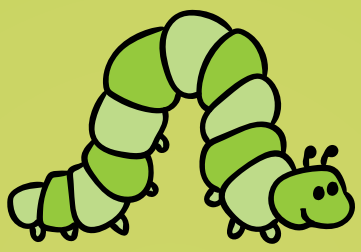

Connections

THE BASICS OF BIODIVERSITY

Module 2

HCTF Education

For more information and resources,
visit **hctfeducation.ca** or contact **education@hctf.ca**

HABITAT CONSERVATION TRUST FOUNDATION

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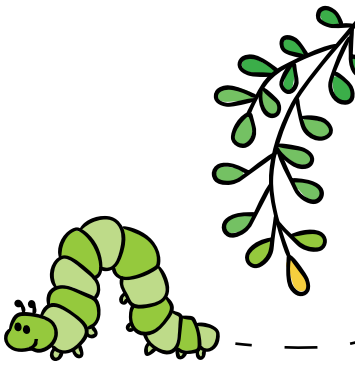


Connections: The Basics of Biodiversity

A Word to the Teacher

In the first biodiversity module, the activities focused on developing a sense of wonder, appreciation and understanding of life's creative expression through art and artists' perspectives through inquiry. In this second module, the activities will be focused on actual problems related to biodiversity. The activities in this module will provide students an introduction to inquiry using a problem-based learning approach while engaging with issues relating to biodiversity in a real-world context. The activities presented can be used as stand-alone mini lessons or as part of a larger inquiry or problem-based learning activity. A short primer on problem-based learning is available for this unit from *hctfeducation.ca*. Students will not only learn about the differences between the different levels of biodiversity (genetic, species and ecosystems), but they will also explore the interactions between these different levels and the role of change in biodiversity. As in many real-world biodiversity projects, the anchor and its driving question will not have a simple solution, may lead to more questions, further inquiries, and or generate several possible solutions.

Inquiry Ideas

Problem-based learning allows students to dive into the complex concept of biodiversity in an engaging and meaningful way. Not only are students involved at each step of anchor, process, analysis, reporting and communicating learning; but they also focus on their essential questions. Thus problem-based learning is a relational journey: a natural fit for the wonder, curiosity, appreciation, and caring that studying biodiversity inspires.

Biodiversity and problem-based inquiries are:

- Connected to real-world issues, and relationships in student's lives. The driving question or problem may be developed by the teacher in advance based on student passions, come from student experience, or student teams may develop it as part of the project itself.
- Inspired by and focused on the learning as part of a process and not the solution itself that encourages transformational experiences.
- Defined by specific parts that guide the work while not losing sight of the complex concept, issue or system being addressed.
- Useful in facilitating critical and design thinking through identifying, analyzing and evaluating information and developing possible solutions.

Ready

1. Brainstorm and develop a biodiversity web using words that students have heard or know. Keep a journal of biodiversity wonders.
2. Try different kinds of walks.
    - Take a shape walk and look for natural shapes
    - Take a colour walk and look for as many colours as you can find, or find objects of different colours.
    - Take a change walk, listing all of the things that are changing as you walk (twigs bending, birds landing, insects carrying things, plants squashed).

- Take a question walk (ask questions; the only "answer" allowed is another question).
- Take a silent walk (how many sounds can you hear?).
- Take an up and down walk (walk only looking up at things; walk only looking down).
- Take an ABC walk (find living things that begin with each letter of the alphabet).

3. Spend some time developing the concept of systems. What systems do your students already know about? What do systems have in common?

4. Invite a naturalist or well-known Elder or conservation person in your community to speak to your class about the important natural features of the area.

Set

The three activities in this module cover three essential ideas (listed below in bold) for relationships in biodiversity studies. If your students have already grasped these concepts, you may wish to modify the activities in this module to suit student experience or design other activities around more advanced guiding questions. Suggestions for such questions are:

Biodiversity is made up of abiotic and biotic entities with similarities and differences interacting in processes:

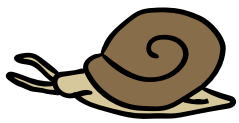
- How many different or similar entities can be found in species diversity, genetic diversity, and/or ecosystem diversity?
- What might be some advantages to these differences and the similarities in biodiversity?
- In what ways are humans biodiverse?
- How does biodiversity contribute to and relate to processes like energy, climate, nutrient, water, etc. cycles?
- How do some definitions of biodiversity help us to understand and relate to it and in what ways do some definitions hinder our understanding?

Biodiversity is related, interconnected systems relating to one another:

- How does biodiversity help to sustain ecosystems, species, or individuals?
- How are the three types of diversity (species, genetic, ecosystem) related to each other?
- How do humans sustain themselves through biodiversity relationships?
- What does a beneficial or negative relationship look like, and how do we know if it is beneficial or harmful?

Change is a constant:

- How do ecosystems survive change, is change required in ecosystems?
- How do humans change ecosystems?
- Are there ways to manage changes that create beneficial relationships?
- What do we need to understand about biodiversity when we make changes?
- What are the impacts to biodiversity of short and long-term natural changes (e.g. fire, floods, insect infestations)?
- Is change beneficial or harmful to biodiversity, how would you know?



At the end of the activities is a section for students to analyze and communicate the learnings in a section called Follow Up. Depending on how you are introducing these mini lessons, you may wish to revise the follow up sections accordingly.

Background

Humans share the planet with millions of types of other living things. All living things, including humans, are interconnected. This variability among living organisms on the earth, including the variability within and between species and within and between ecosystems is called biodiversity.

There are three important concepts related to biodiversity: species diversity, genetic diversity and ecosystem diversity. Greater biodiversity in species, individuals, and ecosystems leads to greater resilience and stability.

Species Diversity

A species is a group of living things that are more or less alike and that are able to reproduce among themselves. It includes all the species ranging from animals, plants to microorganisms on Earth. Species are diverse, dynamic and interconnected to one another. For example, relationships between species exist when herbivores eat plants, carnivores eat other animals, and or different species compete for food, space or mates in the same ecosystem.

Species diversity is the number and abundance of living things found within an area such as community, biome, ecosystem or habitat. All species within these areas are indirectly or directly dependent on one another such that diversity of species results in stable and productive environments. Climate, geography and other environmental conditions can also influence species diversity along with habitat type and genetic make up.

Genetic Diversity

Genetic diversity refers to how each individual is different in some way from every other individual of its species. When genes are expressed, they may affect how the individual of a species looks or behaves. The expressions of a gene can be the same expression as one parent, a blend, or a different expression altogether (such as a recessive white colour flower from red flower parents). Over time, these changes may change the genetic diversity of a species. An individual's genes are inherited from parents—one copy of each gene from each parent. When genes are expressed, they may affect how the individual of a species looks or behaves. The expressions of a gene can be the same expression as one parent, a blend, or a different expression altogether (such as a recessive white colour flower from red flower parents). Over time, these changes may change the genetic diversity of a species. They affect how organisms look and behave.

In humans, genetic diversity may appear as colour differences (e.g. eye colour), size differences (big feet/ small feet), or behavioral differences. Or it may exist in less obvious forms inside our bodies, affecting the way we grow, think and resist disease, for example.

Genetic diversity exists in all species and is very important to the ongoing health of each species. Species with high genetic diversity can adapt better to changing conditions in their environment. Genetic variation in species also provides the raw material from which new species can evolve.

Ecosystem Diversity

Ecosystem diversity describes the variety of different natural systems found in a region, in a country and on the planet. An ecosystem consists of all the living and nonliving things in a given area that interact with one another. An **ecosystem** can be as tiny as a drop of pond water, a square metre of a garden, a grassland soil crust; or it can be as large as an ocean, a rainforest, or a desert biome. Different combinations of animals, plants, micro-organisms and the water, soil, and air result in a multiplicity of ecosystem types and sizes around the world.

Like species diversity, there are interconnections between ecosystems and the components that make up ecosystems. These components include species, biological, geological, and hydrological systems in an area that interact with one another and provide essential services to all life within those systems. All ecosystems undergo continual, gradual change. This natural change over time is called **succession**. The changes people make to natural habitats, however, often affect natural succession. Wildlife sometimes cannot change or **adapt** to survive in areas which undergo drastic and sudden change or in which their habitats disappear altogether, especially when these areas become isolated.

Key Points

1. Biodiversity refers to the variety of living things on the Earth.
2. Species diversity refers to the number and abundance of species.
3. Genetic diversity refers to the genetic variation that exists within a species and is important for the ongoing health of a species.
4. Ecosystems diversity refers to the variety of terrestrial and aquatic ecosystems within an area including the different habitats and ecological processes.

Go!

The following activities are designed as student sheets around a possible project-based learning anchor. Some of the activities can be done in groups or as individual research. There is a fair bit of student choice in the options below and some students may need assistance in where to look for resources, how to work in groups, and / or planning out their research so they have time to complete an evaluation of their learning. Suggestions for how students can demonstrate what they have learned are provided, but you might wish to have them use other methods or a combination of methods or have them work in cooperative groups.

Animal Mania

Aim: To introduce the procedure for individual or small groups studying an animal and basic concepts of biodiversity.

Anchor: Present a profile of a favorite animal species that has widely varied traits, or that lives in different habitats at different life stages. This could be done in a video, in written form, an actual sample etc. The profile should consider why it has so many variations? Can it live in different habitats? and if so what makes it able to do so?

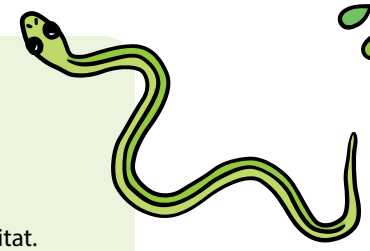
Ready… Set …

Pick your favourite animal (bird, fish, mammal, reptile, amphibian, invertebrate, etc) or an animal you studied earlier through the eyes of an artist that you would like to learn more about. Once you have decided on which animal, participate in some of the following activities as you begin your study and profile creation:

1. Brainstorm all of the different kinds of animals you know. Then divide them into categories. Brainstorm and talk about or write down what the animals in each category have in common. What category would you place your animal in and why?
2. Make a list of some of the things you would like to know about your animal, look for all the ways your animal relates to other species.
3. Read some of the stories or poems or novels that have been written about your animal. Pay attention to what you can learn about your animal from storytellers and poets.
4. Pay close attention to what you can learn about your animal from Indigenous ways of knowing and artists: storytellers, paintings/drawings, myths, and poems.

Go!

Start your research on your animal, and create your own **animal guide** by writing down the following questions and activities on sheets of paper or a field journal. Leave lots of room for answers, other questions you will answer, and space to illustrate your point with photographs and drawings. Work on your own or with partners that might be studying the same animal. Each person in a group might research the information for a different section.



My Animal Study Guide

1. What are some of the things all _____ have in common? Include several pictures or drawings of your animal.
2. Where do _____ live? Describe their habitat. Do they have different habitat needs when they are young versus adults? Do male or female animals look the same or different, why or why not?
3. What do _____ eat, as adults and as baby animals? And how do they capture their food?

4. Make a food web showing the ways _____ connect with or relate to other species (animals or plants).
5. Other interesting information you learned about your animal or its connections to others in its ecosystem, yourself, and First Peoples.
6. Have you ever seen this animal, what is your favorite story about your animal and why?
7. Consider how the animal generates / uses energy, generates heat, and deals with waste products of eating and drinking as well as the roles of producers, herbivores, omnivores, and carnivores in relation to your chosen animal.

Follow-up

As a class, you might use your animal study guide to help other grades learn about animals, or use your research to create a classroom Animal Mania mural. You might put on a skit, where everyone role plays their animal's behaviour in the gym or outside. Or you could write a story about the day in the life of your animal.

Be a Biodiversity Detective

Aim: To provide an imaginative way of learning about ecosystem diversity.

Anchor: Use Google Earth to select an area to study. How much diversity in ecosystems can you see using just Google Earth at the scale of a province, region, or a city? Use the zoom feature to go in closer to see if you can differentiate an ecosystem.

Ready...

Whether you live in an apartment building, house, trailer or log cabin, you require: air to breathe, a source of nearby water, food, safe shelter, and enough space in which to live and grow. If your home excluded one of these basic needs, you and your family would suffer.

The living things in your backyard have the same needs as you—food, water, shelter and space to live and move. Start learning how to recognize the biodiversity in your area by becoming a biodiversity detective. Many biologists studying ecosystems start with satellite photos to look at biodiversity. While not every feature can be seen when looking at satellite images of forests, at a certain distance trees can be identified based on how their cover looks in aerial or satellite photos like the ones from Google earth that gives clues to different ecosystems and what might live there.

Using images, like Google earth, pick an urban area near your home or school, can you identify the places where you obtain their water, food, shelter and spaces to live and play? Now pick a rural or a more natural looking area and try to do the same for an animal or bird. It might not be as easy and you might only be able to see some slight differences, this is why many biologists follow up their aerial research with an on the ground exploration for biodiversity.

Set...

1. With the help of your teacher and the rest of your class you are going to set up a biodiversity "headquarters" at your school. You will work in groups and be assigned a one part of the whole site to 'set' up for the other groups. The day of you will visit all the sites in the area and use the biodiversity clues (see page 9 and cut on the dotted lines to separate them and put them in an envelope).

2. As a class, define the area for the study, perhaps this will be done at a local park, or your teacher may have set this up for a field trip to an intertidal zone, or there is an existing trail or in the surrounding habitats in your community near your school where you can visit several times. Or you could challenge your class to look for biodiversity in an urban setting. If you can find a map of the whole area or draw one, use it to decide and mark out safe sites for each group to have one "ecosystem biodiversity search site."

3. Survey your classmates, the science resource teacher/librarian or your own knowledge to find special features of the ecosystem biodiversity of your selected area. Use the research to make five more clue cards about special features of the ecosystem biodiversity of your area. Put them with the others in the envelope.

4. The day of your biodiversity search, teams should visit their site to confirm the area and set out flags for boundaries so the other groups can see them easily on the trail. Depending on where you are and the access to the sites, you might work through each site as a group or divide into "search parties" of three members each. Search parties or groups could receive two or more clues from the envelope to look for at each site.

Go!

1. Fan out along the flagged safe areas with your team and find what your clues ask you to find. Don't touch anything (or do any collecting), just use a field journal to collect your observations of biodiversity you found at each search site. Make note of anything interesting you found that wasn't on the clues.

2. Regroup with the rest of the class at "headquarters."

3. If time, lead the class to your location sites and describe what you have found. As you make the final visits through the sites or before you leave the area remember to remove the boundary flags.

4. Take all the clues to the "research lab" (classroom!) and group the results by the species, use guidebooks and other online sites to help you identify who's who. If you can't find a name, create a meaningful and consistent one using the details of your observations.

5. Record on a big sheet of poster paper the names of all the organisms identified by the detective teams on the map using sticky notes. If your map is big enough you can put the sticky notes on the map. As you learn more about the ecosystem and the biodiversity you can correct your list by adding, moving, or revising your sticky notes on your chart or map.

6. When the observations are grouped to the classes' liking, answer the following questions.

    - What kinds of plants grow in your study areas?
    - What kinds of animals (birds, mammals, insects and others) live there?
    - Was there one area where there were more clues than others? Can you think of a reason why?
    - Brainstorm some words that describe the biodiversity of your area and give it a meaningful name, like the "Three creeks fern and snail grove".

7. Using all the different clues you collected, create an artist's conception of the biodiversity picture for your study area.

Follow-up

Save all the data from your detective team and do a biodiversity search during another season. Compare the result.

Biodiversity Clues

- ☐ Find three **different-sized leaves** from the same plant.
- ☐ Find at least three **different kinds of plants** growing under a tree.
- ☐ Find at least three **different organisms** and give them names which describe how they look, move or behave.
- ☐ Find at least three **different kinds of plant "skins"** or surfaces.
- ☐ Find a plant which has three different **colours**.
- ☐ Find biodiversity in at least three different **shapes**—square, triangle, oval, heart, rectangle.
- ☐ Find at least three different kinds of **seeds**.
- ☐ Find at least three different kinds of **leaf stalks**.
- ☐ Find three different **spider webs**.
- ☐ Find three different **lichens**.
- ☐ Find at least three different kinds of **holes made by animals**.
- ☐ Find three different **signs of an animal having eaten** something.
- ☐ Find at least three different kinds of **leaves**.
- ☐ Find at least three **leaves** with different **textures**.
- ☐ Find at least three **different plants**.
- ☐ Find three different kinds of **consumers (animals) or evidence** of them.
- ☐ Find three different kinds of **decomposers**.
- ☐ Find at least three **plants with different odours**.
- ☐ Find at least three different **insects**.
- ☐ Find three different **flowers**.

Biodiversity Clues Cards are available in a full colour format to print, or also available for purchase. Please visit hctfeducation.ca.

Biodiversity Means Differences

Aim: To introduce the concept of differences or genetic diversity among individuals of the same species.

Anchor: Show the class photographic or video images of a variety of dog breeds (both pure and mixed breeds). Have students observe and discuss the differences among the various dogs. Are they all part of the same species?

Ready...

Within any species there are many variations. Explore the biodiversity of one species that lives in your backyard.

Set...

Work with a group of three or four people. **Your team will need:**

- Species recording sheet
- 1 magnifier
- 1 ruler
- 1 cup, plastic/paper
- 5–10 spoons
- 5–10 bug boxes/ paper cups
- A sketch pad or notebook
- Optional: Special nets for butterflies, binoculars (for bird study), dip nets for water studies.

Go!

1. Visit an area where you can study six to eight specimens of the same type of plant or animal. In some cases, you might be able to temporarily collect them without harming them, however, when you are finished studying them you will put them back where you collected them. For some birds and animals, you might need to rely on pictures or observe them closely on a field trip and either photograph or sketch them on site.

2. Observe them closely and sketch them in a field journal so you can examine the differences later based on your drawings. While taking a photo can be helpful, sketching and drawing allows for time for close study. The following are some suggestions for the study.

Plants*

- Mosses
- Grasses

Ferns

- Lichens
- Herbs
- Shrubs
- Seaweeds

Animals*

- Birds
- Bees
- Mosquitoes-midges
- Earthworms
- Ladybird beetles
- Spiders
- Slugs
- Woodbugs
- Centipedes
- Snails
- Beetles
- Millipedes
- Squirrels
- Dragonflies
- Springtails
- Snakes
- Flies
- Water boatmen
- Caterpillars
- Earwigs
- Sticklebacks
- Mussels
- Periwinkles
- Moths / butterflies
- Starfish
- Mussels

**Note: Your collection or photographs should be of the same species of plant or animal. There are, for example, some 350,000 species of beetles in the world.*

3. Now be a scientist and using a field journal, transfer the questions on the next page and answer them.

Biodiversity in a Species Recording Sheet

Date: _____ Time: _____

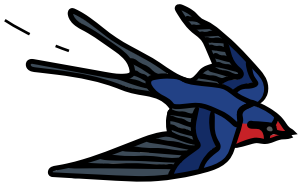
Study Location: _____ Weather: _____

Members (if in a group): _____

Species studied:_____

_____

Number studied:_____



Observations:

1. List the differences between individuals of the same species.

2. Why do you think there are these differences?

3. Scientists often give names to species based on their description. Think of a fun name for each of specimens related to their role in the habitat..

4. How do you know you have the same species (what is similar about them all that confirms you are looking at the same kind of species)?

Sample recording sheet:

Specimen Number	Size (measure if you can)	Shape	Colour	Location	Identifying Marks
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					

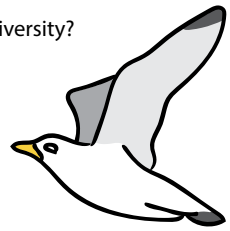
Follow-up

Either individually or in small groups, examine your work or observations from the three activities (e.g. Animal study guide, Be a Biodiversity Detective, or Biodiversity means Difference) and other experiences and activities you've completed for examples of species, ecosystem, and genetic diversity.

1. Analyze your recordings and observations by looking for connections among the various levels of diversity (genetic, species, ecosystem).

2. Demonstrate these found connections by responding to one or more of the following questions.

    - Describe species, genetic, and ecosystem diversity. What does it look like and why is it important?
    - What are some differences among animals of the same species? How might these differences be useful to them in an ecosystem? What role does this difference play during short term or long-term changes?
    - What kind of processes did you find e.g. energy transfer (consumers, decomposers, producers), life cycles, or successional ecosystem processes and describe these relationships for an animal or ecosystem?
    - How might an animal or plant cope if their habitat was destroyed by a forest fire? How might animals and plants respond to climate change?
    - What are the impacts of short and long-term natural changes (e.g., fire, floods, insect infestations) on biodiversity? Are these impacts beneficial or harmful to biodiversity?
    - How are you related to biodiversity?



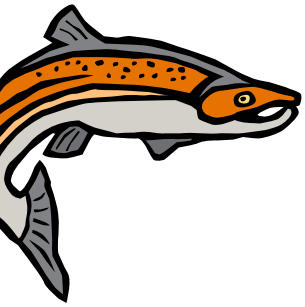
3. Communicate your responses to the above questions. In your responses, be sure to demonstrate in some way what you learned about the various levels of diversity and how they connect to each other and to you. Consider one of these possible formats for your analysis:

    - Graphic organizers
    - Storyboard
    - Presentation (recorded or live)
    - Brochure
    - TikTok Video
    - Movie Trailer
    - Essay
    - Model (with written or oral presentation)
    - An ecosystem "tour"
    - News Interview

Reach-Out

This module's activities were designed to provide students the ability to describe or reflect on questions such as what does biodiversity mean to you? How do the various aspects of biodiversity connect and interact in a balanced way to support life? How are you implicated in biodiversity relationships everyday? Other ways to generate anchors and guiding questions for these or additional activities include:

Mostly Science



- Show a video talking about the importance of and threats to biodiversity
- Brainstorm and develop a biodiversity web using words that students have heard or know. Keep a journal of biodiversity vocabulary.
- Research conservation and restoration activities around one of your animals or ecosystems explored in your investigations. Develop questions or lines of inquiry to follow up with in a future unit or as an extended study.
- Learn about how First Peoples lived within and connected to biodiversity. Explore Indigenous ways of knowing species and ecosystems and how they related to or the concept of interconnectedness.
- View excerpts from a local or national newscast that describe a biodiversity problem or issue to be considered.

Mostly Social Studies

Explorers travel in search of new lands and riches. Often they brought home unexpected treasure from where they visited and sometimes, they left things behind. Look for examples of:

- Animals, seeds, viruses and bacteria that were brought or left.
- The history of "the spice trade," potatoes, tobacco, pineapple, kiwi fruit, bananas, coffee and tea.
- The social effects of diseases and alien species the explorations brought.

How would you investigate if these were positive or negative additions to the local environment socially or culturally? Explain the effect they had on the genetic, species and ecosystem biodiversity that was here using biodiversity to support your claim.

Mostly Fine Arts

In groups, create an ecosystem collage by selecting a particular ecosystem to represent. Use pictures cut from magazines, or draw or paint your own from your investigations in this unit. Be sure to include different plants, trees, insects, birds, animals, soil, water, climate, etc. Start with a poster paper size and glue down all the pieces. When complete, glued down and dry, flip over the collage and use a pencil to create an outline of at least four puzzle pieces (the more pieces, the harder the puzzle). When you are satisfied with your design, cut up the collage. Challenge another group in your class with your ecosystem puzzle and see if they can figure out what you were representing, explain your ecosystem to the rest of the class.