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MNDNR

MINNESOTA MASTER NATURALIST

Minnesota Master Naturalist Explorers Fall Curriculum

CHANGE IS COMING AS NATURE PREPARES FOR WINTER

IN PARTNERSHIP WITH:

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND

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GETTING STARTED WITH EXPLORERS

The Minnesota Master Naturalist Explorers program, developed in 2011, worked with elementary students across the state of Minnesota to foster their curiosity about the world and provided an opportunity for Master Naturalist volunteers to share their knowledge and passion for the outdoors with youth. The Minnesota Master Naturalist program, a partnership between the University of Minnesota Extension and the Minnesota Department of Natural Resources, operated the Explorers program with generous support from the Legislative-Citizen Commission on Minnesota Resources (LCCMR) through the end of the grant period on June 30, 2015. The following materials were developed to assist Master Naturalist volunteers as they planned one hour sessions, once each week for four to eight weeks.

First Day Schedule

Arrive early and be prepared with supplies to set the room up. You should have familiarized yourself with the activities you will be conducting prior to this day.

Welcome individuals as they arrive. Attendance should be taken to assist with learning names. When all participants have arrived, introduce yourself. Share something interesting about yourself with the group. Introduce the Explorers Program and briefly mention that you are a volunteer with the Master Naturalist Program, a program sponsored by the Minnesota Department of Natural Resources and University of Minnesota Extension. It is helpful to share basic information about the structure of the program, "For the next six Mondays we will be learning about the outdoors and nature. Each week we will be spending some time outdoors so be sure you dress for the weather."

Conduct an ice breaker activity to start the day.

Hand out Explorers backpacks, journals, tree cookie name tags, pencils and permanent markers. Have participants put their names on these items. Ask what it means to be an Explorer. Refer participants to page 1 of their journal for what Explorers do and what the rules for Explorers are.

Introduce the Minnesota Weatherguide Environment Calendar by showing the day's date and the calendar features. Briefly mention that each week participants will be using the calendar to look at average temperature and phenological events. Phenology and the study of seasonal changes can be introduced on the first day.

It is recommended to take a brief hike around the schoolyard the first day. The hike can be used to make basic nature and weather observations.

Wrap up for the day. Ask the participants what they observed outdoors and summarize the topic of the day. Collect backpacks, journals, pencils and name tags. Take materials home with you in the materials bin.

Every Day

Consider bringing in a natural "object of the day" that relates to the topic you will be teaching about. This can be placed at the front of the room for the participants to look at as they come in to see if they can figure out what it is and what they will be exploring that day. Suggestions can be found at the beginning of each main activity.

Welcome participants, take attendance, hand out backpacks, journals, pencils and name tags.

Refer to the Minnesota Weatherguide Environment Calendar for weekly phenology, average temperatures and other relevant information.

ICEBREAKERS

The ice breaker activities are designed to be used at the beginning of each session or incorporated throughout the daily lessons. They can help participants feel comfortable with each other and the leader as well as help transition from the normal school day to the Explorers program.

Nature Makes Me Feel

Have everyone stand in a circle. Explain that each person should start by saying, "Nature and/or being outdoors makes me feel _____" and then respond with an expressive gesture. The leader gives an example, "Being outdoors make me feel HAPPY" and then he/she smiles or "Rain makes me want to jump in puddles" followed by jumping up and down. Adapt question based on the season and/or the current weather. When everyone has taken a turn, you can go around again with a different response.

Who Am I?

Place a name tag with an animal or plant found in Minnesota during the fall on the back of each individual. Participants are only permitted to ask one yes or no question per person about their animal or plant. They can go back through the group a second time and ask one question per person if the group is small or more time is needed. The goal is for the participant to guess the plant or animal on his or her back. This activity can also be done by giving only one participant the name of a Minnesota plant or animal and have the class ask questions to figure out the answer.

Animal Search

Prior to the participants' arrival, come up with a list of five native Minnesota animals. This number might vary depending on the size of the group. Spread the participants out around the classroom or outdoors. Whisper the name of one of the animals into each participant's ear. There should be at least two participants with the same animal name. When all players have been named, instruct them to find the rest of their "species" or fellow animals by making the sound or acting like the animal. The activity ends when all animals have found their fellow partners. Examples of animals might include owl, bear, wolf, wild turkey, frog or snake.

NATURE JOURNALING

Adapted from a *Keeping a Journal,* Monarch Lab, University of Minnesota.

Objective

To learn the basics of a nature journal.

Supplies

Explorers' nature journals

Pencils

Thermometer

Minnesota Weatherguide Environment Calendar

Objects of the Day: Examples of nature journals, plant and animal sketches and field guides

Magnifying glass (optional)

Camera (optional)

Background

Keeping records and taking measurements are important to being an Explorer. Good observations come from spending time looking at natural surroundings and making recordings through data collection and drawings. These recordings can be important for short and long term understanding of the environment.

The nature journal can be used to keep track of observed natural characteristics and changes in the environment made through written observations, recorded data and/or drawings. Observations might be based on the senses; sight, smell, touch or recorded data such temperature (actual vs. average), clouds types and wind. The journal is also a tool to record the seasonal phenology and changes around the schoolyard and surrounding neighborhood.

Emphasize that the participants do not need to be expert artists or writers to be good at journaling. Every journal entry is a good entry. Encourage participants to notice as many details as possible. Add labels to the drawings and note details like the date, location and weather. Provide examples of journal entries for the participants either from your own experience or in the Explorers' nature journal to help them get started.

Phenology is the science of seasonal changes and their effect on the natural world. A phenologist is someone who studies the changing of the seasons. Tracking events takes time and patience. First, you have to learn to be a good observer. Second, you have to become an accurate recorder of what you observe. Third, you have to become a critical thinker, finding links among the phenomena you are observing.

Activity

1. Explore and discuss the objects of the day.
2. Ask the participants why it is important to keep nature related records and measurements. What tools and supplies are needed? What would cause us to all have different observations?
3. Encourage participants to practice observation and description skills using words and drawings. Journal prompts are often helpful with weekly entries. Prompts might be sentences or key words that often help to initiate a journal entry. Refer to *Nature Observation* in the Explorers' nature

journal (page 3). The first time the journals are used, take a brief field trip around the schoolyard and record things the participants see. Share the list with each other.

4. One way to practice recording observations is to map the area of the schoolyard that will be visited during the Explorers program. Note key features like buildings, trees or paths. See *Draw a Map of Your Site* in the Explorers' journal for the mapping exercise (pages 4-5). The key can be used to draw symbols such as trees, shrubs or other landscape features to place on the map. The compass rose can be used to label the cardinal directions of North, South, East, and West. A good way to remember the letters and order on the compass rose is Never Eat Soggy Waffles. Consider sharing an aerial map of the schoolyard from a program such as Google Maps to show the participants another perspective of the area. Participants might also select a site in the schoolyard or a tree to observe once a week through the Explorers program. Drawings and photographs may be used to document the changes week by week. Assign a date to each of the recordings.
5. Record weekly weather observations such as temperature and general weather conditions such as precipitation and clouds on the *Weather Tracker* pages in journal (pages 10-11). Clouds may be classified by type or by the amount of coverage – clear, partly cloudy, mostly cloudy or overcast. Ask the participants how making weather observations is different when outside versus looking out the window or viewing photographs. Encourage the participants to compare the weather forecast printed in newspaper or on TV for a particular day with the actual weather conditions. Was the meteorologist accurate? Refer to the Minnesota Weatherguide Environment Calendar as a reference for average temperature data and weekly phenology.
6. Share the information presented in the phenology section of the Minnesota Weatherguide Environment Calendar. It is found after each month's calendar page. Define "phenology" and discuss seasonal changes to watch for in the upcoming month. Show participants the checklist of typical seasonal changes on the *Fall Phenology* page of the Explorers' nature journal and invite them to look for these changes as they go outside (page 7). Participants should observe and record any of the signs of fall in their journals and share with the group.
7. Other questions refer to the season. What are signs of fall? Refer to the Minnesota Weatherguide Environment Calendar and the Explorers' nature journal (page 7). Why it is important for naturalists and scientists to notice as many details as possible? Encourage participants to make general predictions of seasonal phenology. How do fall temperatures and hours of daylight/darkness change as the season changes and what effects do these changes have on plants, animals and weather in the area? What changes happen outdoors when fall arrives, temperatures decrease, etc.? Encourage the participants to observe changes as the seasons change from fall into winter and winter into spring on the *Phenology* page of the Explorers' nature journal (page 6).

Extensions

Constructing a Nature Journal

Objective: To construct a take-home nature journal.

Supplies: Colored cardstock paper, white paper, hole punch, straight stick, and a rubber band.

Activity: Construct nature journal by folding at least five sheets of white paper and place inside a folded cardstock cover. Punch two holes near the folded edge and wrap a rubber band around one end of the stick, guide the rubber band down through the hole then along the back of the journal and up through the second hole. Finally, wrap the rubber band around the other end of the stick. Illustrated directions can be found at www.makingbooks.com/elastic.shtml. The nature journal can be personalized with the participant's name and drawings. Journals can be constructed at any point during the Explorers Program. Encourage participants to make journal entries near the school, neighborhood or favorite outdoor location. Participants are also welcome to add photos to the journal along with a description of the object.

Onion Hike

Objective: To follow a trail using only your sense of smell.

Supplies: Scents that are easy to follow such as an onion. You may also use flavor extracts from the spice aisle at the grocery store.

Activity: Mark out a trail using only an onion or other smells such as mint, anise or vanilla. Rub the scent on trees through the woods. Have participants try to follow the scent. You may consider hiding a treasure at the end of the trail as an added incentive. Ask participants if it was difficult to find the scent. What other scents did they discover? What makes this activity hard or easy? How do animals use their senses of smell in the fall? Have participants mark the scent trail on their Explorers' nature journal map and journal about what they discovered.

Bicycle Spokes

Objective: To challenge the sense of sight and hearing and change participants' perspectives on making observations.

Supplies: None

Activity: Have participants sit in a circle, then scoot directly back and lie down on their backs to form the shape of a wheel with spokes. Be silent for one to five minutes. Ask participants to describe what they heard. How many different sounds did you hear? What proportion of the sounds was non-human? Were you surprised or impressed by anything you heard? What did you see from this perspective? In what ways would you act differently if this was your perspective all the time? How do animals use their sense of hearing to survive in the winter? In their Explorers' nature journals, have participants write about their experiences lying under the tree.

NATURE OBSERVATION BASICS

Objective

To explore the schoolyard using multiple senses and record observations in the Explorers' journal.

Supplies

Explorers' nature journals

Pencils

Objects of the day: Ruler, magnifying glasses or binoculars

Linnaeus List or other field guides (optional)

Background

Making detailed observations of the environment is important to scientists, naturalists and everyday people. Using all the senses can result in a well-rounded understanding of the surroundings.

Every known living organism is classified and named by a set of rules and guidelines. Those rules are used by all scientists around the planet. The names scientists use are called scientific names, not common names.

Common names are the ones you might use when talking with your friends or family. You call your pet a dog or a cat which is the common name. Scientists call those animals by a set of several names like *Felis catus*. That's a domestic cat. Common names for organisms can be confusing because anyone can make them up, and they may apply to more than one species. For example, the mountain lion also has other common names such as panther, cougar, or puma. The scientific name for the mountain lion in North America is *Puma concolor*. *Puma concolor* refers to only one animal.

Scientific names follow a specific set of rules. Scientists use a two-name system called a binomial naming system. Scientists name animals and plants using the system that describes the genus and species of the organism. The first word is the genus and the second is the species. The first word is capitalized and the second is not. A binomial name means that it's made up of two words (bi-nomial). Humans are scientifically named *Homo sapiens*. The name is always in Latin because when this naming process started, most people everywhere knew Latin. Scientific names help scientists to study organisms, especially when working with other scientists since they know which species is being discussed no matter where in the world they may be.

The descriptions used in field guides often refer to the characteristics such as color, size and shape in addition to feeding and nesting habits and the distribution or range of the plant or animal. The range map on the *Field Guide* page can be used to show where the organism is found in Minnesota (page 16).

Activity

1. Explore and discuss the objects of the day.
2. Discuss what tools (if any) are needed to make nature observations. How might the tools assist with making observations?
3. Ask the participants if they have made any recent nature observations.
4. Review the expectations/rules for going outside.

Tips to share with the participants:

- Wildlife is often easily scared by sudden movement and loud noises.
- Participants should be within view and be able to hear the instructor at all times.
- Stay on the trails and pathways, unless told otherwise.
- Walk slowly.
- Look up, down and all around. If something catches your interest, stop to sketch it or write about it.

5. Refer to *Nature Observation* in the Explorers' nature journal (page 3). Spread the participants throughout the schoolyard. Encourage them to complete the observation page by using their senses. Senses may be used at the same time or you may encourage participants to isolate one sense at a time. Gather the participants together and compare and contrast the lists.
6. Ask the participants what unusual items they recorded. What sense resulted in the longest list? What sense was the most challenging to use? Encourage the participants to make nature observations when they go home and report their findings at the next gathering.
7. Refer to the *Field Guide* page in the Explorers' nature journal (page 16). Also show the participants examples of field guides such as the Linnaeus List. Discuss what features help to identify plants and animals and review what information is included in a typical field guide. The field guide page in the journal provides an opportunity for the participant to create an imaginary or real plant or animal. The field guide includes information such as common name, scientific name, description, picture and range map.

Extensions

Closer Look

Objective: To amaze participants with the details not readily observable in nature and to practice using scientific tools.

Supplies: Magnifying lenses or binoculars

Activity: Review how to use the tools and give each individual or pair of participants binoculars or a magnifying lens and allow them to explore. Consider narrowing the focus of a hand lens exploration by challenging participants to discover the smallest living thing or something they never knew existed. Test the binoculars use by asking participants to read words or count something far away. In what ways do these tools help you explore nature? In what ways do they hinder your exploration?

Paint Chips

Objective: To challenge observation skills and increase awareness of nature's many details.

Supplies: Paint sample strips

Activity: Distribute paint sample strips from a hardware or paint store to each participant. Instruct each participant to find a color in nature that exactly matches a color on the paint sample. Did you find an exact match? Is an exact match possible? Why or why not? Were you surprised by how easy or challenging it was to find a match?

Slice of Silence

Objective: To establish a sense of place by using all senses to explore.

Supplies: None

Activity: Have participants find a quiet place to sit alone in a natural area. Give them at least ten minutes to sit and savor the quiet. Discuss the experience: What did you see? Hear? Smell? Touch? How did your experience change as time passed? You may also use blindfolds if available to help participants focus on their senses of hearing. Have participants list the different sounds – natural and those caused by humans. Ask how sounds could be different during different times of the day. With a partner or the whole group, have students share what they noticed when they closed their eyes

FALL WEATHER WATCH

Objective

To determine and record basic weather observations such as cloud cover, precipitation and temperature.

Supplies

Explorers' nature journals

Pencils

Minnesota Weatherguide Environment calendar

Cloud photos/drawings

Thermometer

Objects of the day: Weather page cut from a newspaper, glass jar with frozen water to observe condensation as the ice melts

Background

Meteorologists are scientists who study the weather and the atmosphere. They are best known for forecasting the weather. In this activity, participants will make and record their own weather observations. They will also make connections between changes in the weather and seasonal changes in nature by using the Minnesota Weatherguide Environment Calendar.

High and low temperatures – by recording the daily high and low temperatures throughout the season and comparing them to the rest of the year, participants will see that fall and spring experience greater temperature differences than summer and winter months. By comparing the average temperature for the date and actual readings participants can make seasonal connections and know what kind of weather to expect.

The water cycle is the process through which water molecules move between the atmosphere and the Earth's surface. The main components are precipitation, condensation, evaporation, infiltration, and transpiration.

- Precipitation – moisture, often in the form of rain or snow, that falls to the ground
- Evaporation – when water molecules turn to vapor form and rise into the atmosphere
- Condensation - the opposite of evaporation, when water vapor in the air converts into liquid form
- Transpiration – when plants give off water vapor through tiny pores in their leaves
- Infiltration – the process of water soaking into the soil from the ground level

A cloud is made up of many tiny droplets of condensed water or ice crystals. Clouds help return water to the earth through condensation and precipitation.. Note that the warmer summer months usually result in more variety in cloud types.

A few common cloud types include:

- Cirrus – High wispy, thin clouds spread out high in the sky, horsetails

- Stratus – Clouds in low flat layers, spread out over most or all of the sky, fog
- Cumulus – Big puffy clouds, like giant cotton balls, reduce transpiration and evaporation
- Cumulonimbus – Clouds that can grow very large and tall, often bring rain and storms

The back of the Minnesota Weatherguide Environment calendar and the Explorers' nature journal provide photos of different cloud types. In addition, check out the following websites:

http://cloudappreciationsociety.org/collecting/ has a helpful diagram of cloud types.

Web Weather for Kids – Clouds: http://eo.ucar.edu/webweather/cloud3.html

Activity

1. Explore and discuss the objects of the day.
2. Ask participants what they might typically observe in nature during this time of year. Refer to *Fall Phenology* checklist in the Explorers' nature journal (page 7). Explain that weather can affect how animals behave.
3. Highlight daily weather information along with phenology information for the week found in the Minnesota Weatherguide Environment Calendar. Refer to this information when outside with the group.
4. With the help of participants, draw, label and discuss the main parts of a water cycle including: precipitation, condensation, evaporation, infiltration and transpiration. You can do this on a white board or large sheet of paper or in the Explorers' nature journal (page 8).
5. Discuss the water cycle's connection to weather, the movement of water and ways water moves through the cycle in the fall.
6. Have participants look at the different cloud types in their journals. In addition, show photos in the Minnesota Weatherguide Environment Calendar or copies of cloud photos from websites. Discuss how clouds are formed. Ask where clouds fit in the water cycle. Which type of cloud brings us rain? Thunderstorms?
7. Go outside and have participants lie on their backs to observe the clouds. They can sketch their shapes in their journals. Ask participants how many different cloud types they observed. Are there differences in the clouds depending on the direction you look? Can you predict what the weather might be tonight? What types of clouds do you see? What else do you notice in the sky?
8. Use the Explorers' nature journal *Temperature* page to explain how to read a thermometer (page 12). Have one person from the group determine the actual temperature by looking at the thermometer you brought along. Have participants record the temperature in their journals. As an instructor, you can keep a graph of daily temperatures and average daily temperatures found in the Minnesota Weatherguide Environment Calendar. Together, look at trends across the weeks of the Explorers program. Discuss how changes in temperature can affect organisms.
9. While outside also record wind speed, cloud conditions and precipitation for the day on *Weather Tracker* pages in the Explorers' nature journal (pages 10-11). Compare and contrast conditions from week to week. Also, notice if there is a difference in the number of birds you see or other animal behaviors depending on the various weather conditions.
10. Gather items and head inside. Ask participants to watch the evening weather forecast during the week or review the forecast online then check to see if the meteorologist was correct with the

forecast the following day. When you return the following week, discuss what participants noticed about the forecast during the week.

Extensions

Beaufort Scale

Objective: To understand how to describe wind speed.

Supplies: Copy of Beaufort Scale from www.weatherwizkids.com/weather-wind.htm

Activity: Determine wind speed using the Beaufort Scale which is an empirical measure for the intensity of the weather based mainly on wind power. The wind speed is determined by making basic environmental observations.

Find the Wind

Objective: To determine which the direction the wind is traveling.

Supplies: Container of bubbles

Activity: Since we cannot see the wind participants investigate the direction and speed of the wind using bubbles. Ask if participants can feel the breeze. How can you tell if it is a windy day? Have them look for different signs of the wind blowing (the movement of plants, branches on trees, exhaust in the air, etc.). Make a list of ways to "see" the wind. Now blow bubbles and try to determine which way the wind is blowing. Do the bubbles change direction? When? Why? Are the bubbles moving in the same direction as the clouds? Winds often blow in different directions. Warm air can blow in one direction and cold air in another. Check out www.weatherwizkids.com/weather-wind.htm.

Transpiring Leaves

Objective: To observe leaf transpiration.

Supplies: Plastic bags, twist ties

Activity: Have participants tightly tie a plastic bag over one to three different types of leaves outside. Come back later and notice the condensation on the bag showing that transpiration is taking place. Are the different leaves transpiring equally? Why or why not?

GETTING TO KNOW LEAVES

Adapted from *Variations on a Leaf,* Vermont Institute of Natural Science (VINS) www.VINSweb.org

Objective

To observe the similarities and differences between leaves and understand how they function as food producers for plants.

Supplies

Explorers' nature journals

Pencils

Object of the day: Plant leaves

Magnifying glasses, tree identification guides, crayons (optional)

Background

In most plants leaves are the primary producers of their own food, making them a very important part of the plant. Through a process called photosynthesis, leaves use air, water and minerals to make food. They collect water and minerals from the soil through their roots and carbon dioxide from the air through their leaves. Chlorophyll, a green pigment, absorbs light to provide energy for the process of photosynthesis.

Leaves come in a variety of colors, sizes, textures, and shapes. See *A Quick Guide to Leaf Types* in the Explorers' nature journal (page 19). Leaves can be simple or compound and they may be arranged opposite or alternate from each other on the stem, their edges may be smooth, toothed, doubly toothed or lobed.

In the fall, chlorophyll production stops and often brilliant yellow, orange and red colors emerge. Both the breakdown of chlorophyll and the chemical changes in the compounds in the leaves are triggered by the change in day length. The extent of the chemical change and the brilliance of the resulting colors are related to temperature, moisture and the amount of bright sunlight. Warm sunny days with cool nights create the brightest color.

See www.mndnr.gov/fall_colors/typical_peak.html for additional information on why and where leaves change color in Minnesota.

Activity

1. Explore and discuss the objects of the day.
2. Explain the different shapes and edges leaves by referring to *A Quick Guide to Leaf Types* in the Explorers' nature journal and comparing the drawings to real leaves (page 19).
3. Go outside to an area with a variety of leaf types. Provide ideas for leaves to look for such as a leaf bigger than your hand, smaller than your thumb, with smooth, lobed or toothed edges; unusual texture, or a leaf that has been eaten or partially decayed. Give participants five to ten minutes to collect a variety of leaves from the schoolyard.
4. Bring the participants together and ask them to take a closer look at the leaves collected. Which leaves have a protective coat or waxy texture? Waxy coatings encourage water to drip off and fuzzy coatings help to keep moisture in. Did you find leaves with edges that are smooth, toothed, doubly toothed and lobed?

5. Encourage the participants to attach their favorite leaf in their Explorers' nature journals or make a leaf rubbing on the *Leaf Observation* page of their journals (page 23). With the underside of the leaf up, place the paper over the leaf and rub gently with crayons or edge of the pencil tip.
6. If time, encourage participants to sketch a leaf on *How to Draw* (page 24). Next, have participants draw a leaf they found outside and ask a partner to pick out the leaf sketched from a pile of assorted leaves.

Extensions

Collecting Leaves

Adapted from *Teachers' Guide to Arbor Month,* Minnesota Department of Natural Resources

Objective: To preserve leaves for future observation.

Supplies: Newspaper, books, cardboard

Activity: Collect leaves and then place them between sheets of newspaper. Put the leaf-filled sheets inside large books or between cardboard and place bricks, books or other heavy objects on top. Change newspaper regularly to absorb water better and prevent mildew. When dry, press leaves between wax paper with a warm iron.

A Special Place Through the Seasons

Objective: To observe the seasonal changes in one particular place.

Supplies: Explorers' nature journals, pencil, digital camera (optional)

Activity: Select a special place in the neighborhood or special tree and take a photograph or make a drawing during each season of the year. Record the dates in a journal along with photographs or drawings. Describe the changes noticed throughout the year in and around the area selected. Consider making journal entries more than one time during each season.

SEEDS ON THE MOVE

Adapted from *Seed Dispersal,* Vermont Institute of Natural Science (VINS) www.VINSweb.org

Objective

To understand the different ways plants disperse seeds to new locations.

Supplies

Explorers' nature journals

White board or paper

Object of the day: Variety of seeds with different dispersal methods

Magnifying glasses (optional)

Background

Unlike animals that can walk around, find a mate and then have their young, plants are basically restricted to one location. How is it that they are able to reproduce and spread without being able to move?

One of the ways plants spread is by the production of seeds. Most flowers have male and female parts. Pollen is produced by the male part of one plant and fertilizes the ovule or female part of another like plant. Pollen is transferred from one flower to another by the wind, insects, hummingbirds and sometimes bats. When a flower is pollinated, the ovule begins to change and matures into a seed. A helpful diagram can be found at http://pollinator.org/beeissues.htm.

Most seeds are formed inside a fruit. Even foods we think of as vegetables like green beans or peas are considered fruits by botanists because they have seeds. Most seeds have a hard covering so they can survive without soil or water for an extended period of time. Some seeds, like raspberries and blackberries, have to be eaten by animals in order to sprout. The acid in mammals' stomachs help break through the hard outer coating. Other plants need fire to disperse the seeds. Cones of jack pine trees open when heated in a fire, dropping the seeds. Some seeds can survive over a hundred years before spouting like moth mullein. The plant will not spout until conditions are just right.

In order for seeds to find those "just right" conditions they need to get to just the right place. Seeds are dispersed through a variety of methods and include the following examples:

- Wind – The helicopter-like blades of maple seeds help move the seeds away from the parent tree. The silky white tufts of dandelions and milkweed seeds act like parachutes.
- Animals – Spines, hooks and barbs help seeds like burdock to hitchhike on fur, feathers and clothes. Some seeds have sticky substances that cling to passing animals. Uneaten buried caches or collections of seeds and nuts made by mice, squirrels, chipmunks and some birds develop into plants. Seeds inside fruits such as berries and apples are eaten by animals and then pass through the animals' droppings.
- Dropped or tossed by plants – Touch-me-not (jewelweed), wild lupine and pea plant all toss their seeds when pods explode. Acorns and pinecones fall from trees.
- Water – Water lilies, cattail and other aquatic plants often use water to disperse seeds.

www.mndnr.gov/young_naturalists/seeds/index.html has helpful illustrations.

Activity

1. Explore and discuss the objects of the day.
2. Using a whiteboard or other drawing surface, show how a flower is pollinated and a seed is formed. Ask participants what kind of seeds they eat.
3. Explain that seeds are dispersed so that not too many are in one area; this often happens in late summer or fall. Explain that seeds are spread in four main ways; by the wind, animals, dropped or tossed by the plant itself and water. Show or draw examples of each. Dispersing seeds away from the parent plant increases seeds' chances of survival. If all seeds fell around the plant and grew up around the parent plant they would choke each other out. See *Seed Dispersal* in the Explorers' nature journal (page 14).
4. Divide the participants into pairs or small groups.
5. If you are allowed to collect at the site, use the Explorers' nature journal *Seed Collection* (page 15) and ask participants to search the schoolyard to record and collect seeds that match the following criteria:

- seeds that travel at least one meter (arms spread wide) when you blow on them
- seeds that stick to clothing or the fur coat of an animal
- seed head with at least twenty seeds inside
- seeds that are hard and have a thick coat
- a super tiny seed
- a seed inside a fruit

6. Gather participants together to share at least one type of seed that they found. What criteria did it match? What type of dispersal method did it use? What type of dispersal method seemed most common? Why?
7. Have participants look for seeds around their homes and bring in a few samples to the next Explorers meeting.

Extensions

Milkweed Seed Race

Objective: To observe how wind-dispersed seeds move differently from other seeds.

Supplies: Milkweed or other wind-dispersed seeds and dried beans from the grocery store

Activity: Collect milkweed seeds (or other wind traveling seeds) and distribute a few per participant. This can be done ahead of time or as a group. From a designated spot or line have one to three participants throw their seeds into the air. Measure the distance the farthest seed goes before touching the ground and mark the spot with a rock or other heavy object. Repeat with dried beans. Which seed went the farthest? Why? Repeat activity but allow the participants to blow on their seeds. Did the seeds travel farther than last time? Why or why not?

Just the Facts, Ma'am

Objective: To be able to made detailed observations to describe an object.

Supplies: One natural object per person, Explorers' nature journals and pencils

Activity: Give participants natural objects such as rocks, sticks, pinecones, etc. Instruct them to write twelve different ways to describe their object. They should be as precise and detailed as possible. When everyone is finished, place natural objects in the center of the group. Have one person take a list and read one description at a time. The group should try to guess which object is being described. Try to match all description lists with their respective natural objects. Why was it easy to guess some objects, harder to guess others? Was it difficult to come up with twelve descriptors for your object?

Seed Engineer

Objective: To design an imaginary seed that will successfully be dispersed.

Supplies: Explorers' nature journals and pencils

Velcro was conceived in 1941 by the Swiss electrical engineer George de Mestral. He examined the burrs from a burdock plant that were caught in his dog's fur. It took fourteen years from conception to patent. Design and draw your own imaginary seed and engineer how it would move. Explain how it travels. What kind of products could this seed be used for? Are there other inventions that could be developed based on the design of your seed?

LEAF LITTER SEARCH

Objective

To identify organisms and materials found in leaf litter samples and describe how decomposition adds nutrients to the soil.

Supplies

Identification guides

Magnifying glasses

Explorers' nature journals

Plastic sandwich bags, drinking cups or other small containers to collect material

Rulers

White paper or container (optional)

Object of the day: Leaves that are partially decayed or have been eaten by critters in leaf litter

Background Information

Leaf litter, dead leaves, sticks and bark that fall to the ground, can be abundant with tiny living organisms such as bacteria, insect larvae, centipedes and mites. Many of these organisms act as decomposers, breaking down leaves and organic matter into humus. Others may be scavengers and feed on dead animals. Regardless of the food they eat, most organisms living in the soil are invertebrates, meaning they do not have backbones. Although small and less noticeable, there are more invertebrates in the world than vertebrates, both in total number and in species diversity.

- Decomposer/decomposition – organism whose role in the food web is to break down the remains of other living things so they can return to the environment and be used/the act of breaking down into basic parts;
- Scavengers – eat dead matter but are opportunistic in their feeding strategy
- Omnivores – eat both plants and animals
- Herbivore – eat plants and other producers
- Carnivores – eat other animals
- Leaf litter – organic matter found on forest floor
- Producer – organisms that can produce their own food most through the process of photosynthesis
- Consumer – organism which must consume other organisms to get their nutrients
- Soil – substance containing both small rock particles and decaying organic matter

Activity

1. Explore and discuss the objects of the day.

2. Begin by defining leaf litter. Have the participants predict what they might find during a leaf litter search.
3. Locate an area of the schoolyard to search the leaf litter for living and non-living things. Divide the participants into smaller groups or pairs. String or rope may be used to define a specific area for participants to investigate.
4. Once the search area is defined, ask the participants to carefully explore and remove items, especially critters, from the leaf litter. These items may be transferred to a container or placed on sheet of paper for further investigation. Use *Leaf Litter Critters* to record participants' findings (page 22). Leaf litter can be collected ahead of time and brought inside the classroom in case of rain or if not available at the site.
5. Ask participants what they found. Where did it come from? Was it eating something? What might eat the critter you found? What role does it have? What features make your critter interesting? What happens to the leaf litter at the end of the fall season? Consider counting the critters found. Return all items to the location where they were found at the end of the activity.
6. Discuss what happens to leaves that fall to the ground each fall and why the forests do not fill up with dead leaves. Ask the participants to describe items that have or are beginning to decay. Further discuss and explore the concept of nature recycling and composting.

Extension

From Leaf Litter to Topsoil

Adapted from *Schoolyard, Ecology and Exploration*, University of Minnesota.

Objective: To understand factors that affect decomposition.

Supplies: Clear plastic bags, leaf litter, top soil, cardboard or wood

Activity: Prepare two plastic clear bags, one with leaf litter and one with top soil. Ask participants what the two bags have in common. Point out that over time the leaf litter will become topsoil and that soil contains living organisms. Discuss what factors affect decomposition rates: moisture, presence of decomposing organisms, time, temperature and surroundings (under pine tree, wetland or on an open lawn).

Study life in the schoolyard by placing a piece of cardboard or piece of wood in a remote area. Leave this on the ground and then observe week by week what is living underneath. Check with school and facilities management to make sure placing these items in the schoolyard for an extended period of time is acceptable.

Consider placing small amounts of food such as pieces of apple, carrots, dog or cat food in an area and study what animals visit the area. How long does it take the food to disappear? How does this help demonstrate the importance of the earth's clean-up crew?

INTRODUCTION TO A TREE

Objective

To understand how to observe and record the different types of trees growing in the schoolyard and compare their characteristics.

Supplies

Explorers' nature journals

Pencils

Magnifying glasses

Rulers

Branches with both opposite and alternate arrangements as well as buds

Tree cookie name tags, large tree cookie or photo of tree cookie

Objects of the Day: Deciduous and coniferous tree branches with buds and/or leaves

Tree field guides (optional)

Background

Trees can be found on most schoolyards and are a great way to watch the season progress as daylight gets shorter. The main part of this activity will occur on the first visit but throughout the weeks make sure to take a little time every session to have participants observe their trees, looking for any changes and noting them in their journals.

There are two main types of trees. In general, deciduous trees lose all of their leaves in one season and coniferous trees keep their sharp and narrow leaves called needles on the tree year-round. Coniferous trees produce cones that carry their seeds. In fall, deciduous trees begin to shed their leaves to conserve energy and limit damage to the tree from the snow and storms during the winter.

Many people think you can't tell trees apart once the leaves have fallen off. However, by closely examining the buds and bark, you are often able to identify trees.

The main parts of the inside of a tree include:

- inner wood – supports the tree, stores growing compounds and sugars
- xylem – carries water and minerals from roots to leaves
- cambium – makes trunk, branches and roots thicker
- phloem – carries food (sap) from leaves to rest of tree
- outer bark – dead tissue that protects the tree from injury (much like human skin).

More information can be found at www.mndnr.gov/forestry/education/treeforallseasons/index.html

Activity

1. Explore and discuss the objects of the day.
2. Ask participants how they might identify trees in the fall. Make a list of tree features that may be helpful in identification: height, diameter, bark texture, leaves, shape, etc.

3. Point to a tree or show a fall tree photo and ask participants to make some general descriptions. How might those features change in the spring, summer and winter seasons? How many different kinds of trees do they think they will find on the school grounds? Have them write their predictions in their Explorers' nature journals.
4. Show and discuss the differences between a deciduous and coniferous tree.
5. Open to *Leaves and Branches* in the Explorers' nature journal (page 18). Using real branches, show the difference between an opposite and alternate branch and have participants make a quick sketch of each in the appropriate circle. Then show at least two different kinds of leaves and have participants sketch one in the bottom circle.
6. Have participants predict the number of kinds of trees in the schoolyard and write it in their journals. Go outside and give participants five to ten minutes to find and count as many different species (not numbers) of trees as they can within the boundaries you set. When time is up call them back in and have them write their answer in the Explorers' nature journals. How close were they to their predictions?
7. Group participants in pairs and have them select a tree to adopt in the schoolyard. Pass out rulers and magnifying glasses for participants to make detailed observations.
8. Ask participants to record and sketch their tree on a *Nature Observations/Field Sketches* in their Explorers' nature journals (pages 23 – 26). They should include leaves or buds (color, shape, size, and other observations), bark (color, shape, size, and other observations), tree height and shape and any other observations. Make sure participants write down the date of their observations. If they have made a map in their journal of the schoolyard add the location of their tree to this map (pages 4-5).
9. If time, include other observations like: what does the tree smell and feel like? What signs are there that animals have used the tree? Do a bark rubbing. Determine the circumference (C) around the tree. Using a flexible tape measure, measure to the nearest inch the distance around a tree at a point 4½ feet up from the ground (C). Then convert this number into the tree's diameter (D) using one of these formulas D = C x .3183 or D = C/3.1416.
10. Take a few minutes every week to have participants revisit their tree and record any changes they see.
11. Gather participants together and return to the classroom. Using their tree cookie name tags refer to the *Inside a Tree* page and review the different parts, how to pronounce them and what they do (page 17). Could they see any of these parts on their tree? Why or why not? Do they think the phloem is active now? Why or why not? What about the xylem?
12. Ask participants to notice the different trees that they see on their way home or when traveling to other places.

Extensions

Know Your Branch

Objective: To recognize characteristics of tree branches by touch.

Supplies: One branch for each participant, blindfolds (optional)

Activity: Place a stack of branches on a table or the floor. Ask each participant to be blindfolded or close his or her eyes and find a branch. Once each participant has a branch, ask them to get to know the branches by feeling and recognizing characteristics like length, branching or texture. Place the branches back in the middle, have the participants take the blindfolds off and then find the branch they were holding. The branches can be a mix of deciduous and evergreen species, shapes and sizes.

Connect the Branches

Objective: To closely observe tree branches and pay attention to all characteristics.

Supplies: Pairs of branches

Activity: Before the Explorers session, cut branches of several different tree species in half. Assign one branch to each participant and ask him or her to find its match in the classroom by using clues like color and texture of bark, branching, buds, shape or size.

Meet a Tree

Objective: To identify trees using senses other than sight.

Supplies: Blindfolds

Activity: In groups of two or three, participants blindfold one member of their group and carefully lead the person to a tree. The blindfolded person gets to know the tree by feeling, smelling, listening to it, feeling for the tree's neighbors, etc. When the blindfolded person is confident that he or she knows the tree, the rest of the group leads the blindfolded person back to the starting point. After removing the blindfold, the newly sighted person attempts to relocate his or her tree. Rotate jobs until everyone has had a turn. Were participants able to find their trees? How did participants identify their trees? How are some trees different from other trees?

Tree Height

Adapted from *Teachers' Guide to Arbor Month*, Minnesota Department of Natural Resources

Objective: To estimate the height of a tree using ratios.

Supplies: Twelve inch ruler, masking tape, measuring tape

Activity: Height is the hardest tree measurement to obtain. Use a ruler and follow the instructions below to estimate the height of trees in the schoolyard.

1. On a 12-inch ruler, mark the 1-inch and 10-inch lines with masking tape.

2. Work in pairs to measure height.

3. Person A stands at the base of the tree.

4. Person B, while holding the ruler up in front of their eyes at arm length, moves back until they can see the whole tree from top to bottom between the 0-inch and the 10-inch mark on the ruler.

5. Person B then moves the ruler until the base of the tree is exactly at 0-inches and the top of the tree is sighted exactly at 10-inches.

6. Person B sights out from the ruler's 1-inch mark to a point on the trunk above the base.

7. Person A marks this spot on the trunk with tape.

8. Measure the distance from the base of the tree to the 1-inch mark (X) on the tree.

9. Multiply by 10 to get an approximate height of the tree.

CAMOUFLAGE AND ADAPTATION

Adapted from *Toothpick Prey, Monarchs in the Classroom: An Inquiry-Based Curriculum for Middle School*, University of Minnesota

Objective

To understand how camouflage increases an organism's chances of survival.

Supplies

One box (100-200) of assorted colored toothpicks or toothpicks that are colored with marker. Tri-colored rotini or spiral pasta noodles or pieces of yarn can also be used.

Outdoor grassy area

Watch

Explorers' nature journals

Pencils

Object of the day: Example of camouflage cloth or photos of animals that use camouflage

Background

Plants and animals have adaptations that help them to survive. An adaptation is defined a characteristic of an organism or ability that helps it survive and reproduce in its environment with its given genetic characteristics. One important adaptation is the organism's ability to blend in with its environment. This is called camouflage. This causes difficulty for predators in finding their prey because the prey is hidden within the colors of the environment. Many animals have colors or markings on their feathers, fur, scales or skin that allow them to blend in with their habitat (where they live). Some examples of camouflage are a green frog hiding at the edge of a wetland, the drab brown feathers of most nesting female birds, winter color of snowshoe hare, etc.

Sometimes the coloration of an animal or pattern does the opposite of camouflage. Instead, its markings or colors call attention to the animal. Colors may issue a warning to other species, or may attract members of the opposite sex of the same species (the bright colors and pattern of the wings of Monarch butterfly, the bold color on skunks; the bright showy feathers of the male wood duck).

Activity

1. Explore and discuss the objects of the day.
2. Scatter an equal number of several different colors of toothpicks or other colored objects on a defined area of grass in the schoolyard.
3. Tell the participants that they are going to be scientists and study predation by finding toothpicks in the schoolyard. They will be bird predators finding insects represented by toothpicks. Do not tell the participants that the toothpicks are different colors, only that they will have 30 to 60 seconds to pick up as many toothpicks as they can.
4. When they are ready, tell the participants to begin and start the timer.
5. After time has run out, have participants count the number of each color toothpick that they collected and record these numbers in the Explorers' nature.
6. Total the number of each color of toothpick collected by the entire class and have the participants record this in their journals. Calculate the percentage of toothpicks of each

color left after predation. Compare the number of gathered versus the original number of each color. To calculate the percentage of all the toothpicks found by the class, divide the number that were found by the total number that were hidden in the schoolyard, and multiply this by 100.

7. Ask the participants: What colors were found more easily and why? What colors were more difficult to find? What would happen if we tried this activity at different times and in different areas: when the grass is brown, if the toothpicks were spread out on the asphalt or in a natural area? How does camouflage change with the seasons?
8. Pick up all remaining toothpicks.

Extension

Find a Pencil

Objective: To build observation skills and appreciation for camouflage.

Supplies: Pencil

Activity: Set boundaries and have participants line up along one edge of the playing area, facing away from the area. While the participants have their eyes closed, the leader hides a pencil anywhere within the playing area. Once the pencil is hidden, the participants may look for it. If a person finds it, he or she should not give away (1) where the pencil is, and (2) that he or she knows where it is. Upon finding the pencil, the player should slowly, nonchalantly return to the starting line and act as overtly cool as possible. When most of the participants have found the pencil without giving its location away, the facilitator should have the group point the pencil out for the remaining lookers. Repeat several rounds, hiding the pencil in harder places each time (on top of the leaves, behind the teacher's ear, stuck in a tree, tucked in the leader's shoe, etc.) Why was the pencil hard to find? What does this tell us about how careful our observations really are?

Habitat I Spy

Objective: To understand how plants and animals may blend in with their surroundings.

Supplies: None

Activity: One participant at a time will be "it." The person who is "it" will look around the room or outdoor area and choose one object that may be difficult to see but does not reveal what the object is. He or she will then give one clue by saying "I spy with my little eye, something that starts with _" and give the first letter of the mystery object. The rest of the participants may ask yes or no questions one by one to try to figure out what the mystery object is. If a participant correctly guesses the mystery object, he or she will be "it" next.

NATURE BINGO

Objective

To explore the schoolyard using a nature bingo card.

Supplies

Explorers' nature journals

Pencils

Field identification guide (optional)

Background

Nature bingo encourages participants to summarize what they observed over the past several weeks. Nature bingo is a good way to wrap up the seasonal Explorers Program.

Activity

1. A bingo card is included with the Explorers' nature journal (page 20). As an alternative, each square of a blank bingo card can be filled in with items that the participants have observed throughout the program. Include a variety of plants, animals and other natural features of the schoolyard. The images of the items can be copied from clipart or the text/name can be included and the participant can sketch each item found.

2. Before going outside review each of the items included on the bingo card.

3. The goal is to get bingo (five squares in a row) or blackout (all spaces crossed off) on the card.

4. Review nature bingo items that were found and not found in the schoolyard.

5. Ask the participants to suggest items for future bingo cards that were not listed. Small prizes/treats could be provided for those who get bingo.

Extension

Question Trail

Adapted from *Exploring The Outdoors With Aldo Leopold*, Pheasants Forever.

Objective: To improve observation skills and practice formulating testable questions.

Supplies: Blank tags with string, pencils

Activity: Give each participant a tag and a pencil. Allow them to wander along the trail and come up with a question about something they see. Do not allow simple questions like, "What is this called?" but instead encourage more investigative questions such as, "Why is this bark different on the branch then on the trunk?" How did this cob of corn end up in the woods?" How did this squirrel die and what will happen to it?" When participants come up with a question, they should write the question on the tag and hang it from the questioned object or nearby.

Then, gather all participants at the head of the trail and walk down the trail addressing one question at a time. At each tag, facilitate a discussion on how to make the question listed into something they could test or investigate.

EXPLORERS SCAVENGER HUNT

Objective

To explore the schoolyard for a variety of natural and human-made items.

Supplies

Explorers' nature journals

Pencils

Activity

1. Refer to *Scavenger Hunt* in the Explorers' nature journal (page 21), for items to find around the schoolyard.
2. Review and discuss each item before going outside.
3. Record in writing or with a sketch the items found around the schoolyard and surrounding area.
4. When done searching, ask the following questions: What are some additional items not included on the scavenger hunt form? What things are alike? Which ones are different?
5. Refer to the activity *Nature Observation Basics* for more ideas on making observations.

Note: Other items to include on the scavenger hunt might be something: green, with needles, twisted, curly, round, sticky; a seed, tree bark on the ground, feather, pinecone, something flat, something smooth, rough, red, a flower, leaf, dead twig, weed, or ant. Also, ask participants to compare two different areas such as a sidewalk/paved area to grassy/natural area. List the things that are similar and different between these sites.

Extensions

Nature Alphabet Search

Objective: To search nature items and find each letter of the alphabet.

Supplies: Digital camera (optional), Explorers' nature journals, pencils

Activity: This activity can be completed as a group or individually. Groups and individuals can be assigned groups of letters (i.e. A-F, G-L, M-R, S-Z) to search for. The 26 letters of alphabet can be printed on a sheet of paper to assist with the activity. Provide examples of what different letters might look like in nature before going outside. For example, a branched twig might look like the letters V or Y. The nature letter can be captured with photos or the participants can sketch the items in their journals. Ask which letters were easy to find? Are there common patterns and shapes found in nature?

Scavenger Hunt with a Twist

Objective: To foster reflection on scientific objectivity.

Supplies: Value-laden words on index cards

Activity: Give each participant a card with a value-laden word such as gross, unnecessary, special, or valuable and instruct him or her to find something in nature which their word describes. Show your

finding to the group and explain why this object is described by your word. Were there participants who couldn't find something for their word? Does everyone agree with everyone else's choices? To what extent do our values predict and/or dictate our actions? What impact do our values have on how we view nature? How can you, as a scientist, remove human values from your descriptions of nature? Should you?

Nature Wristband

Objective: To create a wristband of natural items collected from the schoolyard.

Supplies: Tape (masking tape, duct tape or packing tape), natural items like small rocks, seeds, small leaves, pine needles, flowers, sticks, etc.

Activity: Measure around the participant's wrist and cut a piece of tape slightly larger than the wrist to fit over the hand. The tape needs to be sticky side out. Identify an area outside to collect natural items to stick to the wristbands. Do not stick live insects to the wristband. Try to find items on the ground versus picking them off plants. Ask the following questions: What did you find? Where did the items come from? Compare the wristbands and look for similarities and differences in natural items found. Encourage the participants to make a nature wristband at home and compare it with the one they just made.

Note: Natural items can be collected prior to class and this activity can be completed indoors.

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