Energy Use in An Ecosystem

Summary:
Students survey different environments and investigate how sunlight, soil, moisture, temperature, and wind affect living elements - plants and animals - in an ecosystem.

Grade Level: 4-8

Subject Areas: Science, Mathematics, Environmental Literacy

Setting: Outdoor study site such as a school yard or park (with 3 different areas to study)

Time:
Preparation: 50 minutes
Activity: two or three 50-minute periods

Vocabulary: Abiotic, Biotic, Ecosystem, Producer, Autotroph, Consumer, Heterotroph, Decomposer, Food Chain, Food Web

Major Concept Areas:
- Energy flow in nonliving systems
- Energy flow in systems
- Quality of the environment
- Future outlooks for the development and use of energy resources

Connections to Standards:
Wisconsin Standards for Science
- CC5: Energy and Matter
- CC7: Stability and Change
- SEP4: Analyzing & Interpreting Data
- SEP6A: Constructing an Explanation
- SEP6B: Designing Solutions
- SCI.LS1.C: Organization for Matter & Energy Flow in Organisms
- SCI.LS2.A: Interdependent Relationships in Ecosystems
- SCI.LS2.B: Cycles of Matter & Energy Transfer in Ecosystems
- SCI.LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- SCI.PS3.D: Energy in Chemical Processes & Everyday Life

Objectives
Students will be able to:
- Identify ways that nonliving (abiotic) components of an ecosystem affect the living (biotic) components
- Relate living and nonliving components of an ecosystem to energy
- Analyze how energy flow through an ecosystem influences the abiotic and biotic conditions of the ecosystem
- Explore impacts of climate change on beings in ecosystems

Rationale
Having students look closely at their surrounding environment heightens their observation skills and increases their appreciation of the qualities of their surroundings. By comparing different environments, students will begin to consider how the amount of energy (sunlight) an ecosystem receives greatly influences what can live there.

Materials **(K)**=materials in DEN Kit
- Trowel **(K)** or stick
- Lux meter (light meter) **(K)**
- Thermometer **(K)**
- Infrared Thermometer **(K)** *(optional)*
- Meterstick (or yardstick)
- Compass
- Anemometer **(K)** or Pinwheel (or small strip of paper)
- Handheld weather meter **(K)** *(optional)*
- Plant/animal guidebooks or tablet/phone & iNaturalist
- **Survey of Energy Use in an Ecosystem Student Sheets**
- **Comparing Energy Flow and Variations among components at each Site Student Sheets**
- **Examining Climate Projections and Predicting Climate Change Impacts Student Sheets**
- **Beings on the Move Educator Guide and Beings Cards**
- **Energy Use in an Ecosystem Student Assessment**

Check out KEEP's DEN kit to have access to all materials other than printed student copies: https://www3.uwsp.edu/cnr-ap/wcee/library/Pages/trunks_kits.aspx#energykits

Background
An **ecosystem** consists of species in a biological community (the living component-**biotic**) interacting with each other and with the physical and chemical factors that make up their environment (the nonliving Component -**abiotic**). An ecosystem can be as small and obscure as a blade of grass, a vernal pond, or rotting log. It can also be as large and magnificent as the Florida Everglades or the Amazon rainforest. Some scientists even classify Earth as a working ecosystem.

Interactions among species include relationships like pollination, mutualism, predation, and decomposition. Plants and animals in an environment interact with each other in various ways. For example, plants may depend on insects or birds to pollinate flowers and on earthworms to aerate the soil; animals may depend on plants for food or shelter.

Examples of how plants and animals interact with the nonliving elements of their environment include life-sustaining processes such as photosynthesis, water purification, evaporation, and Respiration. Physical factors such as

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Connections to Standards:

Wisconsin Standards for Environmental Literacy and Sustainability

- Connect; Standard 1
- Explore; Standards 2, 4 & 5
- Engage; Standards 6 & 7

Getting Ready: Educators:

Find three study sites that are somewhat different from each other in terms of sunlight, air temperature, soil moisture, wind, and number and types of plants and animals living there. If possible, select one site that is open, like a field or lawn; one that has trees; and one that contains water or a wetland. If your school area does not have a lot of variety in locations, you can compare built environments to natural environments.

Possible study sites include a school lawn; a park, playground, or any other area with many trees; a flowerbed or vegetable garden; a vacant lot; a pond, stream, or marsh; an open field; and a forest. Consider asking facilities to leave a "no-mow" area for a few weeks prior to this activity.

Plan to visit the sites on the same day if possible. If you visit on different days try to visit at about the same time each day. Obtain any necessary permission to take students to visit the sites you have chosen. Check the sites beforehand to identify and possibly remove any safety hazards.

sunlight, moisture, temperature, and wind influence the suitability of an area for particular organisms.

The interaction of living and nonliving components affects the qualities and characteristics of an ecosystem. These interactions can influence the climate within the area (often called a micro-climate). For example, in a forest tall trees intercept the sunlight; this results in a shady moist understory where only shade tolerant plants can live.

Energy is evident in all living and nonliving components of an ecosystem and in the interactions between components. Therefore, energy influences which types of plants and animals live in an ecosystem.

Procedure

Orientation

Take the class on a brief tour of the school grounds or have them think of various locations around the school. Ask them to identify different natural areas (not human-built) and list similarities and differences among the sites. Ask students what they think influences what a site looks like. Note their responses.

Review what an **ecosystem** is. Make sure they understand that it includes all the living species and nonliving components that interact in a specific environment. Share that the living species are **biotic** components of the ecosystem and the nonliving factors are **abiotic** components of the ecosystem.

Help students identify the following abiotic and biotic components in an ecosystem they are familiar with. Be sure they include all of the following:

Abiotic components

- Sunlight
- Air/Wind
- Water/Precipitation
- Soil (type and moisture)
- Temperature

Biotic components

- **Producers/Autotrophs** (produce its own food using light, water, CO_2) Plants
- **Consumers/Heterotrophs** (eats other plants or animals) Animals
- **Decomposers/Saprotrophs** (feeds on decaying plants or animals) fungi/bacteria

Ask students to describe the interactions between **biotic** and **abiotic** components in the ecosystem. If they struggle, suggest any of the following:

- Sunlight provides energy for plants to produce food (photosynthesis); Sunlight influences temperature which impacts what can live/grow in an ecosystem
- Plants absorb nutrients from soil and water which changes the composition of soil and water
- Animals eat plants which can lead to more erosion and change topography, geology, geography; Erosion impacts surface water *(Link to excellent 4 minute video about how wolves impacted the Yellowstone River: https://www.youtube.com/watch?v=ysa5OBhXz-Q*

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Ask students to describe the interactions between **biotic** components in the ecosystem. Discuss that a **food chain** shows how each living organism gets it energy from the sun or from eating other living (or once living) organisms. **Producers** (**autotrophs**) make their own food which provides them with the energy they need to live and grow. **Consumers** (**heterotrophs**) eat other organisms to get the energy they need to live and grow. The transfer of energy from one organism to another and another is a **food chain**. Since most organisms can consume/be consumed by many different organisms in an ecosystem, all the food chains in an ecosystem can be interconnected into a larger system called a **food web**.

Steps for Educators

1. Explain that students will investigate ecosystems at three different study sites to find out how living and nonliving components affect each other. Hand out copies of **Survey of Energy Use in an Ecosystem Student Sheets** to each learner. Have students complete S1 using information from a local weather channel or weather.com.
2. Point out and describe the parameters for the three different study sites. Provide any rules or restrictions as needed. Have students draw a birds-eye sketch of the study areas on S2.
3. Demonstrate or explain each of the instructions to investigate the components of an ecosystem on S2.
4. Divide the class into six teams and assign each team one component to investigate (like wind) **OR** divide the class into three groups and have each group investigate a site (or six groups and have 2 groups investigate each site). If groups are investigating only one site, each student within a group should be responsible for conducting the survey of one component within the study site.

Steps for Students

5. Students should go to the study site(s) and record their measurements or observations in the data table on S3.
6. After teams have had sufficient time to investigate each location, students should come together to present their findings and share what they have learned. Students should record the measurements and observations of other groups in the data table on S3.
7. Students should form new groups with one member from each of the other groups. Each learner will need a copy of the **Comparing Energy Flow and Variations among Components at each Site Student Sheets**. Students should work together to answer the questions on S4, S5, and S6.

Resources:

Beings on the Move Activity - Hannah Panci - Great Lakes Indian Fish & Wildlife Commission (GLIFWC)
https://docs.google.com/presentation/d/1w339qR1CiFo3NRDEJWze1w7iCDiBfIxLRn9OT6c0bTA/edit?usp=sharing

Wisconsin Initiative on Climate Change Impacts (WICCI) - *Nelson Institute for Environmental Studies at University of Wisconsin Madison / Wisconsin Department of Natural Resources*
https://wicci.wisc.edu/

Related KEEP Activities:

The activity "Taking Temperatures" orients students on how to use and read a thermometer. Have students participate in "Food Chain Game" to further investigate energy flow through living systems. Older students can follow this activity with "Puzzling Wisconsin's Biological Communities."

Taking Temperatures:
Food Chain Game:
Puzzling Wisconsin's Biological Communities:
https://drive.google.com/file/d/1weeblPPJRdQjL3C00oapj2BjjQH89II-/view?usp=sharing

Credit:

Adapted from American Forest Foundation. "Field, Forest, and Stream" pp. 156–159 in Project Learning Tree: Pre K–8 Activity Guide. Washington, D.C.: American Forest Foundation, 1993.

Updated by KEEP staff, April 2023.

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8. After groups have had sufficient time to discuss the questions on S4-S6, students should participate in a whole class discussion about the **abiotic** and **biotic** components of each of the survey sites and the interactions between the biotic and abiotic components at each site.

Climate Connection

9. Hand out copies of **Examining Climate Projections and Predicting Climate Change Impacts Student Sheets** to each learner. As a class, read the text, examine the maps, and answer the questions on S7 and S8. If you are interested in sharing additional Climate Change Projection Maps with students, more can be found on the WICCI website. https://wicci.wisc.edu/wisconsin-climate-trends-and-projections/

Climate and Cultural Connection

9. Explain to students that the species in ecosystems near their school are not the only Wisconsin species that might be impacted by a changing climate. Explain that you are going to examine the impact of climate change on seventeen different beings that live in Wisconsin and are important to many residents of Wisconsin, including the Ojibwe and Menominee Tribes of Wisconsin. Lead students through the ***Beings on the Move*** activity. Make sure you have printed the educator instructions found in the google slideshow. https://docs.google.com/presentation/d/1w339gR1CiFo3NRDEJWze1w7iCDiBfIxLRn9OT6c0bTA/edit?usp=sharing
Also be sure to have printed enough species cards for all students to have one during the activity. If you have checked out KEEP's DEN kit, there are laminated *Beings* cards in the kit.

Climate Solutions

10. Many students have anxiety about climate change. It is important that when you address climate change, you also share information about climate solutions and the ways students can be a part of those solutions. At a minimum discuss the following…
    a. Ask students what is causing climate change.
    Answer: Climate change is caused by carbon dioxide and other greenhouse gasses, like methane, being emitted in the atmosphere. CO_2 emissions have increased by about 90% since 1970 and emissions from the use of fossil fuels has been the largest contributor.
    b. Ask students what we use fossil fuels for.
    Answer: We burn fossil fuels for electricity, heat and transportation.
    c. Ask students if they know actions they can take to reduce CO_2 emissions.
    Possible Answers: Reduce consumption by using less electricity, heat, and gasoline. Increase efficiency by using LED lights and energy star appliances and sealing windows and doors to eliminate drafts in your home and driving more fuel efficient vehicles. Switch to renewable sources of energy for electricity, heat, and transportation. Shop locally to reduce carbon footprint.

If you want to further investigate climate solutions with your students, KEEP recommends having students visit the **Project Drawdown Climate Solutions by Sector** webpage. https://drawdown.org/sectors
Students could be asked to examine at least one solution in any sector and share what they learn about it with their peers.

Closure/Reflection

Ask students the following questions:

- Why is it important to learn about the ecosystems that surround us?

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- Why is it important to understand how climate change might impact the ecosystems that surround us?
- What types of adaptations might organisms in the ecosystems near your school need to make in order to survive in the future?

Assessment

Formative

- How thoughtfully did students conduct the investigations and report their observations?
- To what extent did student presentations of their findings indicate they had conducted a thorough investigation?
- Did students listen carefully to each others' reports?
- Were students able to synthesize the results to answer the questions in Comparing Energy Flow?
- Were students able to identify potential impacts of climate change on the Ecosystems that surround them?

Summative

Have students complete the **Energy Use in an Ecosystem Student Assessment S9 and S10**.

Extensions

Visit each site again at a different time of year and repeat your investigations. Compare your results: How has the soil changed? The temperature? The wind? The plants and animals? What factors influenced each change?

Revisit each location to look for ways humans have affected it. Students might look for things such as litter, damaged plants, new animal arrivals, polluted or cleaner waters, or an improved path.

Visit the Minisan website to explore how climate change is affecting twelve ecosystems within ***Wenaboozhoo Minisaning*** (the Apostle Islands). http://www.minisan.org/about/

North American Association of Environmental Educators (NAAEE) Environmental Education Materials: Guidelines for Excellence

KEEP strives to create lessons that meet the NAAEE Environmental Education Materials: Guidelines for Excellence. This lesson meets the following guidelines under the six key characteristics of high-quality environmental education instructional materials.

- 1.1 Accurate
- 1.2 Centers on equity and inclusion
- 2.1 Thinking and process Skills
- 2.2. Skills for asking questions and exploring different perspectives
- 2.4 Skills for addressing environmental challenges and opportunities
- 3.1 Awareness
- 3.2 Focus on concepts
- 3.3 Concepts in context
- 4.1 Sense of personal stake and responsibility
- 5.1 Learner-centered instruction
- 5.2 Different ways of learning
- 5.3 Connections to learners' everyday lives
- 5.3 Connections to learners' everyday lives
- 5.4 Expanded learning environment
- 5.5 Equitable and inclusive learning environment
- 5.6 Interdisciplinary
- 5.7 Goals and objectives
- 5.8 Appropriateness for specific learning settings
- 5.9 Assessment
- 6.1 Clarity and logic
- 6.2 Easy to use
- 6.3 Long lived
- 6.4 Adaptable
- 6.5 Accompanied by instruction and support
- 6.6 Make substantiated claims

S1

Student Sheet
Survey of Energy Use in an Ecosystem

Your Name: _____ **Group Members:** _____

Purpose
To survey different energy-related **abiotic** components of an ecosystem–sunlight, soil moisture, temperature, wind–to investigate how they affect the living **biotic** components–plants and animals–in an ecosystem.

PREPARING FOR THE SURVEY
Today's Weather
Look this information up before heading outside. Use a website like weather.com

Temperature: _____

Humidity: _____

Cloud cover: _____

Wind speed and direction: _____

Other: _____

Team Responsibility
Check which strategy your class is using to survey components within the study sites.

❑ We are investigating ALL components in one study site.

Site _____

❑ We are investigating ONE component in all study sites.

Component: _____

❑ Other strategy assigned by teacher.

Describe: _____

Materials
- Trowel or stick
- Lux meter (light meter)
- Thermometer
- Infrared Thermometer *(optional)*
- Meterstick (or yardstick)
- Compass
- Anemometer or Pinwheel (or small strip of paper)
- Handheld weather meter *(optional)*
- Plant/animal guidebooks or tablet/phone & iNaturalist

S2

Student Sheet
Survey of Energy Use in an Ecosystem

Map of study site(s)
Sketch a bird's-eye view of your school grounds and label each study site (1, 2, & 3). If you are only surveying one study site, circle the one you are surveying.

Components and Survey Instructions

Soil Moisture: Use a trowel or stick to scrape the surface of the ground and to obtain a small sample of soil from underneath the surface. Feel the soil to tell whether it is wet, moist, or dry. (*Moist soil will clump together when you roll it between your thumb and finger.*) Examine the soil for other characteristics such as texture, color, and smell. Record this information. Note any plant material or organisms in the soil.

Sunlight: Determine how much sunlight penetrates the ground. Determine light intensity at each site using a light meter. Remove the cover from the sensor, turn the meter on, and record the measurement. If a light meter is not available use relative terms such as shady, dark, medium light, or bright.

Wind: Use an pinwheel or anemometer to determine wind movement. Record the general speed (slow, moderate, fast) of the wind. Use a handheld compass to determine and record the direction the wind seems to be blowing from. If a handheld wind meter is available, use that instead. If none of these tools are available, use a small strip of paper to determine the wind movement. Have one team member hold the paper away from their body, while the others observe whether it hangs straight down or blows at an angle. Estimate the angle between 0 and 90 degrees. Use a compass to determine the direction the wind is blowing from. Record all information on your student sheet.

Temperature: Measure the temperature at 2.5 cm (1 in) deep in the soil, 2.5 cm (1 in) above the soil, and at 1 meter(m) (or 1 yard) above ground. If a site has a pond, stream, or lake, measure the temperature at just above the water, at 2.5 cm (1 in) deep, and at 1 meter (or 1 yard) above. Record your measurements on your student sheet.

Plants: Observe the various species of plants (large trees, small trees, shrubs, small plants, and grasses—if you have a field guide or iNaturalist, try to identify species). Record the most common types of plants found and how many different species there are. Estimate, in percent, the amount of ground area that is covered or shaded by plants.

Animals: Note the various species of animals at each site (insects, spiders, worms, birds, reptiles, fish, amphibians–use field guides if you have access to them). You may move things around a bit (such as lifting up rocks or logs) but always leave things the way you found them. Try not to disturb anything you find. If you cannot find anything, look for evidence of animals such as scat, tracks, burrows, or leaves that have been chewed. Try to determine if the animal is a primary consumer (**herbivore** = eats plants), a secondary consumer (**carnivore** or **omnivore** = eats animals or animals and plants), or a decomposer. Record the most common type of animal living in or visiting the site and how many different species there are.

Student Sheet
Survey of Energy Use in an Ecosystem

Component	Characteristic	Tool	Site 1	Site 2	Site 3
Soil	**Moisture** (wet, moist, dry)				
	Other Characteristics (list)				
Sunlight	**Light** (lux)				
Wind	**Speed** slow, moderate, fast				
	Direction				
Temperature	**2.5 cm below soil**				
	2.5 cm above soil				
	1 m above soil				
Plants	**Most common species** (write name or describe)				
	Number of different species				
	Ground cover (estimate %)				
Animals	**Observed** (list animal seen)				
	Evidence (describe tracks, scat, etc.)				
	Most common species (write name or describe)				
	Number of different species				

S4

Student Sheet
Comparing Energy Flow and Variations among Components at each Site

Answer the following questions based on your team's observations, discussion with your peers, or class discussion.

Abiotic Components

Describe what happens to sunshine as it enters each of the sites.			
	Site 1	**Site 2**	**Site 3**
Where does most of the sunshine fall at this site? On plants, the ground? Explain.			
Explain how the amount of sunshine falling on the ground might affect soil moisture at each site.			
Is there a relationship between the amount of sunlight received and temperature at each site? Explain.			
Describe what happens to wind as it blows through each of the sites.			
Explain how the amount of wind might affect the plants and animals living in each of the sites.			
Explain how the amount of wind might affect soil moisture at each site.			
Explain how the amount of wind might affect temperature at each site.			

Student Sheet
Comparing Energy Flow and Variations among Components at each Site

Biotic Components

Describe a possible food chain for each site. Try to include a producer, multiple consumers and a decomposer in each food chain. If possible, develop the food chain into a food web.

	Site 1	Site 2	Site 3
Food Chain			
Food Web			

The more diverse an ecosystem is, the richer it is. Diversity of an ecosystem can be measured by the number of different species in the ecosystem. Ecosystems that are rich in species diversity are generally more stable than ecosystems that have poor species diversity.

Describe the species richness at each site.

Species Richness			

Which site is the richest (has the greatest variety of plants, animals, fungi)**? Why do you think this site is richer than the other sites?**

Student Sheet
Comparing Energy Flow and Variations among Components at each Site

Interactions between Abiotic and Biotic Components

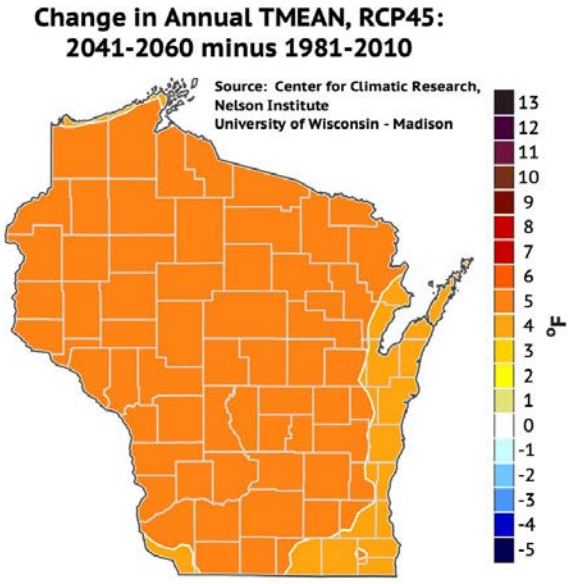
Describe how each of the following abiotic components might influence the biotic components (plant and animal species) at each of the study sites.			
	Site 1	**Site 2**	**Site 3**
Sunlight			
Soil Moisture			
Temperature			
Select the abiotic component (from above) **that you think has the greatest influence on the plants and animals at each site.** **Explain your thinking.**			

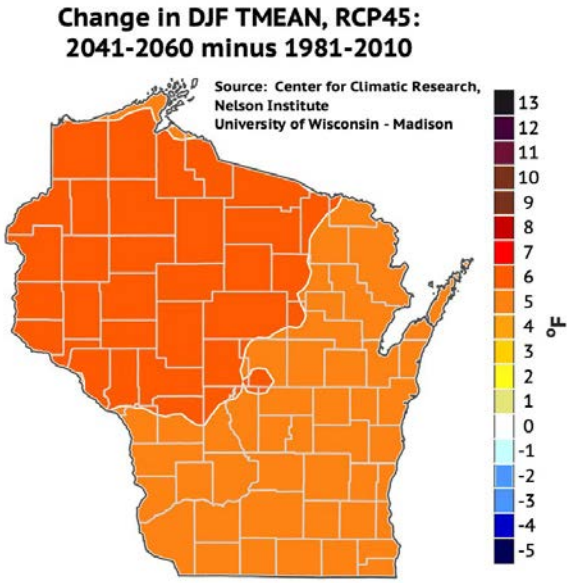
S7

Student Sheet
Examining Climate Projections and Predicting Climate Change Impacts

The Wisconsin Initiative on Climate Change Impacts *2021 Assessment Report: Wisconsin's Changing Climate* shows that Wisconsin's climate continues to change. New data show continued warming, increases in rain and snow, and more frequent extreme rainfall events. Use the projection maps provided to consider how climate change might influence the abiotic and biotic components of the ecosystems surveyed near your school.

Maps created by Nelson Institutes Center for Climatic Research, University of Wisconsin - Madison
Maps published on the WICCI site: https://wicci.wisc.edu/wisconsin-climate-trends-and-projections/





The maps at the left show the projected change in annual average daily temperature (top left) and the projected change in winter average daily temperature (bottom left).

1. What changes are projected in the annual average daily temperature map (top left)?

2. How might the increase in the annual average temperature predicted on the map impact the abiotic (nonliving) components of the ecosystems near your school?

3. How might those changes in the abiotic components impact the biotic components (plants and animals) of the ecosystems?

4. What changes are projected in the winter average daily temperature map (bottom left)?

5. How might the increase in the winter average daily temperature predicted on the map impact the abiotic components of the ecosystems near your school?

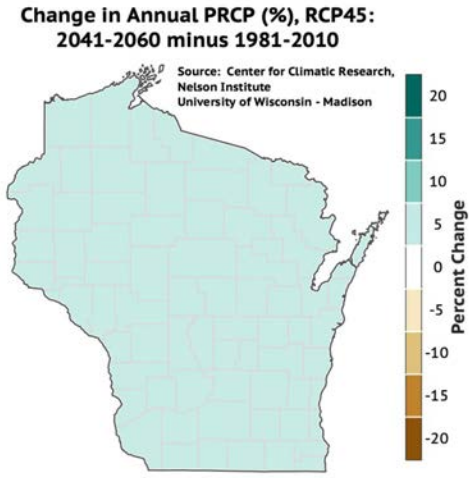
6. How might those changes in the abiotic components impact the biotic components of the ecosystems?

Student Sheet
Examining Climate Projections and Predicting Climate Change Impacts

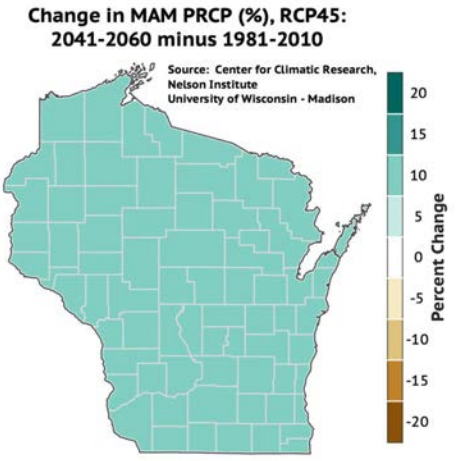
The maps at the right show the projected change in annual precipitation (top right) and the projected change in spring average precipitation (bottom right).

Think about the abiotic and biotic components in the sites you surveyed.

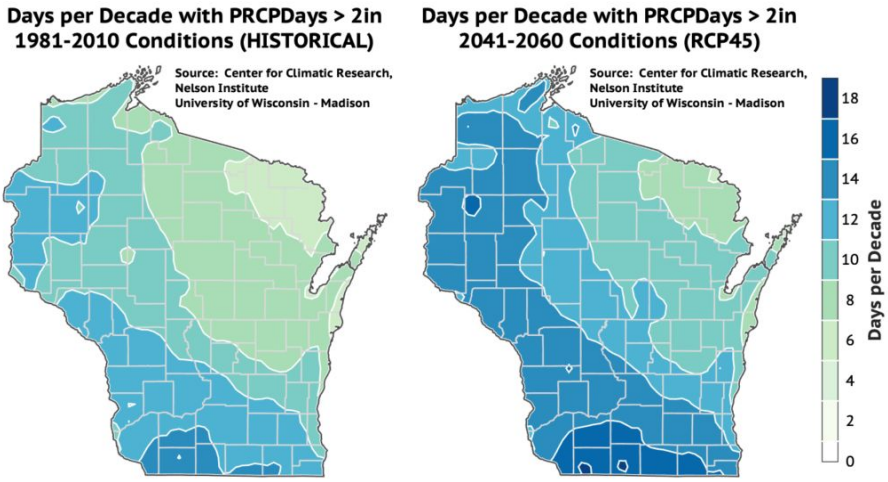
7. What changes are projected in the annual precipitation map and the spring average precipitation map?



8. How might the increase in precipitation predicted on these maps impact the abiotic components of the ecosystem?



9. How might those changes in the abiotic components impact the biotic components of the ecosystem?



The maps at the left show the historical (far left) and projected (immediate left) days per decade with more than 2 inches of precipitation in a day.

10. What changes are projected related to the days per decade with over 2 inches of precipitation in a day?

11. How might the increase in extreme rainfall events impact the abiotic components of the ecosystem?

12. How might those changes in the abiotic components impact the biotic components of the ecosystem?

S9

Student Assessment
Energy Use in an Ecosystem

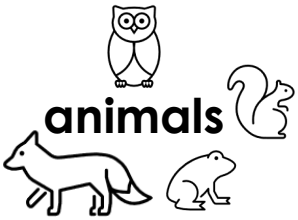
Directions: Select one of the survey sites. In the space below, draw lines showing connections that you observed or learned about. On each line, briefly describe the relationship between the two components.

NAME: _____

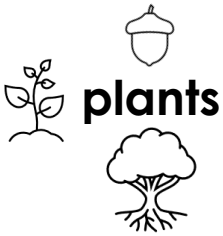
- ❑ Site 1
- ❑ Site 2
- ❑ Site 3

sunlight

temperature



animals



plants

soil moisture

wind

S10

Student Assessment
Energy Use in an Ecosystem

The Wisconsin Initiative on Climate Change Impacts *2021 Assessment Report: Wisconsin's Changing Climate* shows that Wisconsin's climate continues to change. New data show continued warming, increases in rain and snow, and more frequent extreme rainfall events.

Which projection do you think will have the greatest impact on the ecosystems near your school? Continued warming, increases in rain and snow, or more frequent extreme rainfall events?

Use complete sentences to write a paragraph to answer the question. Your paragraph must include:

- An answer to the question (you MUST choose one of the following):
  - Continued warming
  - Increases in rain and snow
  - More frequent extreme rainfall events
- Reasons/evidence to support your answer which must include:
  - At least two pieces of supporting evidence from the *Energy Use in an Ecosystem* lesson
  - At least one piece of supporting evidence from the *Beings on the Move* activity
- The following vocabulary words from the lesson: **abiotic**, **biotic**, **ecosystem** and **food chain** OR **food web**. Optional vocabulary words: producer/autotroph, consumer/heterotroph and decomposer/saprotroph.
- Begin your paragraph with a claim… "I think _____ will have the greatest impact on the ecosystems near my school because…"

Educator Instructions
Beings on the Move

Activity: Climate Change Vulnerability of Culturally Important Beings

Original activity created by Hannah Panci, GLIFWC

Adapted by Gina Smith, Wisconsin Center for Environmental Education - Feb 2022

Participants should gain an understanding of:

- What climate change effects we might expect in the region
- How climate change may affect culturally important beings
- How treaty rights and the lifeways of Ojibwe people may be impacted by climate change; How culture of the Menominee may be impacted by climate change

Estimated time: 45 minutes – 1 hour

Age: 4th – 12th grade

Supplies:

- Laminated sheets with 1) a picture of an animal/plant, plus its English, Ojibwe, & Menominee names and preferred habitat on the front, and 2) a list of climate change impacts to that animal/plant on the back.
- A separate instructor page with a list of climate impacts we might see in the region.

Introduction:

- Brainstorm list of climate impacts we will experience and share one way these climate impacts might affect your life.
- How will climate change impact plants and animals?
- What are some ways humans depend on plants and animals?
- Think about the Ojibwe and Menominee people who maintain treaty rights related to harvesting and hunting that only extend to their reservations and/or ceded territories. How might climate change impact their ability to harvest/hunt the beings important to their way of life?

Activity:

- Hand out cards to individuals or partners
- Instruct students to NOT look at the back of the sheet
- Before the activity, find a partner. Brainstorm how their animal/plant might be affected by climate change (think about where it lives, what it eats, etc.)
- Have the group line up facing the same direction
- Read off climate impacts one by one; have group members take steps forward if their animal/plant is affected by that climate impact
- After each one, ask group members to explain what animal/plant they are and why they moved
- At end, have everyone notice where they ended up relative to everyone else

Wrap-up:

- Who was most vulnerable? Who was least vulnerable? Was anyone surprised by how far they did or did not move?
- Were there any beings that may benefit from climate change in some ways?
- What does this mean for people who have treaty rights to harvest these plants/animals and depend on them for so many things? (use your sheets for clues)
- What can we do to help these beings?

Climate Change Vulnerability of Culturally Important Beings

CLIMATE IMPACTS:

If your plant or animal will be affected by…

- Increasing temperatures – air temperatures are expected to increase in all seasons, but particularly in the winter. Water temperatures will increase too, in many cases more than air temperatures.
- Drought – we can expect longer dry periods, particularly in the summer
- Increases in predators – some beings are expected to be favored by climate change and those beings may predate more heavily on other beings
- Pathogens/diseases/parasites – warmer temperatures may favor certain diseases or pathogens that can affect native beings
- Extreme precipitation events – we can expect more rain to come in the form of large rain events, with inches of rain that may cause flooding
- Decreases in snowfall – more winter precipitation will fall as rain as the temperatures warm
- Low genetic variation – some beings may not be able to respond as easily to climate change because of low genetic variation
- Competing beings – some beings may be favored by climate change and may outcompete others
- Changes in diet – some beings might have fewer food sources available
- Limited dispersal – some beings cannot travel very far or across barriers, and may not be able to move north as climate change continues
- Human development – development of towns and cities may disrupt habitat for some beings

…. Then take the number of steps listed on your sheet.