



United Nations
Educational, Scientific and
Cultural Organization



**MOUNT
ARROWSMITH**
BIOSPHERE REGION

BIOSPHERE BOOKLETS

Lesson Plans & Activities

BIODIVERSITY

SUMMARY/OVERVIEW

Grades:
3-5

Prep Time:
1 hour

**Learning
Environment:**
Outdoor & Indoor

**Total Lesson
Length:**
6 hours

DESCRIPTION:

This booklet introduces the concept of biodiversity to students and promotes a greater awareness of their environment, the importance of biodiversity, and how it affects us (including economically). Activities involve outdoor exploration as well as indoor worksheets and discussion topics. Students will examine some of the current threats to biodiversity as well as what we can do to help. Activities can be delivered separately or on the same day.

CURRICULUM EXPECTATIONS:

Questioning and predicting:

- Make observations in familiar and unfamiliar contexts
- Demonstrate curiosity about the natural world
- Identify questions about familiar objects and events that can be investigated scientifically

Processing and analyzing data and information:

- Experience and interpret the local environment
- Compare results with predictions, suggesting possible reasons for findings

BACKGROUND:

Biodiversity refers to the total number of different species found in the same area/habitat. Different species are interconnected and depend on each other for food, shelter, defense, etc. Biodiversity provides us with several "ecological services". The number of species in each habitat (biodiversity) is distributed differently across the globe, with more species found in the tropical/equatorial latitudes.

LESSON PLAN

TIME	ACTIVITY	LOCATION	MATERIALS
1 hour	1. Introduction – What is Biodiversity?	Outdoor	Printed worksheet
30 mins	2. Benefits of Biodiversity	Indoor	Printed worksheet
1 hour	3. Matching Challenge	Indoor	Printed worksheet, scissors, glue
3 hours	4. Threats to Biodiversity	Indoor	Printed worksheets, coloring pencils
30 mins	5. Conclusion – Survival of the Fittest	Indoor	Printed worksheet

TIME	ACTIVITY	LOCATION	MATERIALS
1 hour	1. Introduction – What is Biodiversity?	Outdoor	Printed worksheet

Introduction: What is Biodiversity?

GOAL: Provide students with an understanding of what biodiversity is.

PREPARATION: Print page 4/20 (next page). Bring pens and clipboards to a nearby park or school park.

LESSON PLAN:

INTRODUCTION: Initial Discussion (10-15 mins)

1. Ask students if they have heard the term “**biodiversity**” before. If so, ask them to explain what it is. If not, ask what they think it means by breaking down the name. (bio=biological=living, and diversity=different)
2. Ask if they have noticed or counted the **number of animals and plants** around them when they go out for a walk or even in their own backyard.
3. Explain the **interconnectedness** between species - as different animals eat different things. Animals can either be a **GENERALIST** (eats several different types of food), or it can have a specific **NICHE** diet, meaning it is very “picky”. (Disappearance of its food = Disappearance of the animal as well).

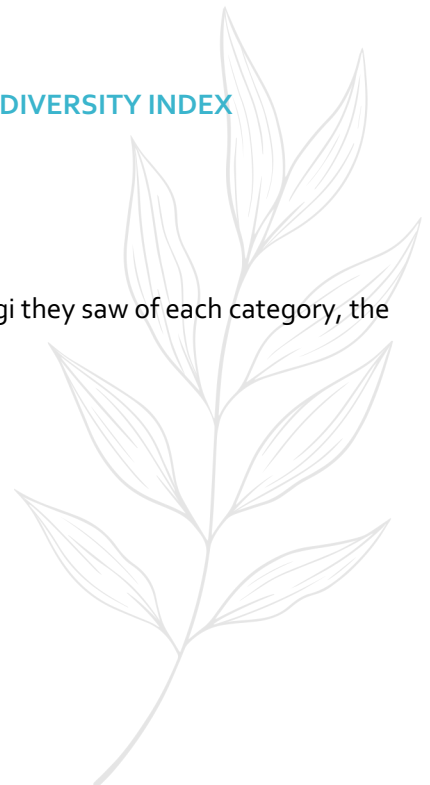
Biodiversity is the total number of species found in a certain area

HANDS ON: Counting Biodiversity - Gathering Data (45 mins)

4. Take the students to a nearby park and ask them to **explore and fill in the BIODIVERSITY INDEX WORKSHEET** (next page = 3/20 and 4/20).

The next activity can be conducted in the classroom or in the park

5. Ask students to count the number of different animals, plants, insects and fungi they saw of each category, the number of individuals, and calculate the Biodiversity Index.
6. Ask them to rank the categories from most diverse (1) to least diverse (4).
(Expected Answer: 1-Insects 2-Plants 3-Fungi 4-Mammals)
7. Compare and discuss their results as well as the Biodiversity Index results.



Biodiversity Index Worksheet - Example

At a nearby park, count the number of different plants, fungi, insects and animals, and the number of individuals you see in each category below and record it. You don't have to know their names, simply identify that they are different and record the total number.

PLANTS




OF SPECIES:
|||

Hint: Look for different types of leaves, flowers, bark, etc.

OF INDIVIDUALS:
||| ||| |||




FUNGI



OF SPECIES:
||

Hint: They may grow on the bark of trees (living and dead) or on the ground.

OF INDIVIDUALS:
|||



INSECTS




OF SPECIES:
||| |

Hint: Look for flying, crawling, or hopping insects. They may be hiding under rocks or bark.

OF INDIVIDUALS:
||| |||




ANIMALS



OF SPECIES:
|||

Hint: Think of animals you've seen in the area before.

OF INDIVIDUALS:
|||



$$\text{BIODIVERSITY INDEX} = \frac{\text{Total \# of Different Species}}{\text{Total \# of Individuals}} = \frac{5}{15} = 0.33 \text{ (Plants)}$$

(Calculate the Biodiversity Index for each category)

RANK THE FOUR CATEGORIES IN ORDER OF MOST DIVERSE (1) TO LEAST DIVERSE (4)

1. _____ 2. _____ 3. _____ 4. _____

Biodiversity Index Worksheet

At a nearby park, count the number of different plants, fungi, insects and animals, and the number of individuals you see in each category below and record it. You don't have to know their names, simply identify that they are different and record the total number.

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OF SPECIES:

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OF INDIVIDUALS:



FUNGI



OF SPECIES:

Hint: They may grow on the bark of trees (living and dead) or on the ground.

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INSECTS




OF SPECIES:

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OF INDIVIDUALS:




ANIMALS



OF SPECIES:

Hint: Think of animals you've seen in the area before.

OF INDIVIDUALS:



BIODIVERSITY INDEX = $\frac{\text{Total \# of Different Species}}{\text{Total \# of Individuals}}$ = _____ = _____

(Calculate the Biodiversity Index for each category)

RANK THE FOUR CATEGORIES IN ORDER OF MOST DIVERSE (1) TO LEAST DIVERSE (4)

1. _____ 2. _____ 3. _____ 4. _____

TIME

30 min

ACTIVITY

2. Benefits of Biodiversity?

LOCATION

Indoor

MATERIALS

 Printed
worksheet

What are the Benefits of Biodiversity?

What is biodiversity "good" for?

GOAL: Understand the importance and effects of biodiversity.

PREPARATION: Print page 7/20 for each student.

LESSON PLAN:

INTRODUCTION: Ecological services "checklist".

Ask students why they think biodiversity is important. In other words, what is biodiversity "good" for? Biodiversity is beneficial because it provides us with several benefits or "services" that make life possible, and for free! Look over the checklist below to view some of the main biodiversity benefits:

- **SOIL** formation and quality maintenance – did anyone use any soil lately? The food you eat is certainly dependent on quality soil.
- Upkeep of **WATER QUALITY** by plants and filter-feeder organism such as clams, sponges and cyanobacteria. We need water to drink, to cook, to clean, and most importantly, our cells need water to work well.
- **WASTE REMOVAL** is done by decomposing fungi and bacteria. Waste includes not only animal droppings but dead leaves, dead trees, dead animals, etc. These things don't just "disappear", they are recycled by animals that eat decomposing organisms (called detritivores).
- **POLLINATION AND SEED DISPERSAL** is crucial for the life cycle of plants, flowering or otherwise. It is the spread of pollen from one plant to another which ensures that the genetic material is passed on. Without pollination, most of the crops we have would disappear. Has anyone recently eaten plants that need pollination? Absolutely! Most berries, tomatoes, oranges, almonds, watermelons, cabbages, peppers, pumpkin, broccoli, apples, bananas, etc. require pollination.
- **MEDICINE & ECOTOURISM** are also provided by biodiversity. A lot of the medications we use today are derived from plants. Ecotourism refers to enjoying the outdoors while travelling. Medication that is dependent on plants include: aspirin, morphine, quinine. The horseshoe crab's blood is collected to be used in medications that help with our immunological system, frog skin components are used in some antibiotics, as well as some snake venoms. Has anyone ever taken a medication before?

This discussion will set them up for the fill-in-the-blanks activity. They will need to read the short description to know which word fits in each sentence. Note that there are three bonus words to be found in the wordsearch!

Benefits of High Biodiversity

ANSWER KEY

SOILS: Biodiversity includes not only the large plants and animals we see, but also really small **bacteria**, **fungi**, **ALGAE** and many tiny **insects** and **invertebrates**. These smaller organisms are the ones responsible for creating **SOIL** and maintaining the quality of soil.

WATER QUALITY: The benefits of biodiversity include keeping water clean and high quality. In **WETLANDS**, plants will take up contaminants in water and process and clean the water. Shellfish such as mollusks take in nutrients from the water, thereby preventing a condition called **eutrophication**, which leads to lack of **OXYGEN** in water and die-offs of organisms.

WASTE REMOVAL: The diversity of microbes, fungi, and other smaller organisms is important in **decomposing/breaking down** waste matter. Organic material in nature (leaves, logs, twigs, animal droppings, dead animals, etc.) is **DECOMPOSED** by the **biodiversity** of organisms in the ecosystem. It is a **DELICATE balance**, in which insects or microbes perform a vital function in removing waste from the environment.

POLLINATION AND SEED DISPERSAL: Bees are not the only organisms responsible for **pollinating** plants and crops. In fact, birds, **BATS**, and butterflies play a vital role in spreading pollen and in spreading **SEEDS**.

MEDICINE & ECOTOURISM: Thousands of modern **medicines** use natural ingredients from plants. Should any of these plants become **EXTINCT**, medicinal treatments would suffer. Examples of plants used in modern medicine include **quinine** from South

America used to treat malaria, and **taxol** from the Pacific Yew Tree, which is a main ingredient in treatments for breast and lung cancer. Travel companies promote tours into off-the-beaten-path locations, where tourists can observe and enjoy nature without disturbing the **ECOSYSTEM**. Money from ecotourism goes back into the region and helps to preserve the diversity of plants and animals.

SOURCE: SCIEINCING.COM



WORD BANK: ALGAE SOIL WETLANDS OXYGEN DECOMPOSED DELICATE BATS
SEEDS EXTINCT ECOSYSTEM

Benefits of High Biodiversity

Find the words that fill the blanks below. There are three bonus words in the wordsearch!

SOILS: Biodiversity includes not only the large plants and animals we see, but also really small **bacteria, fungi**, _____ and many tiny **insects** and **invertebrates**. These smaller organisms are the ones responsible for creating _____ and maintaining the quality of soil.

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P I H H Y N O U W T I H R H E
P L E W Q G G D R S O I L M C
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W A B A Q S S O S E E L P S Y
F E X T I N C T V Y M S C X O
M Z U I S F R L X A W M M O I

TIME
1 hour

ACTIVITY
3. Matching Challenge

LOCATION
Indoor

MATERIALS
Printed worksheet,
scissors, glue

Matching Challenge

GOAL: For students to understand that biodiversity is applicable to several different environments and that different species vary in the food they consume and/or the environment they live in.

PREPARATION: Print one copy of page 9 and 10 for each student. Ask the student to cut the rectangles (page 9) and match the animal's diverse habitats or diets (page 9). Students will need glue and scissors for this activity, and might want to work in pairs/small groups/as a class.

LESSON PLAN:

INTRODUCTION: Initial Discussion (10-15 mins)

This exercise is meant to highlight the biological diversity in different scenarios.




Birds may live in the same habitat, but are adapted to have different diets and not compete with each other, enhancing their chance of survival. Animals may also live in different habitats, adapting to different temperatures, humidity levels, oceanic pressure, etc.

ANSWER KEY:

HABITAT DIVERSITY

<p>Golden Toad: Males were about 2" long and bright orange in color. Females of the species were longer and black/dark olive in color. Species went extinct in 1989. Habitat: Costa Rica</p> 	<p>Archey's Frog: One of four remaining species of native frogs found on mainland New Zealand. Status: Endangered. Up to 3.7 cm long.</p> 	<p>Western Toad: Whitish line along mid-back is diagnostic but may be indistinct in small toadlets. About 2.5cm (nearly 1") size. Habitat: British Columbia, Canada</p> 
<p>endangeredlist.org/animal/golden-toad/</p>	<p>doc.govt.nz/nature/native-animals</p>	<p>www2.gov.bc.ca/gov/content/environment</p>




HABITAT DIVERSITY

<p>The Spotted Ratfish is an evolutionary "relative" of sharks and rays. They're found throughout the Northeast Pacific (including BC) around 50 to 400m depth.</p> 	<p>Lingcod are unique to the west coast of North America, with a great abundance off the coast of British Columbia. Most individuals occupying rocky areas at depths of 10-100 m.</p> 	<p>The Sockeye Salmon is a PELAGIC (which means it lives in the top layers of the ocean) fish that is one of the most commercially sought. Like other salmon, it live in the ocean, but spawns in freshwater.</p> 
<p>oceannetworks.ca/article-tags/spotted-ratfish</p>	<p>https://www.dfo-mpo.gc.ca</p>	<p>pac.dfo-mpo.gc.ca/fm-gp/salmon-saumon</p>

DIET DIVERSITY

<p>Can you guess why the Dung Beetle received its name? It's because it spends most of its life living around and feeding on animal waste. It can be found all over the world and it is considered the world's strongest insect!</p> 	<p>This beetle is found worldwide and deemed "adorable" by many humans. It is a predatory insect, eating mostly APHIDS, which are very small plant-eating insects. Sometimes called "Lady Beetle", it may eat leaves as well.</p> 	<p>The Ten-lined June Beetle (also called June Bug) are among the species of beetles that eat plants. More specifically, plant roots, causing them to die. Found in several places all over the world.</p> 
<p>natgeokids.com</p>	<p>naturemappingfoundation.org</p>	<p>entomology.wsu.edu</p>

DIET DIVERSITY

<p>The Belted Kingfisher is specialized in, well, fishing! Although small fishes are the main component of their diet, they also eat small aquatic insects, frogs, and the occasional berry. Found in most of North America.</p> 	<p>Anna's Hummingbird is a native species that can be seen in Vancouver Island throughout the year. It specializes in eating nectar from flowers, and some small insects.</p> 	<p>The Pileated Woodpecker looks for food inside dead trees by "excavating" with its beak. It eats many small insects like ants and beetles, as well as berries and nuts. Lives in North America.</p> 
<p>https://www.audubon.org/</p>	<p>https://www.audubon.org/</p>	<p>https://www.audubon.org/</p>

Biodiversity Matching Challenge

The number of species is a reflection of the diversity in the habitat/environment the organisms live in. A variety of species allows specialization and the use of several different types of habitats, resorting to different strategies to eat food, hide from predators and reproduce.

Cut and glue the animal's pictures to match their habitats and diets below:

HABITAT DIVERSITY

Golden Toad: Males were about 2" long and bright orange in color. Females of the species were longer and black/dark olive in color. Species went extinct in 1989.
Habitat: Costa Rica

Archev's Frog: One of four remaining species of native frogs found on mainland New Zealand. Status: Endangered. Up to 3.7 cm long.

Western Toad: Whitish line along mid-back is diagnostic but may be indistinct in small toadlets. About 2.5cm (nearly 1") size. Habitat: British Columbia, Canada

HABITAT DIVERSITY

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Lingcod are unique to the west coast of North America, with a great abundance off the coast of British Columbia. Most individuals occupying rocky areas at depths of 10-100 m.

The **Sockeye Salmon** is a PELAGIC (which means it lives in the top layers of the ocean) fish that is one of the most commercially sought. Like other salmon, it live in the ocean, but spawns in freshwater.

DIET DIVERSITY

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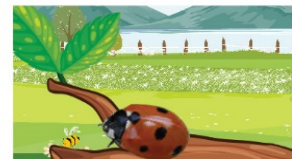
DIET DIVERSITY

The **Belted Kingfisher** is specialized in, well... fishing! Although small fishes are the main component of their diet, they also eat small aquatic insects, frogs and the occasional berry. Found in most of North America.

Anna's Hummingbird is a native species that can be seen in Vancouver Island throughout the year. It specializes in eating nectar from flowers and some small insects.

The **Pileated Woodpecker** looks for food inside dead trees by "excavating" with its beak. It eats many small insects like ants and beetles, as well as berries and nuts. Lives in North America.

Biodiversity Matching Challenge



TIME 3 hours	ACTIVITY 4. Threats to Biodiversity	LOCATION Indoor	MATERIALS Printed worksheets
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Threats to Biodiversity

What is affecting biodiversity?

GOAL: Explain to students that biodiversity isn't a fixed and permanent thing. It is delicate, currently vulnerable and needs to be protected.

PREPARATION: Print pages 13, 14, and 15 for each student. Provide coloring pencils to students for Part 2 of activity (bottom of page 12).

LESSON PLAN:

INTRODUCTION: Initial Discussion (30 mins)

Ask the students if they think **biodiversity is threatened** in any way. Give examples of threats to biodiversity. Some of the biggest threats to biodiversity are:

HABITAT DEGRADATION

Human developments often disrupt and/or destroy the natural habitat of many species. We expand and grow our cities, log for wood, and pollute, for example.

EXTRA VOCABULARY:

ENDEMIC = a species that only exists in one area of the world.

INVASIVE SPECIES

When animals are found in a habitat where they do not originate, meaning they are not in their natural habitat.

EXTRA VOCABULARY:

A species that is often **INTRODUCED** accidentally by humans can be also called an **ALIEN** species.

CLIMATE CHANGE

Many years of observation and research describe a trend in variations on Earth's climate. Global warming is just one consequence of climate change. Others are ocean acidification and species extinction.

EXTRA VOCABULARY:

EXTIRPATION = when a species disappears completely from an area that used to be its habitat. The species isn't **EXTINCT**, as populations in other locations of the world still remain.

LOW POPULATION

The higher the number of individuals a population has, the more variation of DNA (*an organism's "blueprint"*) there will be, leading to a healthier and stronger population of that species.

EXTRA VOCABULARY:

A small population leads to low **GENETIC VARIATION** (or **GENETIC DIVERSITY**), meaning that species has a lower chance of survival in the case of a catastrophic event or disease.

HANDS ON:

Part 1: Examples of threats to biodiversity (15-20 mins)

This will provide students with some **real-life examples for part 2 of the activity**. Ask the students to read the descriptions below (page 13/20) and identify what type of threat to biodiversity that animal is facing.


Part 1 ANSWER KEY:

Western Painted Turtle is being threatened by **INVASIVE SPECIES**
 Source: wildlifepreservation.ca



Axolotl is being threatened by **HABITAT DEGRADATION + LOW POPULATION**


Source: www.bellmuseum.umn.edu



Polar bear is being threatened by **CLIMATE CHANGE + HABITAT DEGRADATION**



Vancouver Island Marmot is being threatened by **HABITAT DEGRADATION + LOW POPULATION**



Part 2: Create a Comic Challenge! (Suggested 2-hour activity)

Ask the students to draw a comic strip (page 14 and 15) telling a story where they create a solution for a threat to biodiversity. The story can be a real-life case, or it can be a made-up case. The main focus is to ask the student to create a viable solution for the problem.

OPTIONAL:

Ask the class to **vote on the most creative comic.**

Threats to Biodiversity

Read the descriptions below and identify which type of threat to biodiversity that animal is experiencing in the blank spot. The four categories are **invasive species**, **climate change**, **habitat degradation** and **low population**; can be more than one answer.

The **Western Painted Turtle** (*Chrysemys picta bellii*) is a native species of turtle on Vancouver Island, BC that is currently competing for food and space with the Red-Eared Slider Turtle that is native to southern US (and is a common pet). They were released in the wild by pet owners that did not want to care for them anymore. Sadly, they were unaware of the consequences.



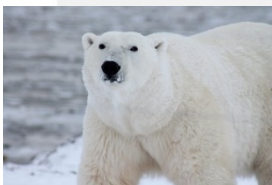
What is being done? Population awareness with signs, camera monitoring and nest protection by local researchers.

City growth and introduction of exotic species in Mexico are the leading causes for the sharp decline in **Axolotl** (*Ambystoma mexicanum*) populations (endemic). There were only two populations that we know of in Mexico, one in Lake Xochimilco and the other in Lake Chalco. As amphibians, they are very vulnerable to pollution and depend on water for survival and reproduction.



What is being done? Captive breeding and habitat protection.

Polar bears (*Ursus maritimus*) are powerful carnivores that spend most of their lives around water and ice. Unfortunately, the Arctic ice has been melting away twice as fast as the global average.



What is being done? Canadian government-funded research.

(Reducing carbon emissions significantly on global scale is also needed, but harder to achieve)

The **Vancouver Island Marmot** (*Marmota vancouverensis*) is a rare mammal endemic to Vancouver Island. There are only about 200 individuals remaining, a great improvement when compared to the population of only 30 individuals in 2003. Ongoing human pressures in parallel with periodically stronger predator-prey dynamics have contributed to the decline.



What is being done? Captive breeding and release and habitat protection.

Threats to Biodiversity

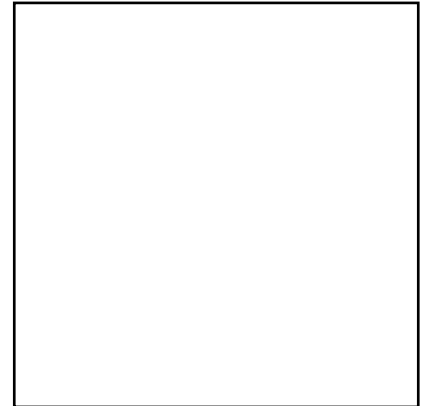
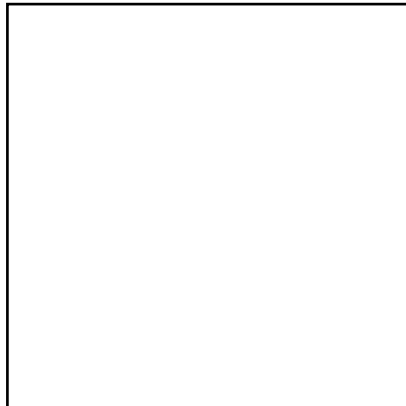
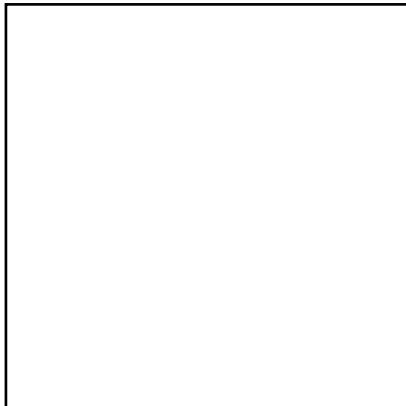
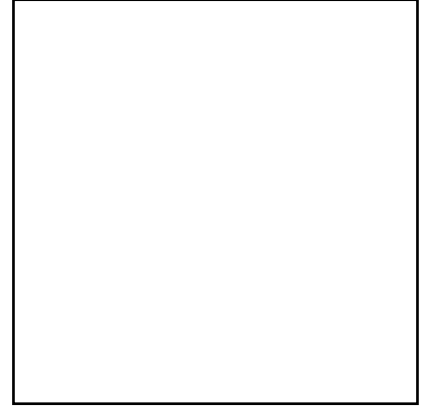
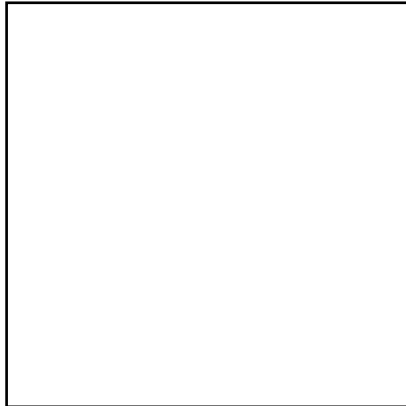
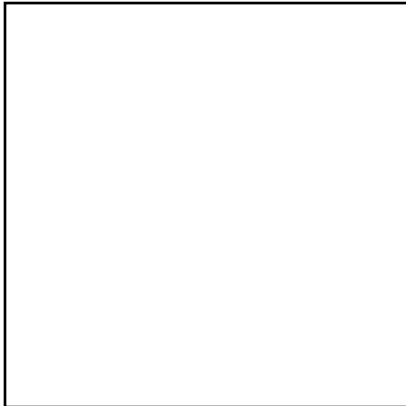
Use the frames below to create your own comic story highlighting a threat to biodiversity, as well as a plan to preserve and save biodiversity.

Name:

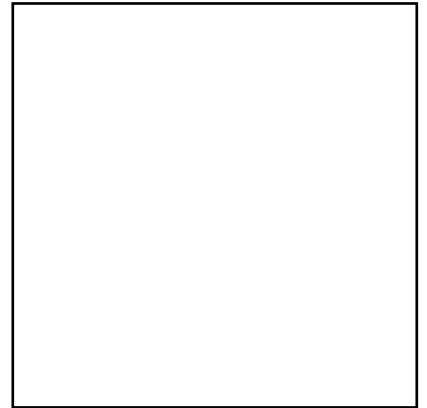
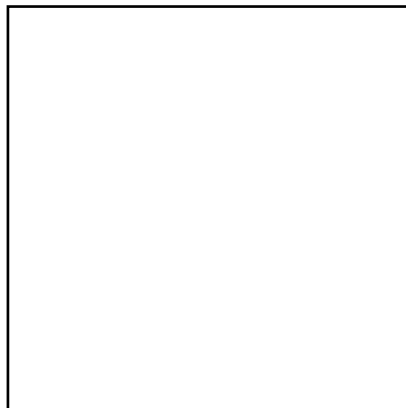
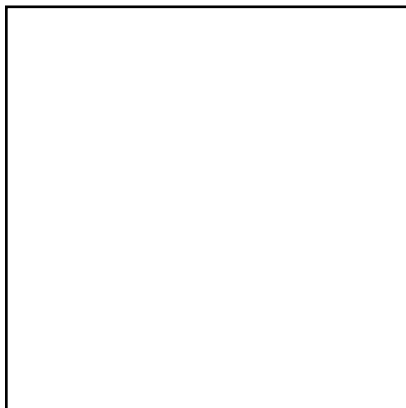
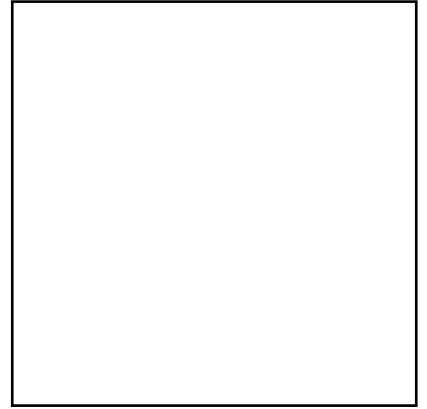
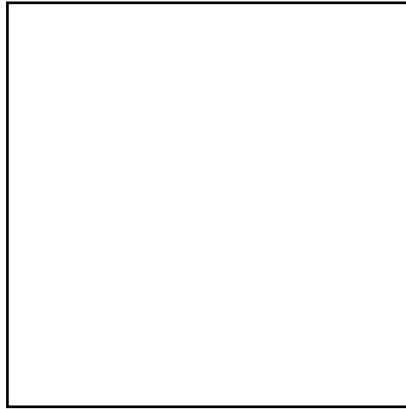
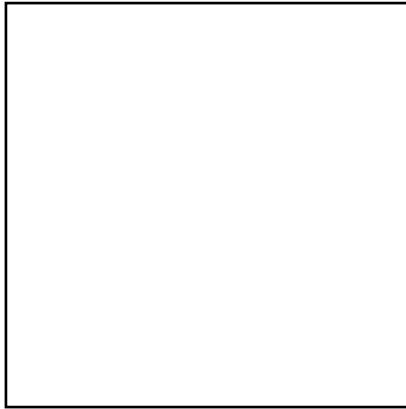
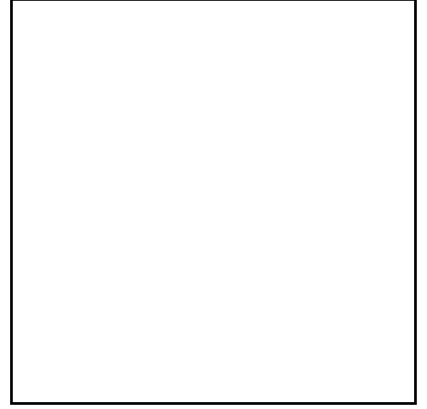
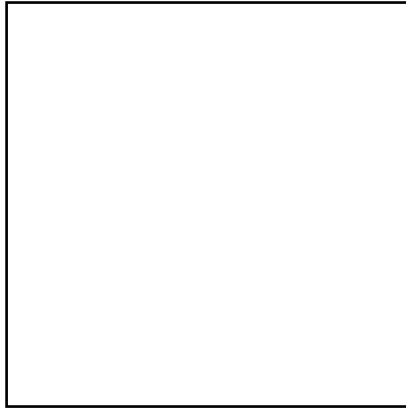
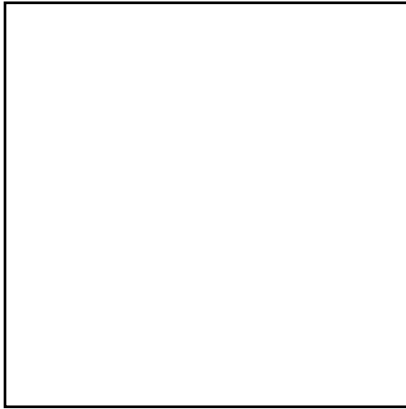
Class:

Teacher:

TITLE



Description: _____



Description: _____

TIME
30 min

ACTIVITY
5. Conclusion

LOCATION
Indoor

MATERIAL
Printed and cut
cards, tape

Conclusion: Survival of the Fittest!

GOAL: Conclude the topic by understanding and playing with the famous phrase “survival of the fittest”.

PREPARATION: Draw a BLANK table like the one below (but without the answers!) on the board. Print the cards on the following pages (page 17-21). Lamination is recommended but not required.

ORGANISM	HABITATS			
	DESERT	TREE	CAVE	SEA
PLANT	CACTUS	ORCHID	NOT FIT (needs sunlight)	KELP
MAMMAL	MEERKAT	SQUIRREL	BAT	WHALE
FISH	NOT FIT (needs water)	NOT FIT (needs water)	CAVEFISH	SHARK
ARTHROPOD (insects + crustaceans)	SPIDER	BEETLE	CAVE MILLIPEDE	LOBSTER
BIRD	GREATER ROADRUNNER	WOODPECKERS	NOT FIT (uses sight to fly)	NOT FIT (cannot survive underwater)

LESSON PLAN:

INTRODUCTION: With our new knowledge of the importance and meaning of biodiversity, it now becomes clear that the famous phrase “survival of the fittest” actually means “**survival of the one that is most fit to survive in its environment**” and not necessarily the *strongest* individual in a population, as it is commonly thought.

HANDS-ON:

1. Give each student one card and ask them to place/stick their card in one of the available spots on the table drawn on the board. Check if the answer is correct and discuss with class. Encourage questioning and make sure the answer is correct before the student goes back to their desk. The goal is to complete the table and understand all the different (DIVERSE) types of “fitness”.

CACTUS

ORCHID

NOT FIT

KELP

MERKAT

SQUIRREL

BAT

WHALE

NOT FIT

NOT FIT

CAVEFISH

SHARK

SPIDER

BEEBLE

CAVE MILLIPEDE

LOBSTER

**GREATER
ROADRUNNERS**

WOODPECKERS

NOT FIT

NOT FIT

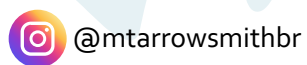
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 mandy.hobkirk@viu.ca