Morgan Clark

Topic: Changes in Environmental Conditions and Animal Interactions

Lesson Objective: "Students will explain fluctuations in animal populations in terms of invasive species interactions by modeling animal community interactions and demonstrate their mastery by producing a graph that displays population flux over time."

State Standard Addressed:

- *Next Generation Science Standards for Public Schools (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."
- *Next Generation Science Standards for California Public Schools (HS-LS4-5):* "Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species."

Instructional Procedures:

Anticipatory Set: Kahoot! Animal interactions and associated vocabulary

- As class begins ask all students to pull out mobile devices, or pair up with a partner that has an electronic device
- Instruct students to navigate to kahoot.it and type in the designated game pin
- Display the Kahoot! questions using the overhead projector and play the game

Perceived Objective and Rationale

- Today we are going to discuss how different biotic and abiotic conditions and interactions can affect ecosystems
- In our last lesson we learned how we can utilize scientific research to understand factors that impact climate change
- The impacts of climate change can be studied at many different levels, and today we are going to be focusing on a local scale here in a local Mediterranean ecosystem and neighboring watershed!
- Right now we are going to become experts on members of the freshwater community in a Mediterranean ecosystem, and then we are going to demonstrate how these animals interact with endemic and invasive species to result in ecosystem-wide changes

Input

Materials Used in this Lesson

- News articles and scientific profiles detailing characteristics and adaptations, as well as threats to and conservation towards the California newt, local species of frogs, benthic macroinvertebrates, the red swamp crayfish, and nitrate pollution
- Whiteboard and pens
- Large poster board to graph population changes (predator-prey activity)
- Construction paper outfitted with diagrams of different animal species
- Cones or flags (activity markers)

Lesson Activities

Animal expertise Jigsaw Strategy

- Students will sit in table groups of four
- Students in groups of four will become masters of their designated subject
- Subjects include the invasive red swamp crayfish, the California newt, endemic frog species of Southern California, and benthic macroinvertebrates and nitrates
- Students will read the articles on their mastery subject, highlighting the most important information, focusing on material that explains specialized adaptations of their animal of study and threats to that animal's existence
- When students have finished reading the articles, they will break into "expert groups" and share what they have chosen as the most important information in the article regarding adaptations and threats. The expert group will then work together to summarize information regarding habitat, defining characteristics, and ecological threats
- Students will then return to their original heterogeneous groups, each student now a "master" of their individual subject
- Each master will summarize the information in their article to the rest of the group until all members have summarized their individual subjects

Modeling predator-prey interactions using kinesthetic learning

- Students will be provided with a piece of colored construction paper which represent different animals
- Orange paper will represent the California newt, red paper for the red swamp crayfish, green paper for endemic frog species, yellow paper for benthic macroinvertebrates, black paper for nitrates, and blue paper for invasive fish species
- Each student will receive one piece of paper each- this is their assigned animal role for the following activity (the class should be split into half predator animals and half prey species)
- Students will then walk out to the baseball field that has been previously outfitted with the game parameters
- Two cones or flags will represent areas of "shelter" or "resources"- these will be the safety zones
- Prey animals (newts, frogs, and benthic macroinvertebrates) will stand on the far end of the playing field, opposite of the resource safety zones
- Predator animals will stand in the field between the prey species and the resources
- This will be a touch-tag exercise; during each round, predators will attempt to "tap out" prey animals before they can reach their designated safety zones. When a predator species taps a prey species, both predator and prey will leave the game area and stand in the "out zones". Prey animals that made it to the resource zone will be counted and recorded by species in a data table.
- Predator-prey relationships will be determined by species. Fish may only prey on macroinvertebrates, nitrates may only "prey" on macroinvertebrates, crayfish may prey on all prey species
- The predator-prey interaction game will proceed over 5 rounds which will look like the following:

    Round 1: Prey species: all newts, frogs, and macroinvertebrates. Predator species- only fish

    Round 2: Prey species- all newts, frogs, and macroinvertebrates. Predator species- all fish and all nitrates

Round 3: Prey species- all newts, frogs, and macroinvertebrates. Predator species- all fish, nitrates, and crayfish
Round 4: same as round 3

- When all rounds have been completed, students will return to the classroom and assume their original seats
- Display the chart of surviving prey and predator counts per round
- Refer to axes constructed on the whiteboard in order to graph population size of both predator and prey populations over time
- Demonstrate how to convert raw data in a chart to points on a linear graph using x and y axes, labeling each axis
- Discuss the relationship between the predator and prey trend lines, and demonstrate visually how collapse of an ecosystem can be modeled in this format and can be correlated with the introduction of an invasive species (crayfish)

Vocabulary:
Newt, amphibian, macroinvertebrate, predator, prey, population, fluctuation, nitrate, run-off, watershed

Modeling

- Using one example article, demonstrate for the class an example piece of information that should be highlighted to share with mastery groups during the Jigsaw Strategy
- A reminder of specific predator-prey relationships will be displayed visually on each piece of construction paper to ensure every student knows their individual prey pair
- During construction of the linear graph, use the data chart to plot the first example point to model stream populations prior to predator introduction

Guided Practice

- Explain instructions for the Predator-Prey activity using a whiteboard diagram of the playing field

Check for Understanding (Questioning techniques)
During discussion on the fluctuating animal populations in response to ecosystem disturbances ask the following leading questions:

- “What could explain the sudden change in prey populations around _____ time?”
- “How could we make this graph more specific to accurately describe what is occurring in this ecosystem?” “Why is this important?”
- “Why might we care about what ecosystem interactions are occurring around us?”
- “Why did we choose these model organisms? What do they tell us about ecosystem interactions as a whole?”
- “After reading your articles, what are some practical ways we could communicate the importance of these ecosystems and the changes that need to be made to benefit them? What might be different public reactions?”

Independent Practice & Formal and Informal Assessments
The time of informal assessment will be the time in which students are modeling predator prey interactions using the kinesthetic activity. The teacher will monitor the activity and between rounds will ask students guiding questions to informally assess comprehension of the underlying ecological concepts

Closure

- We first discussed the broader impacts of climate change, and then today we modeled how those impacts can be seen on smaller scales very close to us
- What is one example of small scale or local interactions that reflect systems that are affected by climate change?
- The introduction of new and detrimental elements to an ecosystem, whether that is an invasive species like the crayfish, or it is anthropogenic influences like the introduction of nitrates from water runoff, can significantly impact large areas and different trophic cascades
- How can we tell when trophic cascades are affected negatively?
- Changing conditions will always result in a changed ecosystem, whether those changes work toward ecosystem benefit or not. What are some changing conditions? Are these abiotic or biotic? What are examples of negatively impacted ecosystems?

Differentiation:

Lesson differentiation and adaptation will include:

- A variety of teaching techniques cater to a variety of learners: there are listening, kinesthetic, visual, and tactile components to this lesson which will be useful for students that may have difficulty providing written work products with an IEP or a need for improvement with academic English
- Whole-class instruction using the whiteboard provides discrete verbal and visual cues to refocus attention without penalty for the student with an IEP
- The lesson is structured so that students will never have to go more than a few minutes without interacting by talking. This breaks the lesson up and creates a more engaging environment for students who might have trouble participating in other ways
- All necessary directions will be put on the board. This allows students to reference them more than once to gain understanding