity, and breadth of our students' learning experiences. We can help counter some of the pernicious effects of sedentary, verbally-saturated styles of education and commercially-driven, electronic entertainment / enculturation. Enjoyable team games where individuals run (hop, jump, etc.) with their friends to collect cards or objects that represent a set of factors required for a particular, real process can help make learning more physically and emotionally engaging. Indeed, education becomes more humanistic, self-directed, and less aversive when we respect children's affective and motor propensities as well as their intellectual curiosity about the world in which they find themselves. Such games can be readily adapted to add genuine exercise, social bonding, expressive decision making, and fast, time-sensitive, 'executive function' cognitive skills to many types of learning challenges.

And indeed, isn't this the time for all of us to move beyond teaching methods that were shaped by narrowly rational, excessively competitive, alienating, and industrial-style models of society and socialization? Shouldn't we be accustoming our children to learning and working together joyfully, respectfully, and creatively with and within Nature – for everyone's mutual, long-term benefit? Such results would be good, not just for us humans, but for all the other beings on this lovely blue planet, beings whose relationships and harmonies undergird our presence here, making our lives both possible and pleasant.

A Family of Baltimore Orioles

Younger Students: Please color this family of Baltimore Orioles.
Could you write a story or a poem about a few moments in the life of these birds?
Older students: Please write about how the Orioles will take care of their fledglings.
What will the fledglings have to learn now that that they have left the nest?





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26.2 - Notes for Parental Care Game

[i]Bowlby, John. *A Secure Base: Parent-Child Attachment and Healthy Human Development*. New York: Basic Books/Harper Collins, 1988.

[ii]Hrdy, Sarah Blaffer. *Mothers and Others, the Evolutionary Origins of Mutual Understanding*. Cambridge, Massachusetts: The Belknap Press of Harvard University Press, 2009.

[iii]Leopold, Aldo. *A Sand County Almanac and Sketches Here and There.* New York, Oxford, London: Oxford University Press, 1970 [1949]. "The Land Ethic." p. 201- 226.

[iv]Berry, Thomas. *The Dream of the Earth*. Berkeley, CA: Counterpoint Press, 2015 [1988].

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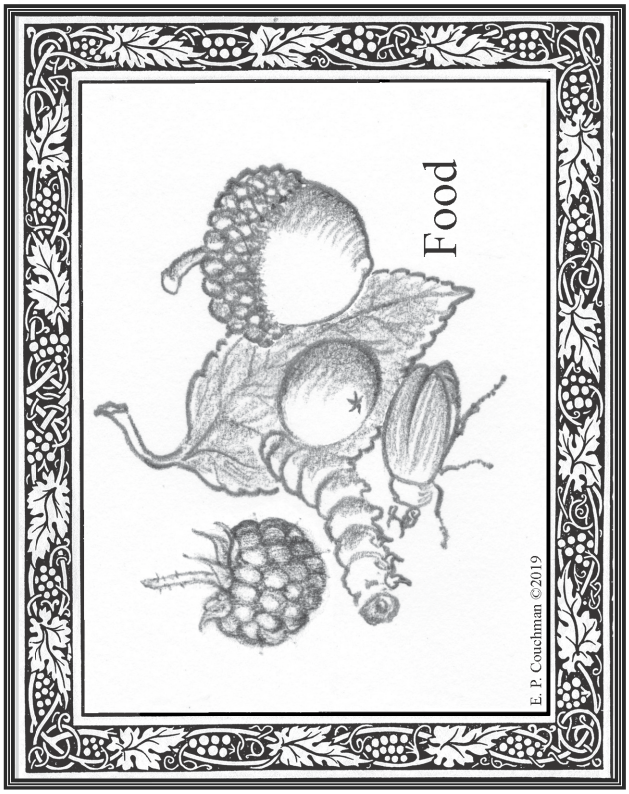
26.3 - Parental Care Game Cards



26.4 - Supplemental Script about Parental Care among Robins

Here's a sample of the sort of story I would share with my older students to prepare them for a Parental Care Game about American Robins.

To begin, I would ask the youngsters to exchange with their classmates some of the impressions and ideas that they've already acquired regarding these ubiquitous songbirds. As the anecdotes and facts emerge, I try to add any relevant characteristics that have been omitted, crafting a quick sketch of these omnivorous, gregarious, versatile birds who are so well-adapted to coexistence with humans. Before describing robins' lives, I might note that they are a bird in the thrush family of songbirds, related to the melodious Hermit Thrushes and the charming Bluebirds. Youngsters usually enjoy (or are at least startled into attention) if I recite or read a short poem about the animal we're studying. The poem by "A Bird Hopped Down the Walk" by the marvelous New England poet Emily Dickinson can work perfectly here: http://www.poets.org/poem/bird-came-down-walk-328.

I mention that while adult robins have rather short lives, managing, on average, to survive for only a year and half, they're capable of living up to10 years in captivity. Typically, adults raise at least one or two batches of babies every summer. This process begins as soon as the male robins fly north from their wintering grounds. In the early spring, they search out - and begin to defend - sections of land that they treat as their territories. These territories are places with an abundant food supply and a good building site for a nest. One of the ways that the male signals his control of a particular piece of real estate is by singing loudly and frequently from the trees in his realm (although in this species, the song is definitely associated with other activities as well). He usually chases away other male robins who attempt to intrude on his chosen property. The male's oft repeated songs not only advertise his spatial claims but are also thought to help attract potential mates.

Once a suitable female has arrived and the two have formed a pair bond and mated, the female will begin constructing a strong nest formed out of wet mud, twigs, grass, and rootlets. This new home is carefully situated on the top of a tree branch or on some other flat surface. It has the shape of a rounded cup, achieved in part, by the mother robin turning around and around in the center of the building materials, pushing them into a perfectly fitting bowl shape. The female does most of the collecting, transporting, and building herself, although sometimes, the male assists. (Robins, like people, show variability in their personalities.) Nest finished, the female lays one sky-blue egg a day for three to five days and then begins to incubate them. 'Incubate' is a word that describes the way that the mother keeps the eggs next to her warm body, assuring that they're dry, safe, and held at a constant temperature. This in turn facilitates an incredibly intricate series of chemical reactions within the egg that will eventually result in the assembly and development of the baby robins. The mother turns the eggs several times a day to prevent the yolk sac from sticking to the inner shell membrane. During the daylight hours, she typically flies off to forage for about five to ten minutes every hour. The rest of the time, she is on the nest, warming and guarding the eggs. She maintains this schedule for approximately two long weeks. During this time, the male stays nearby providing an additional measure of protection.

At last, the unborn robins begin tapping on the inside of the shell. With great effort, they succeed in breaking through their vaults of calcium carbonate. The newly hatched robins tumble out

onto the floor of the nest. They can barely lift their heads, cannot walk, and are blind. They have naked, blueish-pink skin. At this point, the father sets to work finding food for them. He carries it back to the hungry newborns. The female continues to stay on the nest to 'brood' (another word that means 'keep warm') the nestlings for several more days, until they are mature enough to regulate their own body temperatures at a constant level of approximately 104 degrees Fahrenheit. By now, the babies are sprouting small feathers and can open their eyes and see. The mother can begin leaving the nest for longer periods, and both she and the father continue providing food, and security. They diligently carry away the waste sacs, an important activity that helps keep the babies clean.

In Joan Dunning's excellent book, ***Secrets of the Nest***, she describes the huge appetites of the nestlings: these tiny creatures will each be eating three pounds of food during the two weeks after they hatch - gobbling down the equivalent of a 14-foot earthworm every single day! The youngsters' feathers (including contour and flight feathers) continue to grow. They enable the young to maintain their constant body temperature even more effectively. The young also gain more skill at coordinating their muscles. After some fourteen days, the new robins (now known as fledglings) are able to leave the nest. Following several days hiding on the ground and in shrubs, they are actually able to fly.

Now the male takes over most of the caregiving and the female prepares for the next batch of babies. Once the young are mobile, they travel about with their father, and in so doing, learn more about suitable foods and food gathering techniques, various vocalizations, and how to avoid dangers such as cats and hawks. The male robin teaches his youngsters to roost with the flock of adult robins who have been his night companions throughout the nesting season. The adult male now returns during the day to help the female robin with their second batch of babies. Then, once this second batch has fledged, the entire family joins the larger flock. In this protective assembly of many watchful eyes, they will all scout for food, try to avoid danger, rest, and often migrate south during the fall. In the spring, the robins start new families - usually in or near the same place where they lived the previous year.

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