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Title: Climate Scientists: Telling the Story of the Species Who Live Here

Theme: Climate scientists face change and uncertainty with skill and curiosity as they explore how the climate is shifting.

Goals:
Background: Students have been introduced, (in the classroom), to climate change definitions and have spent time beginning to understand what it means, how it happens and its impact. They have begun to look at how it influences their lives and other cultures. They have each studied a specific animal in relation to climate change. They have completed a project cycle exploring the impact of climate change on a country. A small group completed a project cycle focusing on food and climate. They have shared these projects with the larger school community and parents/friends. This particular field lesson is designed to hone the students skills and give them real-life experience in exploration and deepening understanding of the interconnected, complex situation of climate change that climate scientists face, and skills they can adopt to support them in understanding.

The ultimate goal of this program is for students to enjoy being outdoors and exploring, so much so that they inherently become curious about the interconnected and ever-changing landscape of species around them and their connection to it. Hopefully this curiosity will lead students to want to understand the landscape in the past, present and potential future, particularly as they study specific species impacted by climate change, leading toward a desire to understand if not change their own behaviors at home toward a gentler effect on the planet. The structure of this outcome will occur through the imaginative lens of being a climate scientist and honing those skills.

This lesson plan structure also includes the elements of the Spiral used in The Work that Reconnects by Joanna Macy. The Spiral supports people with tools for dealing with emotions that may arise in the face of learning about climate change (often things like "geez, this is depressing") and/or other human or planetary challenges. It includes Gratitude, Despair, Seeing with New Eyes, Going Forth, Gratitude.

Objectives: The student will…

1. …explain why they are grateful for at least one thing they see while on trail.
2. …participate in the lesson by taking on a climate scientist characteristic.
3. …name at least five species impacted by climate change and explain what is happening to these species by telling its story.
4. …reflect on how they feel about the shifting climate and it's impact.
5. …understand they have a choice in behavior and recognize how this choice might help.

Time: 2 hours

Age Group: Middle School 6th-8th, ideally 7-10 students

Location: Copper Falls State Park

Materials:
Gratitude Cards - appreciation
Binoculars – curiosity
Compass- clarity
String for plot- exploration/data
Map- leadership
Plant and Animal Identification books – problem solving
Species List - knowledge
Journal – creativity
Heart Stone - predicting
Copper Falls Handout- storytelling

Content:

10min. I. Introduction: Welcome students to the two-hour adventure. Spread out materials from backpack in front of students. Have each student pick one item that sparks their curiosity. Each item has a sign with it that marks a climate scientist skill. Take time for students to introduce themselves and their item.

After introductions, explain how these items represent the skills of a climate scientist. Engage the students in a short discussion about the link between climate, scientists, weather and knowledge, reinforcing past lessons. Define the following in the discussion:

Scientist: one who engages in a systematic activity to gain knowledge
Knowledge: facts, information and skills acquired through experience
Traditional Ecological Knowledge: evolving knowledge acquired by indigenous and local peoples over hundreds or thousands of years through direct contact with the environment
Climate: long-term regional and continental atmospheric patterns
Weather: the state of the atmosphere at a place and time; intensity, frequency and duration of short-term events

State: "Climate scientists face change and uncertainty with skill and curiosity." Explain that scientists are working to solve a complex problem that takes time to understand. Explain that the students are going to get a taste of what it might be like to be a climate scientist, practicing some of the skills they would need.

10min. II. Curiosity Sketch: Ask each student to take a moment and find something they are curious about and then go sketch it. Give students a few minutes to do this sketching. After they are finished, meet back as a small group and have students share what they sketched and what they appreciate about the object they

found. Reinforce the idea that two of the key skills of being a scientist include curiosity and appreciation. Time to use them!

10min. III. Leadership Exploration: At this point, explain to students that the rest is up to them. They will take turns leading the group through a series of different activities, stretching themselves to apply the skills of a climate scientist. Make sure each student understands their role (based on the item they chose in the first introduction circle) and the activity involved. For example, if the student chose binoculars they are responsible to help everyone remember to be curious.

75min IV. Begin Hike – Make sure you leave enough time to go out and come back with time for the conclusion. Guide the students in deciding which direction they want to head first. Make sure the Leadership and Clarity students are using their map and compass skills. The remainder of the hike involves exploration, stopping at a chosen spot by students to take part in a Exploration Plot exercise and continued exploration. The teacher will make sure that the Knowledge student will share about specific species information as the group hikes.

Map – Leadership: Responsible for keeping track of where the group is on the map and leading them. You will need to work with the Clarity/Compass person.

Compass – Clarity: Responsible to keep us going in the right direction, or, if we get lost to make sure you can be clear about where we need to be. Work with the Map/Leadership person.

Binoculars – Curiosity: Responsible to help remind everyone to be curious and to show us/model how to be curious. This includes helping us look for small worlds and big worlds. Working with everyone.

Copper Falls Handout- Storytelling: Responsible to read the share the story of Copper Falls at some point during the hike and to make sure we are adding to the story as we explore. Working with everyone.

String for plot- Exploration: Responsible to help everyone set up Exploration Plots. Small groups will get string and mark out a 4x4 foot square area and then sketch the species and plot. They will think about who lives here and how are they relating/connected to each other? Work with Knowledge and Problem Solving people. Predicting/Heart Stone person will also add to activity.

Heart Stone – Predicting: Responsible for helping hold the wisdom of the past and the future with the group, particularly in regard to other cultures who have lived here before us. Work with everybody. Based on the knowledge that we gain from our experience and the knowledge we learn from books, we will try to weave in an understanding of what the past and future may hold. Work with Exploration person during Exploration Plot activity. You will work with teacher to lead a discussion about what the plot looked like a couple hundred years ago

and what it might look like a couple hundred years in the future and how this may or may not tie to climate change.

Identification books – Problem Solving: Responsible to help identify species we are looking to find. Work with Knowledge and Exploration people. Also responsible for helping Predicting/Heart Stone person with activity.

Species handouts- Knowledge: Responsible for spreading the knowledge about the ten species we are seeking to learn more about who live at Copper Falls State Park. Work with Problem Solving and Exploration people.

Journal – Creativity – Responsible in bringing a creative eye to how we view the world, draw the world, observe the world, explore the world. Work with Exploration group for mapping plot.

Gratitude Cards – Appreciation – Responsible to let students know what's on the card at some point during the program and then to hand out cards at the end during the conclusion. Also responsible to help people speak to the things they are grateful for throughout the exploration.

15min V. Conclusion – Review the different skills and why they think the skills are important for climate scientists. Give each student a Gratitude card and have them write down four things: one thing they appreciate about the time together today; one skill they want to use more often; one species that sticks out to them as important to remember; one thing they want to do when they go home that Earth might thank them for doing.

Resources

Wisconsin Master Naturalist notebook
http://dnr.wi.gov/files/PDF/pubs/ss/SS0197.pdf
http://www.epa.gov/climatechange/impacts-adaptation/forests.html
http://climatewisconsin.org/story/forestry
www.g-wow.org

Species in Northern Wisconsin Impacted by Climate Change

Climate Stats

Direct Impacts:

- Increase in winter and spring temperatures
  - Earlier migration of plants and animals
  - Climate niche for certain species gets changed- lose their niche and have to move or die or adapt
- High Temperature Extremes
  - Physiological stress or death: as organism gets stressed, immune system is weakened = more susceptible to disease. Moose,
- Shorter snowfall season
  - Less snowfall means less snowfall cover = loss of habitat and protection for certain animals. American Marten
- Heavy Rainfall/Precipitation
  - Destroys habitat, structures for resting/breeding, or species themselves. Black Tern- due to nest failure along rivers/streams
- Drought Conditions
  - Amphibians susceptible because of permeability of skin and moisture requirements for survival. Tree frog.
- Longer Growing season
  - Projected 28-56 days longer = alter tree and shrub species, forest types

Indirect Impacts

- Wildlife Habitat- shifting in plant species due to direct impacts = vegetation change and wildlife response. Bark Beetle Infestation

- Interspecific Interactions – as the number and types of species shift, it creates a different set of interactions among species. This trend can allow non-native species to encroach and change entire systems. Gypsy Moth. Disease Outbreaks such as type C and E botulism -= avian diseases caused by warming temperatures in water and lower levels.

- Net loss of biodiversity and simplification of ecological communities = certain species that are able to handle the changes more easily ie. Canada Goose, Gray Squirrel, European Starling. Most likely will lose American Marten, Purple Marten, Black Tern.

Specific Species to look for at Copper Falls

Brook Trout	White tailed deer
Hemlock	Eastern Red Backed Salamander
Wood Frog	Trillium
Maidenhair Fern	Common Loon
Paper Birch	American Marten
Sugar Maple	Balsam Fir

Species Cards- Some species cards are simpler than others in order to reflect on student prior knowledge and applying it to new species.

White-Tailed Deer: I love the warmer temperatures and less snow coverage because it's easier for me to forage and survive winter. However, I'm finding that the larger family I have is increasing chances of my getting a disease, particularly as new insects move in. There is a form of midge that causes a viral disease. It is thriving with warmer temperatures and lower summer precipitation. This causes outbreaks among my family. These outbreaks make it difficult for humans to manage me and my family these days.

American Marten: I have a lean body. In winter I need cover. This requires snow, woody debris and enough insulation to keep a comfortable temperature. If I don't have this I get too cold. My body isn't designed for these new conditions. I also need rodents for food. They are also vulnerable to less snowpack too though. What do you think the long term outlook is for me and those who I depend on?

Common Loon: I like to spend winters in the South Carolina and in the Guld of Mexico. But I come back to Wisconsin every summer. However, I keep moving further and further north. Housing and agriculture has been encroaching on my favorite habitat and it's making it difficult to find good nesting areas. It's possible that in the future I might have a hard time because of extreme flooding and droughts that occur with climate change. I like to build my nests right by the water. Floods take them out and I lose my eggs. Contrary to that, drought has made lake levels low and if I'm lucky I can find a good nest spot and materials for a nest. I'm also stressed by the increased population of black flies. They love the warmer, consistent higher temperatures and are thriving. They

drive me crazy and sometimes I have to leave my nest with eggs and find a better home.

Brook Trout: I need cold water to survive. I help keep the frog population, leeches and other animals in check by eating them. Otters and fishers like to eat me. It is difficult for me to handle the extreme flooding and increase in water temperatures. What do you think can be done to help keep my habitat cold?

Eastern Red Back Salamander: I am food for many: birds, reptiles and mammals like to eat me. But, I'm complex. I have permeable skin which makes me sensitive to hot, dry conditions. It makes it hard for me to live. In dry conditions, I have to burrow underground and rely on the soil moisture to keep me from dehydrating. I need the canopy and woody vegetation of the forest to keep things humid. Higher temperatures keep me from going out and getting the food I need, limit my growth, reproduction and overall survival. My needs are so sensitive, I don't think I'll be able to move north. Most other amphibians are similar to me. I wonder what you can do to support my spot in this ecosystem?

Wood Frog: I like to hibernate in the winter. I need good snow cover for insulation so I can make it. I also need moist conditions in other seasons. Drought and flooding is hard on me. I'm important as a key indicator species of climate change. Not only do I need others in the food chain, they need me. Birds and fish eat me and I like to eat insects.

Maidenhair Fern: I've been around for thousands of years. What will happen to me as the shifts in climate continue to occur? If I disappear, will it have an impact on culture?

Hemlock: I am one of the native trees to Wisconsin. More of my family was around before logging. After loggers took most of the White Pine, they sought after me. They only wanted my bark and

would cut me down, skin me and leave the rest of me to rot. Eventually they came back and decided to use the rest of my body for pulp. Today, I get stressed by the hotter temperatures and do my best to keep insects from destroying me. I have the potential of becoming old growth forests again if the temperatures don't change too much. If I can do this, I can provide rich habitat for other species important to this land and the Ojibway.

Paper Birch: I've been an important resource for Ojibway for many many years. I provide bark for canoes and baskets that support people in travel and carrying food. This aids in their nourishment and survival. I have a difficult time adapting to warmer temperatures and will most likely move north. What will the impact be on people who depend on me? I'm also important for many species who depend on me for habitat, protection and regeneration.

Sugar Maple: People like to turn my sap into syrup! They've been doing this for hundreds of years. You can tell who I am by my grey bark and 5-point leaves with bowl-shaped lobes. I have a difficult time staying here as the climate is changing. It stresses me and I'm producing less sap because of changes in temperature. Who am I?

Gratitude Card

One thing I appreciate about today is…
Examples from the program:
…being outside and learning about different things.
…that Ms. Jenkins is here today.
…nothing. I didn't sign up for this.
…the good weather.

One skill I want to use more often is….because…
Examples from the program:
…a skill I want to use more often is creativity because it helps me feel better.
…knowledge because its interesting stuff to learn.
…exploring and learning more about the world.

One species I want to remember is…because…
Examples from the program:
…the wood frog because I like frogs. They are in my backyard and I like them.
…brook trout because they taste good.
…paper birch because they are pretty and I don't want them to move.
…white spruce because I know how to identify it now. It has sharp needles.

One thing I can do that the Earth might thank me for is…
Examples from the program:
…saving some of Earths species.
…clean up my garbage and not make as much garbage.
…to try to not touch things that might die. That are sensitive.