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Lionfish as an Example of Invasive Species Ecology

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Computational Modeling in STEM Teaching

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Investigating Invasive Species Ecology Using Computational Modeling

Content Area: Biology (Living Environment), Math (8th grade/Algebra)

Grade Level: 9

Central Focus:

Stable ecosystems depend on the interaction of all the organisms present in the ecosystem and the physical environment to achieve homeostasis. Introducing non-native organisms into a stable ecosystem may result in the destruction and subsequent collapse of the ecosystem. Non-native species are considered invasive when their population expands to the point of adversely affecting the native species, through competition, predation, or change of the physical environment. Efforts to eliminate or control invasive species are often very difficult and expensive. Lionfish are an example of an invasive species with severe consequences to the biodiversity of coral reefs in the Caribbean and Atlantic coast.

Alignment to Standards:

Living Environment Core Curriculum Standard 4 Performance Indicator 6.3a The interrelationships and interdependencies of organisms affect the development of stable ecosystems.

Living Environment Core Curriculum Standard 4 Performance Indicator 7.2b When humans alter ecosystems either by adding or removing specific organisms, serious consequences result.

NGSS Crosscutting Concepts 7. Stability and Change For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Mathematics 8.F.IF.1 Understand that a function is a rule that assigns to each input exactly one output.

The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.

Mathematics 8. F.IF.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.

Mathematics 8.F.IF.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

Mathematics 8.F.IF.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear).
Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

Instructional Objectives:

Students will

Explain the difference between native species, non-native species and invasive species

Use the computational model to explore the relationship between the invasive species lionfish on clownfish population and the health of coral reefs

Use mathematical concepts to demonstrate the population growth of lionfish in an environment without competition.

During this lesson, students will be able to work conceptually, procedurally, so they can reason mathematically and be able to:

- *Describe mathematically* the negative impact relation between native population species-clown fish- and invasive species –lionfish using the Netlogo modeling.
- *Describe* the impact of invasive species on the ecosystem using mathematical representations.
- *Graphically* identify the point of local extinction on the native species (clown fish)
- *Define* the domain and range of the function based on their graph.
- *Graphically identify* the independent and dependent variables based on the Netlogo modeling.
- *Identify* the increasing and decreasing sections of the graph.
- *Explain* the characteristics of functions, as well as the contrast between a function that represent the native population species growth and the invasive species growth.

Learning Targets:

I can

Explain the difference between native species, non-native species and invasive species using lionfish as an example.

Demonstrate the changes that occur in a stable environment when an invasive species is introduced using the computational model.

I can graphically demonstrate the population explosion of lionfish and the population decline of clownfish in our modeled coral reef environment.

Lesson Timeline

10 minutes--Anticipatory set: Teacher will introduce concept of environmental homeostasis using the example of a coral reef. New terms will include native species, non-native species and invasive species. Students brainstorm what they know/observe about picture of lionfish. Students watch video introducing the problem of lionfish on Atlantic coast ecology (http://oceantoday.noaa.gov/lionfishontheloose/).

30 minutes—Students receive worksheet and instructions on accessing the instructional model "Lionfish Ecology". Student will explore program and manipulate variables to model the effects of lionfish on native fish (clownfish) and living coral. Variables include physical environment (water temperature) and control attempts (eradication procedures). They will graphically demonstrate the population changes dependent on the variables and mathematically express the population dynamics that they observe.

10 minutes—Conclusion and completion of worksheet with sharing of findings. Worksheets will be turned in for assessment purposes.