Lesson Plan

Description

Through these lessons (approximately 3), students will explore the relationship between predators and prey. They will either use or create a program (using Python) to predict and assess how populations of predators and prey impact each other.

Big Ideas

Ecosystems are dynamic and can respond to change, within limits, while maintaining their ecological balance.

Specific Expectations

B1.1 assess, on the basis of research, the impact of a factor related to human activity that threatens the sustainability of a terrestrial or aquatic ecosystem.

B3.1 compare and contrast biotic and abiotic characteristics of sustainable and unsustainable terrestrial and aquatic ecosystems.

B3.3 describe the limiting factors of ecosystems (e.g., nutrients, space, water, energy, predators), and explain how these factors affect the carrying capacity of an ecosystem (e.g., the effect of an increase in the moose population on the wolf population in the same ecosystem)

Introduction

- Put students into groups of 3 or 4. Provide each group with chart paper and markers. Set a 5-minute timer. Have them produce the most intricate food web they can come up with. Have groups present their food webs to the class and talk about how energy passes through them. Have students identify predators and prey.
- Explain that students will continue thinking about predators and prey using a computer model. Discuss what the term computer model means.
    - A computer model is a simulation that uses math to predict what we might see in nature. A computer model can be used to let us see things that would be too dangerous, take too long, require a microscope or satellite, etc.
    - Check out this computer simulation that shows how evolution might affect rabbits. The material would be beyond a grade 9 classroom however, it can be used to demonstrate why a computer simulation/model might be helpful. In real life, we would need many years to see several generations of rabbits.
    - Check out this simulation that demonstrates how predator and prey populations might be affected if one population is increased. The model is flawed but it is relevant to the class and something that students can reproduce! It could be used to demonstrate how

a computer model can show us what might happen in nature if certain factors (population) are changed.

- Encourage the class to explore the models and see what they do.
  - The evolution model ends in all rabbits dying, rabbits taking over the world, or it continues indefinitely because a balance has been reached. Students should be encouraged to think about how the biotic and abiotic factors impact one another.
  - The predator-prey simulation shows how other organisms are impacted when there is more of another organism. This is done by clicking on each animal to see how the others are impacted. Challenge students by asking them to identify the flaw in the model (populations cannot increase to infinity)

Action

- Discuss how we can model the predator-prey relationship. Ask the following:
  - What factors do we need to consider?
  - How are these factors related?
  - Students should end with
    - # of predators (related to # prey consumed)
    - # prey
    - # prey deaths (natural and consumed)
    - # predator deaths
- Introduce the assignment.
  - The students' goal is to learn more about how predators and their prey interact by using a computer program. By the end of the assignment, students should be able to read a graph and explain what happens when the number of prey increases and when the number of predators increases.
  - There are four options for the assignment. Students should choose the assignment that challenges them but is also achievable before the due date.
    - Tier 1: Students must guess what might happen if the number of predators increases. Then they should guess what would happen if prey increased. Students should justify their guesses. They will then use the program provided to input numbers so that they can graph what happens over time for predators and prey.
    - Tier 2: Students will write out the steps a computer program would have to take to figure out what would happen to an ecosystem if the number of predators increased. Then write out the steps to figure out what would happen if prey increased. Groups will then use the program provided to input numbers so that they can graph what happens over time for predators and prey.
    - Tier 3: Students write their own code. They will write code to figure out what will happen to predators if the number of prey increases and vice versa. The variables they will need to use are time, number of predators,

number of prey, the growth of prey, and growth of predators. Students will then use their program to graph what happens over time to predator and prey populations.
    - Tier 4: Students should be creative! They must use computer coding software to create something that demonstrates how biotic and/ or abiotic factors interact in an environment.
- Have students begin their assignments. Pair or group students if needed.
- Circulate while students are working to support coding, graphing, and other skills.

Consolidation/Extension

- Put students in groups by the tier of assignment they completed. Have them compare their findings and share what they learned.
- Highlight unique thinking such as students who identified the carrying capacity of an ecosystem.
- Encourage students who need a challenge to think about how they would approach the other tiers.

Accommodations/Modifications

Students may be allowed to work collaboratively and/or use assistive technology such as speech-to-text. Four tiers have been provided to allow students choice

Assessment

Assessment *of* learning: assess the assignment based on the provided rubric.
Assessment *for* learning: interacting with models allows students to test hypotheses and determine their level of understanding.
Assessment *as* learning: students are offered a choice of level of difficulty which causes them to assess their ability. Working through the project will allow them to determine if they assessed their ability accurately

Additional Resources

Evolution simulation: https:/phet.colorado.edu/en/simulation/natural-selection
Predator-Prey Model:
https:/www.codesters.com/preview/ef72685cc1054a30aab873f67ca804dc
Codesters: https://www.codesters.com/
https://www.codesters.com/project/
Additional coding platforms: Coding platforms for students to explore:
https://www.commonsense.org/education/top-picks/best-coding-tools-for-middle-school

Predator-Prey Code:
https://www.codesters.com/preview/392e547690164697b89dc7ec0e7ccf33/
Lotka-Volterra Equations:
https://en.wikipedia.org/wiki/Lotka%E2%80%93Volterra_equations

- Students are not expected to understand the lotka-volterra equations, rather they should be able (with guidance) to identify the variables and figure out how they interact. Guiding questions could include:
    - How would the number of predators affect prey?
    - How would the number of prey affect predators?
    - Can prey kill predators? How would the predator population change over time?
    - How would the prey population change over time?
    - Does each factor contribute positively or negatively to population growth?