SciREN Lesson Plan Template

Part 1: Lesson Abstract

Lesson plan title: Adapting to Survive: How Animals Thrive in Their Environments	**Essential question**: How do animals respond behaviorally, physiologically, and evolutionarily to survive in their environments?
Scientist biopic link:	
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Abstract to Lesson Plan: (Max. 1 paragraph) *In this lesson, students explore how animals adapt to survive through behavior, physiology, and evolution. Students will investigate behavioral thermoregulation in lizards, conduct an experiment to understand how salamanders reduce water loss with skin adaptations, and discuss evolutionary changes in bear fur color. Students will engage in hands-on inquiry, record observations, and connect their findings to real-world ecological and evolutionary principles. The lesson emphasizes creative thinking, critical reasoning, and making connections between biology and survival.*	

Part 2: Lesson Plan Information

Class Subject and Grade Level:
Middle School Biology

Class Duration/Logistics: (How long will each part of the lesson be?)

1. Engage (5)
2. Explore (20)
3. Explain (15)
4. Elaborate & Evaluate (20)

Class Setting:(e.g. Indoors/Outdoors/Online)

Indoors but can be adapted to online

Learning Objectives (L.O.):

ASSESSMENT: By the end of the class my students will be able to –

Explain –

- The difference between behavioral, physiological, and evolutionary adaptations.
- How adaptations improve survival and reproduction in specific environments.

Do –

- Conduct a hands-on experiment modeling water retention in salamanders.
- Collect, record, and interpret data to draw conclusions about adaptations.
- Discuss and apply adaptation concepts to novel examples.

Answer this sample problem:

	How does a salamander's ability to reduce water loss represent a physiological adaptation? How does this differ from a lizard basking in the sun or bears evolving different fur colors?
Class Size: (Group sizes and number of students activities are designed for) The activity is designed to be used for any size class	**Lists of Standards (Common Core, NC Essential Science, Next Gen, etc.):** **LS.6.2.2** Analyze and interpret data to predict how the abiotic factors (such as temperature, water, sunlight, and soil quality) and biotic factors affect the ability of organisms to grow and survive in different biomes (freshwater, marine, temperate forest, rainforest, grassland, desert, taiga, tundra). **LS.8.2.1** Carry out investigations to explain how changing biotic and abiotic factors such as food, water, shelter, and space affect populations in an ecosystem.
Materials Needed for Teacher: (Including Technology) Tupperware containers (or something similar). Preferably one per student. Paper towels Construction paper Food coloring Water Timer	
Materials Needed for Students: (Including Technology) Notebooks, pencils, timers	

Part 3: Lesson Activity

ENGAGE: LEARNING OBJECTIVES PREVIEWED - Capture students' attention, activate prior knowledge, and stimulate student thinking so that they are prepared for today's lesson and have sufficient context around which to construct new knowledge.	
Hook Question: Ask: "How do you stay comfortable when it's hot, cold, or raining?" "How do you 'change' your surroundings (or yourself) to become comfortable?" "If you didn't have access to AC or heating, what would you do?" Animal Connection: Show pictures of desert lizards basking in the sun, salamanders in moist forests, and other animals in extreme environments. Ask: "How do these animals survive in such different conditions?" Misconceptions: Some students may think all adaptations happen instantly (confusing behavior, phenotypic plasticity, and evolution), or that animals consciously "decide" to evolve.	*What prior knowledge must be brought up to get them ready to explore the new concepts of today's objective?* *What questions can I ask to elicit that prior knowledge?* *To what previous content and/or real-life experience can I connect today's objective to capture students' attention and build*

	anticipation for the lesson? *What misconceptions might students have and what questions can I ask to have them reveal those misconceptions?*
EXPLORE: LEARNING OBJECTIVES DISCOVERED - Students make observations, record data, design and execute experiments, create graphs, interpret results, organize their findings, and develop hypotheses or conclusions so that they can construct knowledge independently and practice their scientific habits of mind.	
There are multiple ways that an animal can adjust itself or its surroundings to survive in a changing environment. Below are a few examples of how animals can do this, and the examples are ordered in increasing time it takes for these changes to occur. 1) Behavioral Example (Lizard): Show a short video or demonstration of lizards basking or hiding in shade. Have students brainstorm how this affects body temperature. Behavioral changes can occur immediately. Lizards warming up and adaptations for avoiding predators: https://www.youtube.com/watch?v=QSBCOexk50I Desert lizard cooling down: https://www.youtube.com/watch?v=1rkkKyYCxio Ask students if they can think of any examples they've seen of animals acting this way. Alligators on riverbanks? Tortoises basking on rocks? Anything in a zoo? Encourage students to connect what they're learning to what they've seen. 2) Physiological Example (Salamander Water Loss Project): Now, we're going to shift to physiological changes. Changes in physiology require more time than behavioral changes, but less time than evolutionary changes. Changes in physiological traits happen within an animal's lifetime. The purpose of this activity is to show how physiological adjustments to the skin can change rates of water loss. Salamanders can change the structure and composition of lipids in their skin, and certain lipid structures likely result in lower rates of water loss, as shown by the two types of paper in this activity. Instructors can provide a picture of a salamander while the class completes the activity. a) Students separate into groups of 2, and each student gets their own Tupperware container (filled with water). b) Each group will be provided with food coloring, a paper towel, and a piece of construction (or printer) paper. c) One student will gently place the paper towel in one Tupperware container, and the other student will place the construction paper on the other Tupperware.	*What must students be doing and thinking to discover the key points through their doing instead of my telling?* *How can I set up an experience to allow my students to do and think these things?* *What questions must I ask to guide their thinking to arrive at the key points?* *How are students pushed to develop the explanations or solutions I am looking for?* *How and where are students recording information/data?* *How will I ensure that all students are not just participating in the activity, but engaging in the thinking required to arrive at the key points?*

d) They will then drop food coloring on each and observe. Students will record data in notebooks: how long it took for the food coloring to pass through the paper, where the color spread, and how quickly. e) Once this experiment is conducted, we will discuss, as a class, the meaning behind the experiment. What could the papers represent? What if they represented different compositions of skin? f) Take away: animals can alter their physiology to better survive in different environments. 3) Evolutionary Example (Polar Bears vs. Brown Bears): Provide worksheet of images of closely related bear species. Have students observe differences (fur, fat, color) and hypothesize why those traits help survival. Evolutionary adaptations require multiple generations, as opposed to behavioral and physiological responses.	
EXPLAIN: LEARNING OBJECTIVES FORMALIZED - Solicit student ideas of what they've just done, introduce laws/models/theories/vocabulary, guide students towards generalizations that explain the results of their explorations, and confirm ideas so that students are clear on what is correct, why it's correct, and what they need to take away.	

Strategy:

- Introduce Vocabulary: Define behavioral thermoregulation (actions like basking), physiological adaptation (internal processes like thicker skin), and evolutionary adaptation (long-term genetic changes like fur color). Each definition should be paired with an example (can use the examples provided above – lizards, salamanders, and bears).
- Group Discussion: Ask students to form groups and discuss: "What did your experiment show about water loss?" Guide them to connect: paper towel = salamander with less lipid protection and more water loss; paper = salamander with more lipid protection and less water loss.
- Encourage students to think of one more example for each category – behavior, physiology, and evolution
- Groups present their findings. Teacher writes common themes on board.
- Correct Misconceptions: Clarify that physiological changes happen within a lifetime but evolutionary adaptations require many generations.

How will I set students up to create accurate explanations and justify them with evidence?

How will students share and engage in the findings of their classmates (whole class or smaller groups)?

How will students receive information on formal definitions, labels, rules and procedures – and record in a way that makes sense?

How will students compare their explanations to formal definitions and rules so that they make sense of their own experience?

What misunderstandings do I anticipate students still having and how can I correct them?

How will I know when students understand? What questions must they be able to answer?

ELABORATE: LEARNING OBJECTIVES USED - Students practice applying ideas to new domains in an increasingly independent way and practice problems for skill objectives so that they reinforce their knowledge, check their understanding while the teacher is present, and can extend ideas beyond just the problem or application in the example.

Application Activity: Students will be separated into groups (size of groups can vary depending on class size) and given a specific environment (rainforest, desert,

How will students use their new definitions,

grassland, taiga (snowy), etc.). Each group will then design their own "adapted animal" for that environment. They will choose traits (behavioral, physiological, evolutionary) that would help their animal survive. Once each group has created an animal, we will return as a class and share how each trait helps survival. Can the same animal survive in different environments? If yes, then why? If no, what other adaptations could they develop to survive in that different environment? Connections: Relate to climate change: "If the salamander's forest dries up, what adaptations would help them survive?"	*rules, and skills to investigate or solve problems in a new, yet similar situation?* *How will I scaffold my support and include whole class, group, and individual checks for understanding?* *How will students demonstrate their knowledge of the new information and ability to apply it in new ways?* *How will I ensure that students are able to apply their knowledge in an increasingly independent (and eventually independent) way?*
EVALUATE: LEARNING OBJECTIVES ASSESSED - Assess students' current mastery of knowledge, skills, and concepts, and determine students' self-assessed level of comfort and confidence with the objective so that the teacher knows where to remediate or reinforce ideas the next day, and the extent to which each individual has mastered the lesson.	
Same as elaborate! As students develop their adapted animal and share with the class, instructors will be able to determine if the students followed the lesson or need additional assistance.	*How will students show mastery of the objective?* *If students will be self-evaluating their efforts and abilities, what are the guidelines they will follow?*
NOTES/CONSIDERATIONS:	

Part 4: Differentiation Strategies

Modifications for Online/Hybrid Classroom: *(Are there ways to run this activity online?)* Yes! All of the necessary tools for the activities are common household objects and videos.	**Differentiation Strategies:** *(Are there ways to make the activity more or less challenging?)* Yes. The traits animals exhibit to survive in different environments can span from simple (such as an arctic fox having white fur in the winter but dark fur in the summer to blend into their surroundings) to more complex (such as birds evolving nasal turbinates to reduce respiratory water loss). Instructors can shift the traits they focus on to better match the skill level of the classroom. The activity itself is already rather simple, but the level at which the experiment is conducted can increase in difficulty. For example, additional 'skin layers' can be used (i.e., cardboard, fabric, etc) to represent different types of 'skin'. Students can track the rate at which the food coloring diffuses and the direction it diffuses in the water.

Part 5: Electronic Resources

List Electronic Resources for Activity *(List any images, powerpoint slides, worksheets, appendices, or extra reading that should be included with this activity)*

There is a worksheet to go along with this lesson.

Part 6: Kit Supplies (optional)

SciREN operates a "kit program" that provides teachers with kits of low-cost materials that are needed to successfully run certain lesson plans. If your lesson plan requires materials that are not commonly found in classrooms and which can be purchased for less than ~$20/classroom, then your lesson may be a good candidate for a kit!

If you are interested in a kit, what materials not commonly found in a classroom would be required in a kit? Please indicate quantities on either a per classroom, per group, or per student basis (depending on the structure of your lesson) and provide Amazon links for any specialized materials.

Worksheet



Brown bear (*Ursus arctos*)

Habitat: forests, arctic tundra

Size: 176 – 1,321 lbs

Coloration: brown fur

Extra facts: bear cubs are born without fur



Polar bear (*Ursus maritimus*)

Habitat: arctic and polar regions, surrounding the North Pole

Size: 330 – 1,760 lbs

Coloration: black skin, clear fur

Extra facts: the soles of all feet have extra fur; bear cubs are born with a thick coat of fur; polar bears have an insulating fat layer, thicker than other bear species

Questions:

1. What are the main differences between these two bears?

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2. How may these differences help the bears survive in their respective habitats?

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