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NYSSLS 5-E Lesson Planning Template

Grade/Grade Band: 9-12 Science: Living Environment , Environmental Science, and AP Biology.	**Topic:** Climate Change & Survivorship of the Eastern Gray Squirrel Morphs	**Timeline:** Lessons can be completed in upper level Science classes in 80 minute blocks. Classes that meet for shorter times during the week may need more time. **Lesson:** Day 1 of possible week long activity

Lesson Title: The Role Climate Change may play in the Survivorship of the Eastern Gray Squirrel Morphs

Brief Lesson Description:

Students will be introduced to the online game, "Squirrel Spotter", during our unit on climate change. They will create a CER poster based on their prior knowledge of genetics and climate change to provide the reasoning for how climate change may impact the survivorship of one morph of squirrel over the other. Students will use their data from the game as evidence. We will spend a few days learning and investigating the two different morphs of Eastern Gray squirrels and examining historical data before they get into their groups.

Performance Expectation(s):

- **HS-LS4-4:** Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
- **HS-LS2-6:** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
- **HS-LS2-7:** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*
- **HS-LS2-8:** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Specific Learning Outcomes:

- Students will be able to explain how human impact through urbanization will influence "survivorship" of the color morphs of the Eastern Gray Squirrel population.
- Students will create a model (CER) explaining possible questions they investigated as well as present their findings to the class upon completion.
- Students will be able to explain the relationship between climate change and urbanization as an extension to the lesson.

Narrative/Background Information

Prior Student Knowledge:

This lesson should be taught after students have had previous instruction on genetics, evolution and climate change. Students should also know what "CER'' (claim, evidence, reasoning) is and how to use it to develop a scientific explanation. We discuss several different species in our Genetics unit, (Epigenetics), that exhibit different morphs and have the inherited receptor gene, MC1R. Rock Pocket Mouse, Bananaquit, Snow Geese and Arctic Fox. HHMI Biointeractive is one source that we use for the Rock Pocket Mouse.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Engaging in argument from evidence in 9–12 builds from K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from	LS2.C: Ecosystem Dynamics, Functioning, and Resilience Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive	▪ Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2- 7),(HS-LS2-8)

current scientificorhistoricalepisodesin science. ▪ Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-6) ▪ Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-8)	species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7) LS4.C: Adaptation Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3)	

Possible Preconceptions/Misconceptions:

- Some preconceptions students may make is that the two color morphs of the Eastern Gray Squirrels are due to two different species of squirrel as opposed to the same species. Many students have not seen the black color morph in their neighborhoods. It would be interesting to ask them why they may be more populated in cities versus rural environments such as Chittenango?

Teaching Materials:

- Computers, Promethean Board, Markers, Post it Note Posters, Squirrel Mapper website, youtube videos, squirrel kit provided by ESF (squirrel pelts, 3D skull, real squirrel skull, book on squirrels, trail cams).

Safety:

- If students are allowed to, walk the grounds of the school looking for evidence of the two different morphs of gray squirrels. Be aware of surroundings and any possible trail hazards. Also, if students have any type of environmental allergies.

LESSON PLAN – 5-E Model

ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:

Opening Activity:

- To introduce this lesson I will pose a question to my students regarding the melanic and gray color morphs of squirrels. Have you ever seen a black squirrel in your community? If so, what type of environment were they in? This will lead us into playing the “Squirrel Spotter'' game on squirrelmapper.org. I will let the students spend a few minutes looking at the website and familiarize themselves with how to play the game. (~ 20 minutes) The website also provides data from different cities, select the morph and see their distributions.

- **SCRIPT:**
  - **Bellringer:** Has anyone ever seen a black squirrel in their yard or in their community? If you have, what type of environment did you see them in?? Today we are going to play a game called “squirrel spotter” to see if you can spot the squirrels in different environments, urban and rural, and help measure evolution in action!

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:

1. To introduce the lesson I will pose this question to my class; “Will climate change impact the survivorship of one morph over the other, and how will this vary geographically”? Students have worked previously in class on creating Claim-Evidence-Reasoning (CER) posters and they will use their prior knowledge and a class poster template to answer the question. I will also have a squirrel kit provided that includes; 2 study skins(gray and black), 2 pelts, a real squirrel skull, a 3D printed skull, a book on Natural History of Squirrels, and two trail cams (extension activity).

EXPLAIN: Concepts Explained and Vocabulary Defined:

Direct Instruction:

1. Upon completion of the opening activity students will learn about the history of the two different morphs of the Eastern Gray Squirrel. Students will also have an opportunity to zoom with Jess Proctor, creator of squirrel mapper and Dr. Adam Parlin. Jess will explain her research and what she hopes to learn from it. Adam will provide students with background information on the squirrels as well as answer any questions students may have regarding the two morphs. We will also have previously watched videos on species that experience color changes based on environments; Rock Pocket Mouse, Himalayan Rabbit, Arctic Fox. HHMI has a wonderful lesson and video on the Rock Pocket Mouse. Setting aside one class period for this but this is at teacher's discretion. (40 minutes)

2. This lesson will build upon students' prior knowledge of genetics, ecology, and climate change. I will allow students to choose their groups, no more than 3 students for this project. We will review CER; Claim, Evidence, and Reasoning. Students will be investigating a question that they come up with regarding how urbanization will affect the phenotype of the Eastern Gray Squirrel.

Key vocabulary that you will introduce/use: Morphology, urban islands, review of key genetics terminology, gene flow/variability, melanism, epigenetics.

ELABORATE: Applications and Extensions:

- The extension of this lesson would focus on how humans might alter the landscapes of the urban areas due to climate change and the effect that may have on the future survivorship of the different morphs of the Eastern Gray Squirrel. I am hoping that each group of students choose a different human modification. Some examples would be; habitat fragmentation, tree distribution change, urban heat islands, etc. I will assess groups progress daily but hope to spend 3 instructional days on this component (120 minutes). This may provide a "next step" for my upper level/advanced classes.

EVALUATE:

Formative Monitoring (Questioning / Discussion):

- Students will be evaluated based on CER rubric, presentations, and how they answer follow up questions.

Checks for Understanding:

- I will circulate around the room during my student's brainstorming session to see what modifications (human induced) they would like to investigate and make sure that they understand the lesson. This will be ongoing throughout the lesson.

Summative Assessment (Quiz / Project / Report)/Closure/Assessment:

- Students will create a "CER" poster with their groups and present their findings to the class. Upon completion of their poster students will present their CER to the class. I will save time for questions and comments. Time needed would be dependent on the number of groups presenting. The most I have would be 5-6 groups so a whole class period would be needed (40 minutes). Alternatively, students can put their posters up in the hallway and we will do a "museum or gallery" walk-through.

Differentiation/Modifications:

- I teach several different classes; Environmental Science, ESF Global Environment, and AP Biology. I wanted to be able to give this lesson to all three of my classes but modify each one based on the different learning styles. The Environmental Science class has several students with IEP's so class notes and an instructional aid to assist in differentiating instruction is provided.

References:

https://www.biointeractive.org/classroom-resources/making-fittest-natural-selection-and-adaptation: This is the link to the video clip on the Rock Pocket Mouse.

https://squirrelmapper.org/: This link will take you to the website where students can play squirrel spotter as well as learn about citizen science projects and have access to data sets.