

Teacher Instruction Sheet

INVESTIGATION TITLE: Fiddle Me This

Investigation Designers:

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Inquiry Scale



Confirmation Structured Guided Open

Grade level:

High School Biology

Time Required: Two 45-55 minute periods

Inquiry Scale: Structured

Investigation Focus:

In this investigation students will use multiple models to analyze and draw conclusions about climate change and its effect on fiddler crabs.

State Learning Standards:

MA STE Science Standards 2016

HS-LS2-7 Analyze direct and indirect effects of human activities on biodiversity and ecosystem health, specifically change. Evaluate and refine a solution for reducing the impacts of human activities on biodiversity and ecosystem health.

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.

NGSS Science and Engineering Practices

Practice 2: Developing and using models

Practice 4: Analyzing and interpreting data

Practice 7: Engaging in argument from evidence

Practice 8: Obtaining, evaluating and communicating information

Learning Outcomes:

Students will be able to:

- Use and analyze graphs to make claims and evidence to support those claims.
- Understand how changes in the ecosystems can lead to changes in populations.
- Be able to make claims about population changes in fiddler crabs in response to temperature changes.
- Evaluate how changes in populations can affect other ecosystems.
- Summarize how human activity has impacted the ecosystems to cause these changes.

Materials List:

- Climate Change Activator
- POGIL™ (Process Oriented Guided Learning) Activity
- Student Instruction/Activity Sheet (Attached)
- Laptop cart for any research needed to be done for extension activities

Introduction/Engaging Experience:

- Start by giving out the climate change activator to start the lesson.
 - The activity will be a think, write, pair, share collaborative activator. (See attached).
 - Students will review the graph and answer the questions given to them on the sheet. Once both partners at the tables are done they will pair up and quietly discuss their thoughts and what they wrote down.
- As students are doing the activator the teacher will take attendance then circulate to ensure students are on task, and help facilitate the sharing, and do formative assessments through observation of oral communications.
- The class will go over the activator quickly.

Guiding Question(s):

1. How has the fiddler crab population range been affected by climate change?
2. How might this change in the fiddler crab population range affect the ecosystems in which they live?

Investigations:

- The POGIL™ packet will be handed out.
- Students will work on the packet in their partner groups.
 - The POGIL™ will guide them with the use of models to analyze and make claims.
 - The POGIL™ will also have students at different parts, share with another group to encourage collaborative discussion, debate or argument.
 - The last portion of the POGIL™ will have students do research to investigate more questions and make further claims.
- Lastly, when class is almost over students will be directed to finish the rest of the POGIL™ activity for homework if not already done, and to share out with the class any interesting things they learned today.

Present Findings and Draw Conclusions:

The climate change activator asks students to draw conclusions using models. A Venn diagram is provided for comparison the male and female fiddler crab. The Fiddle Me This POGIL™ activity encourages students to communicate with other groups on multiple occasions. Students share evidence and predictions. Students are also asked to research alternative explanations to predict future changes in salt marsh ecosystems.

Vocabulary: students

Population - a group of organisms of the same species

Immigration - when organisms move into a new habitat

Food web - a model showing the flow of energy through an ecosystem

Distribution - the members of a population spread over a habitat

Biotic - the living parts of an ecosystem (example: plants)

Abiotic - the nonliving parts of an ecosystem (example: oxygen)

Detritivore - an organism that receives energy from decomposing animals and plants

Detritus - decomposing plant and animal matter, including feces

Sediment - matter that settles out of a liquid

Assessment:

1. Think, Write, Pair, Share (formative).
2. Making predictions about the graph projection (formative)
3. POGIL worksheet questions (formative)
4. [Collaboration](#), [oral communication](#), and [problem solving](#) skills rubrics (formative)
Note: These rubrics are school-wide rubrics used at Weymouth High School.
5. Summary paragraph from students to communicate learning (summative - use [written communication](#) rubric)
6. Summative assessment on unit test for Ecology (future)

Resources:

http://www.carolina.com/images/product/large/142450_a_la.jpg
<http://us.123rf.com/450wm/barbulat/barbulat1212/barbulat121200048/16672937-crabs.jpg?ver=6>
http://www.fiddlercrab.info/u_pugnax.html
http://static.nsta.org/files/ss1207_26.pdf
www.exploringnature.org
<http://Pie-Iter.ecosystems.mbl.edu>
<http://knowledgebase.lookseek.com/Fiddler-Crab-Uca-pugnax.html>
http://www.carolina.com/images/product/large/142450_a_la.jpg

Johnson, D.S. (2014). Fiddler on the Roof: A northern range extension for the marsh fiddler crab *Uca pugnax*. *Journal of Crustacean Biology*: 34(5), 671-673.

D. Johnson, personal communication, July 12, 2016

Wrap Up:

Throughout the lesson, students will share out as a class. The final portion of the POGIL™ asks students to relate their conclusions to the guiding questions. The summative paragraph also serves as a wrap-up and will be assessed using the written communication rubric.

Adaptation to Different Levels of Inquiry:

- **Confirmation, Structured, Guided, Open**

This investigation could be modified or adapted to make it more guided or open. Instead of structuring the investigation as the teacher giving students questions for every model, teachers could instead give students one model at a time. The teacher would still provide the models in the same order. The investigation would then be more guided as students would be required to ask their own questions about each model, to make claims about each, and to make connections as each new model is provided. To make the investigation open, the models could be provided all at once, requiring students to ask questions and make connections without any guidance as to what order they should be analyzing the models.

Connection:

In the summer institute we have learned about climate change and evidence to support it. We have also gone over how ocean temperatures and overall climate change are changing and how that might affect many different organisms at many different trophic levels. The institute also helped us all learn about Salt marsh ecology and ecosystems which relate to the activity with fiddler crabs as an invasive species as the populations range pushes more and more north with the higher average temperatures of ocean water. This activity also prompts classroom discussion about the resiliency of ecosystems as they face different challenges from changing global temperatures of the air and oceans.

Student Activity/Instruction Sheet

Student Name: _____ **Period:** _____ **Date:** _____

Title of Investigation: Fiddle Me This

Background Information:

http://www.carolina.com/images/product/large/142450_a_la.jpg



Please read the paragraph at the top of the POGIL™ before beginning the activity. This activity encourages you to look closely at the models to arrive at your answers. Keep in mind that you will not know all of the responses and will have to problem solve based on your prior knowledge and critical thinking skills to come up with an answer.

Guiding Questions:

- How has the fiddler crab population range been affected by climate change?
- How might this change in the fiddler crab population affect the ecosystems which it emigrates from and immigrates to?

Procedure/Methodology:

- Analyze each graph given in the POGIL™ activity and answer the questions fully in the space provided as a collaborative group.

Data:

- The models in the POGIL™ activity contain data that you should use as evidence in your responses.

Analyzing and Interpreting Data:

- Use the models to find connections among the data in order to make claims.

Constructing Explanations:

- Communicate with other groups at the stopping points indicated by this symbol.
- I will be walking around making observations of how well you collaborate and communicate.
- At the end of the activity, you will have to write an explanation of your findings to show what you have learned.



Argumentation from Evidence:

- In both your spoken and written responses, you will have to defend your answers with evidence. Remember that it's okay to disagree, but you need to be able to support your responses with data.

Communication to other Students:

- Again, you will be evaluated on your ability to communicate and collaborate with both your partner and other groups.



Fiddle Me This

Authors: M. Faulkner, J. Flaherty, M. Northup, C. Pekarcik

Image courtesy of: http://www.carolina.com/images/product/large/142450_a_la.jpg

Activity Overview:

In the following activity, you will analyze various types of models to analyze and draw conclusions about fiddler crabs and their role in ecosystems. The goal of this activity is to address the following guiding questions: How has the fiddler crab population range been affected by climate change? How might this change in the fiddler crab population range affect the ecosystems in which they live?

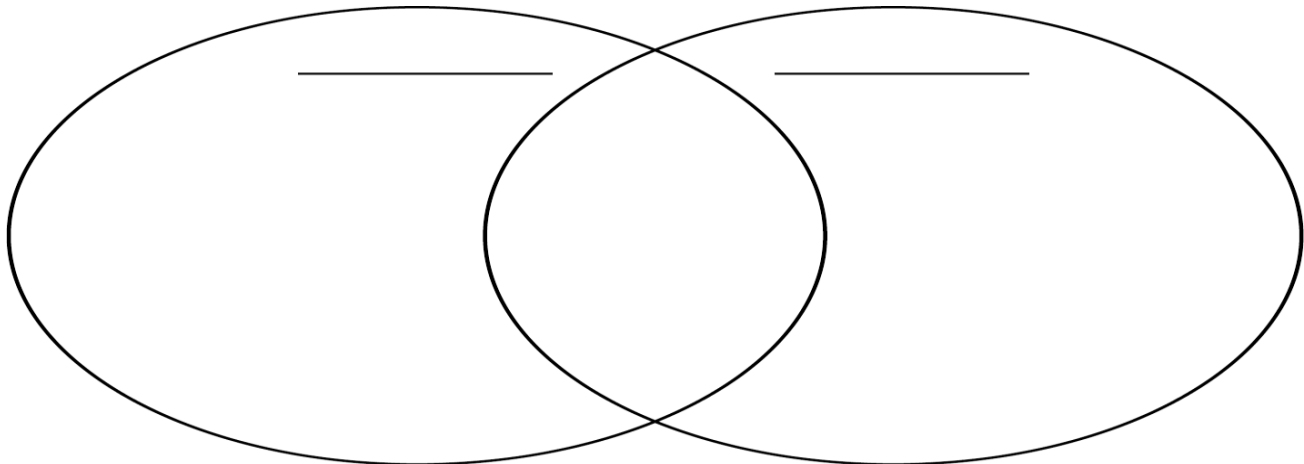
Model One: Below are images of the male (left) and female (right) marsh fiddler crabs (*Uca pugnax*).



Image courtesy of <http://us.123rf.com/450wm/barbulat/barbulat1212/barbulat121200048/16672937-crabs.jpg?ver=6>.

Questions for Model One:

1. Complete the following Venn diagram based on your observations of Model One.



2. There are obvious differences between male and female fiddler crabs. Give reasons that may explain why these differences have evolved. Cite a specific difference.



3. Compare your responses to questions 1 and 2 with the student pair across the table. How do your answers differ?

4. What do you think is the habitat of the fiddler crab? Explain why.

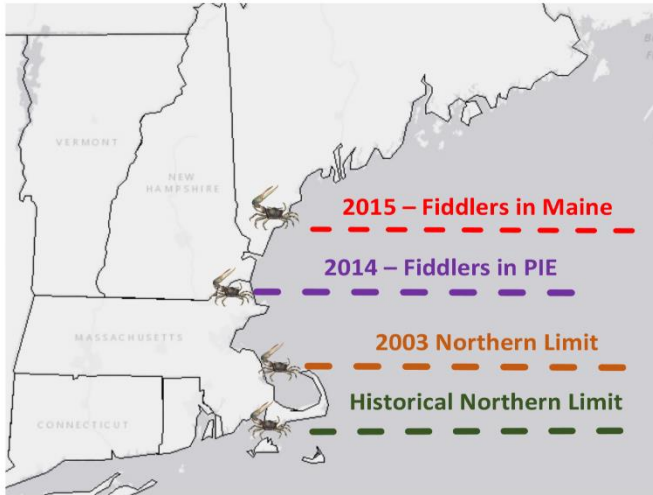
5. Predict what role they play in the ecosystem? Explain your reasoning.

Read This!

Fiddler crabs are small crustaceans (shell width of approximately 1-1.5 inches) which can be found on beaches, mudflats, and salt marshes. The two major differences between the males and females are that males have an enlarged claw and are approximately 30% larger in size. Fiddler crabs lay their eggs in the salt marsh at high tide which hatch almost immediately. Their larvae are carried out to the open ocean to develop. Juvenile crabs return to the salt marsh with the tide to continue to grow. Fiddler crabs can create narrow burrows up to 2 feet in length to provide a location for mating, sleeping, and protection.

Model Two:

Map 1 shows historic and current range limits of the Fiddler crab off the coast of New England in the Gulf of Maine. Map 2, from 2010, shows the range of the Fiddler crab along the Atlantic coast.



Map 1

Image courtesy of: David Samuel Johnson, Bethany Williams, Cynthia Crowley Virginia Institute of Marine Science



Map 2 Image courtesy of:

http://www.fiddlercrab.info/u_pugnax.html

Questions for Model Two:

1. Summarize the data shown in Map 1.
2. Make a claim based on the data from Map 1.
3. Use evidence to support your claim.
4. Use scientific reasoning to explain why this may have occurred.
5. What other evidence would you need to support your claim?



Find another group that is done with this section and share your responses and discuss it.

Model Three:

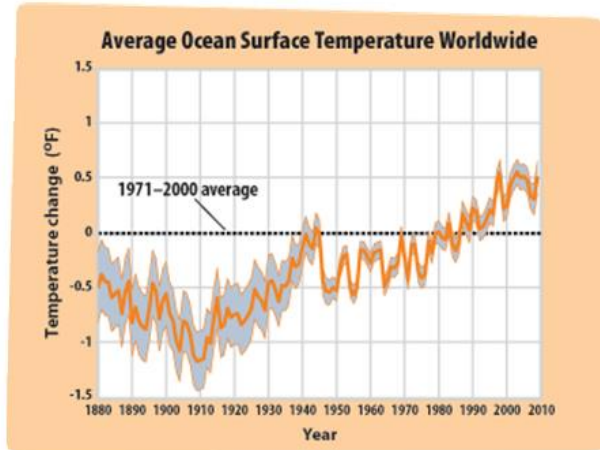


Image courtesy of http://static.nsta.org/files/ss1207_26.pdf
NEFSC/NOAA

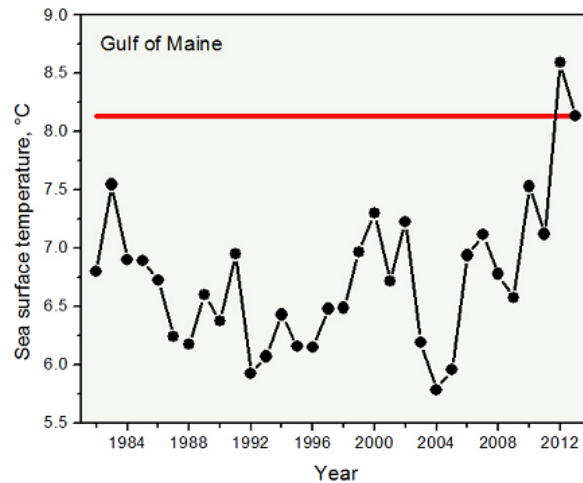


Image courtesy of

Questions for Model Three:

1. Analyze the models by making a few statements about what they are showing.
2. How can you connect this information to the previous model (Model 2)?



Find a different group that is done with this section to share your responses and discuss them.

Read this

While working in Woods Hole in 2014, Dr. David Johnson surveyed salt marshes of the Gulf of Maine and confirmed the presence of the first fiddler crabs north of Cape Cod. Fiddler crabs are most successful in warmer waters. One reason is that the length of larval development is shortened with warmer temperatures. They typically release their eggs during the warmest months for optimal development; larvae will not complete development below 18°C (64°F).

3. Does this information above support the connections your made in question 2?
Explain your answer.

Model Four:

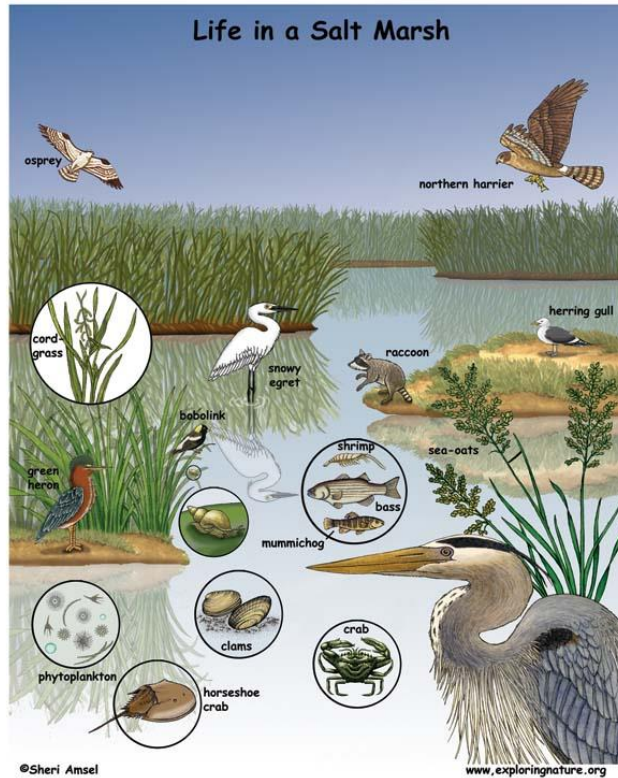
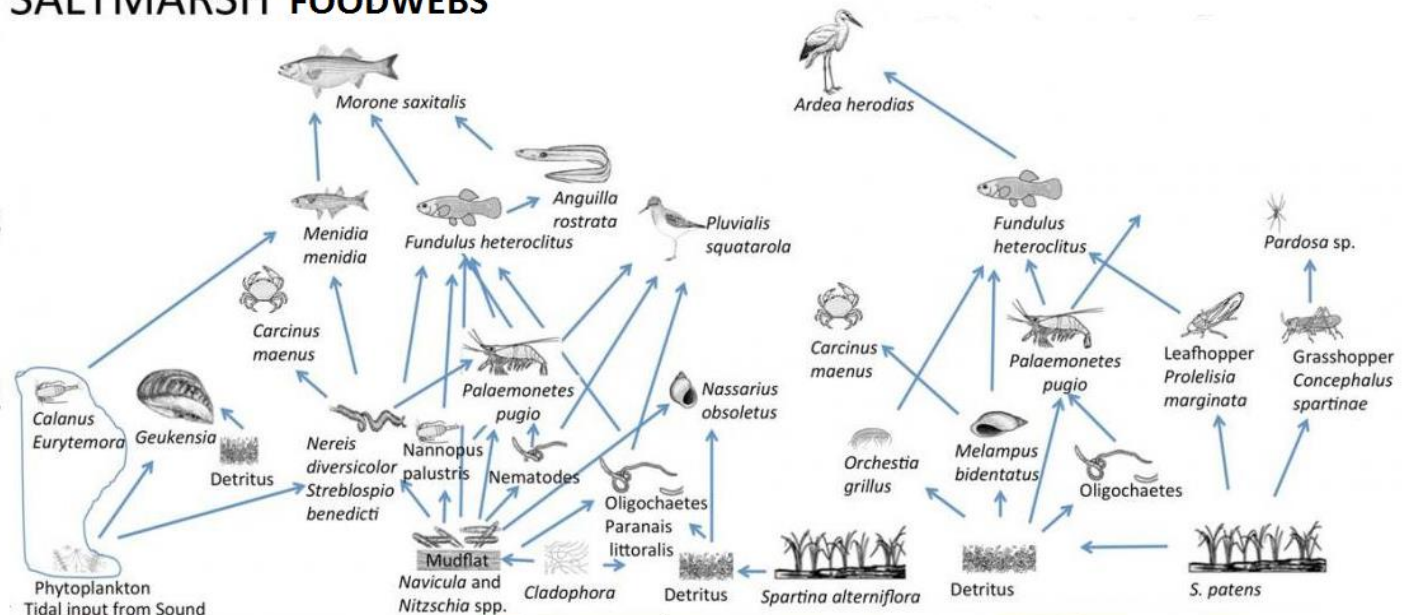


Image courtesy of
www.exploringnature.org
Image modified from pie-liter.ecosystems.mbl.edu

SALTMARSH FOODWEBS



Model Four Questions:

1. Where do you think the fiddler crab would fit in this ecosystem's food web? Why?
2. How might the change in fiddler crab distribution alter the current salt marsh food web?

Read This!

Fiddler crabs are detritivores which means they eat anything from decomposing detritus to algae, microbes and fungus by sifting through sand and sediment. They are more active at low tide. They can help with marsh hay growth due to their burrows helping with root growth and aeration.

4. Based on the information above, how might you revise your answers to questions 1 and 2?
5. Is the food web the only component of the ecosystem to consider? What other factors may be affected when the fiddler crab is introduced?

Summary Paragraph - DO THIS ON A SEPARATE SHEET OF PAPER TO BE HANDED IN

With all the information you learned from the models, reflect and write a summary paragraph about what you have learned during this activity. Refer back to the guiding questions at the beginning of this POGIL™

EXTENSION QUESTIONS



Directions: Get a laptop and do research to answer the questions below.



1. Research additional characteristics of an ecosystem that may be affected by the introduction of non-native species.
2. Develop an argument to support whether fiddler crabs could have a positive or negative impact on the salt marsh ecosystem. Make sure you have evidence to support your argument.