Teacher Resources---Mission: Caddisfly Range

Research Question: How is climate change affecting the range of caddisfly populations?

Total class time to complete the Mission:

For the full unit: 10 to 15 class periods

For collecting and posting data only: 3 to 4 class periods

Standards Alignment- Next Generation Science Standards (NGSS):

Performance Expectations:

- Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Cross Cutting Concepts:

- CCC4: Systems and System Models
- CCC7: Stability and Change

Science and Engineering Practices:

- SEP 3: Designing and Carrying Out Investigations
- SEP 4: Analyzing and interpreting data
- SEP 7: Engaging in Argument from Evidence
- SEP8 Obtaining and communicating information

Disciplinary core ideas:

- LS2A: Interdependent Relationships in Ecosystems
- LS2B: Cycles of Matter and Energy in Ecosystems

Materials

For each group of 2 to 4 students:

Vital Signs Freshwater Species and Habitat Survey
Vital Signs Caddisfly larva ID card
Vital Signs Caddisfly family ID resources
Clipboard
Camera/ipad
Waders/boots
Small net (optional)
Meter stick
Small dishes, egg cartons, or ice cube trays to place caddisflies for identification

For the class:

GPS
Chart paper
Optional: Water quality monitoring supplies (optional) thermometers, pH strips, dissolved oxygen tablets, refractometer, vials
Optional: microscopes
Optional: vials and isopropyl alcohol for sending caddisfly samples

Before you begin

1. Locate a still body of water near the school. Caddisfly data must be collected from still or standing water, such as ponds, lakes, marshes, and vernal pools. If you are interested in investigating a stream or river, check out Mission: Macroinvertebrate Function, Mission Freshwater Bioassessment, or Mission: Crayfish instead.

2. Read Mission: Caddisfly Range, look over these teacher resources pages, and plan the scope of your investigation. Lessons indicated with an * are designed to support students in building background knowledge, developing skills in data collection and analysis, and communicating their results. They are supplemental and not essential to the caddisfly mission.

Find Mission: Caddisfly Range here: http://vitalsignsme.org/mission-caddisfly-range

3. Set up a Vital Signs investigation for your class. Create fieldwork teams of two to four students. Use this guide to help you: http://vitalsignsme.org/how-teachers-set-investigations-their-students

4. Look over assessment options. The student notebook provides multiple assessment opportunities, including a task-neutral rubric at the end. Look through the resources provided and pull out the pieces that are useful to you. You can download the student notebook on the Mission: Caddisfly Range teacher resources page.

5. If you are interested in trying to arrange a visit to Dr. Greig's lab, let Vital Signs know! Dr. Greig and his students love working with young scientists.

Consider combining this mission with Mission: Bioassessment Function or Mission: Crayfish for a deep dive into cutting edge research in freshwater ecology!

Lesson 1: Intro Activity for Freshwater Bioassessment Mission (one class period)*

Develop concepts behind the role of macroinvertebrates in water quality assessments and build skills in distinguishing caddisflies from other macroinvertebrates.

Find a powerpoint presentation, station materials, and student handouts here: http://vitalsignsme.org/intro-activity-water-quality-bioassessment-mission

Lesson 2: Conduct background research (one class period)

Introduce students to the Vital Signs and Mission: Caddisfly Range. Let them explore the mission page.

Assign students to field work teams of two to four. They will use their fieldwork teams as "home groups" for their background research. Each member of the home group is responsible for researching 1 to 2 perspectives.

Give students time to research their perspectives. Allow students from different home groups researching the same perspectives to get together to share resources.

Once students have completed their research, have them share their learning with the rest of their fieldwork team (or "home group").

Research perspectives:

- Perspective 1: What's the big deal? Why do we care about caddisflies?
- Perspective 2: What do I need to know to be able to collect data?
- Perspective 3: Ecosystem connections- What are the roles of caddisflies in ecosystems? What do they eat? What ways do they contribute to healthy ecosystems?
- Perspective 4: What data already exists?

Resources can be found on the student notebook pages for Lesson 2.

Extensions:

Explore range shifts in different species:

Check out the data visualizations below that show changes of distributions of other of species in response to climate change. Use these resources to practice interpreting information from maps and graphs.

Once students are able to understand the data, use these as the basis for discussion on the possible implications of the large-scale movement in species: How will people be impacted? How might these changes cause other types of shifts?

- This animated map of changes in Lobster distribution over 50 years (you will need to scroll down to see the map): https://www.climate.gov/news-features/climate-and/climate-lobsters
- A variety of maps and graphs showing changes in different marine species: https://www.epa.gov/climate-indicators/climate-change-indicators-marine-species-distribution
- Line graphs showing changes in bird wintering over 50 years: https://www.epa.gov/climate-indicators/climate-change-indicators-bird-wintering-ranges

Lesson 3: Fieldwork skills stations (one to two class periods)*

Prepare students for fieldwork by looking at models of high quality observations and familiarizing students with Vital Signs resources. See the full lesson plan linked below for station instructions.

Read over the full lesson plan and follow the instructions for set up here: Fieldwork Skills Stations: http://vitalsignsme.org/developing-skills-preparation-fieldwork

Modifications of the lesson plan for the Caddisfly Unit:

- When previewing example observations, focus on caddisflies. Here are two great examples:
  http://vitalsignsme.org/species-trichoptera-order-was-found-rhodonite363-2017-10-18
  http://vitalsignsme.org/species-trichoptera-order-was-found-gmscod-2017-10-02
- For "Spot the Difference" pull photos from the identification resources of the two different caddisfly families for students to compare.
- Skip "How many are there?"
- In "Preparing for scientific Observation" have students choose one family from the caddisfly family identification resources to fill out the observation tool: http://vitalsignsme.org/sites/default/files/content/vs_caddsifly_family_id_guide_122117.pdf

Some tips for great observations:

- ✓ Take photos on a white background.
- ✓ Zoom in *very* close for caddisfly family identification, so you can get lots of detail.
- ✓ If you have microscopes, use them to focus on the caddisfly first, then hold a camera lens up to the eye of the microscope for a great close-up!
- ✓ Include a size reference or hold a ruler up to the caddisfly in the photo.
- ✓ In written observations, be sure to explain what the identifying characteristics are for caddisfly families in addition to the features observed.

Lesson 4: Collect data (one class period)

Bring students out to the field collect data. Follow the protocol described in the mission.

Some extra tips for data collection:

- Give each group a dish or tray filled with 1 to 2 inches of water (ice cube trays work great). Place any found caddisflies inside to make it easier for students to observe and photograph the specimens.
- You can use a variety of protocols for this mission. The simplest is to have students do a timed search, as described on the mission page. If you want to try something different, here are some alternative protocols:
  - Leaf bag traps: These will need to sit in the water for a minimum of three weeks. See the "Leaf Bag 'How-to' document in Mission: Macroinvertebrate Function for full instructions: http://vitalsignsme.org/mission-macroinvertebrate-function .
  - Dip nets: See a demonstration of how to use the net here (begin at 1:18): https://youtu.be/43BwiImx71k?t=1m18s
  - Kicknet: Here is a kicknet protocol: http://vitalsignsme.org/sites/default/files/content/method_kicknet_092509.pdf
    Video demonstration: http://ecosystems.psu.edu/youth/4-h-stream-teams/how-to-guides/video-kick-net-study
    Here are instructions for how to build a kicknet: http://www.saveourstreams.net/sites/default/files/attachments/How%20To%20nets.pdf

- For advice from Vital Signs teachers on managing students outside, see: http://vitalsignsme.org/forum/strategies-field

Identifying and counting caddisflies can be done either in the field or in the classroom. Many find it easiest to control factors like lighting, weather, student movement etc. in the classroom.

Use the following resources for help with identification.
Vital Signs Caddisfly larva ID card:
http://vitalsignsme.org/sites/default/files/content/fn_trichoptera_042910.pdf

Caddisfly family ID cards:
http://vitalsignsme.org/sites/default/files/content/vs_caddsifly_family_id_guide_122117.pdf.

Use the Vital Signs Freshwater Species and Habitat Survey to record data:
http://vitalsignsme.org/sites/default/files/content/level2_freshwater.pdf

Make sure that each fieldwork team records one "FOUND" or "NOT FOUND" observation **for each caddisfly family** and records counts of each family found (a total of 2 observations per fieldwork group). If students find caddisflies that do not fit the characteristics of the two in the ID guide, they should record their observations as just "caddisfly larva."

Dr. Greig wants your caddisflies! Once you have collected your data, send any found caddisflies to the lab for further analysis.

1. Place caddisflies in small vials of isopropyl alcohol. The alcohol can be purchased at a pharmacy. Reach out to Dr. Greig if you are in need of vials.
2. Ship the vials to:

Dr. Hamish Greig
Assistant Professor of Stream Ecology
School of Biology & Ecology
212 Deering Hall, University of Maine
Orono, ME 04469

Lesson 5: Post Data (one class period)

Have students post their observations to Vital Signs. Here are resources to support students in doing that: http://vitalsignsme.org/how-students-put-their-data-website

Each team of students should post one observation for caddisfly, Phryganeidae, one for caddisfly, Limnephilidae, and if other, unidentified caddisflies were found, they should post an additional observation as "caddisfly larva."

Lesson 6: Analyze Data (one to two class periods)*

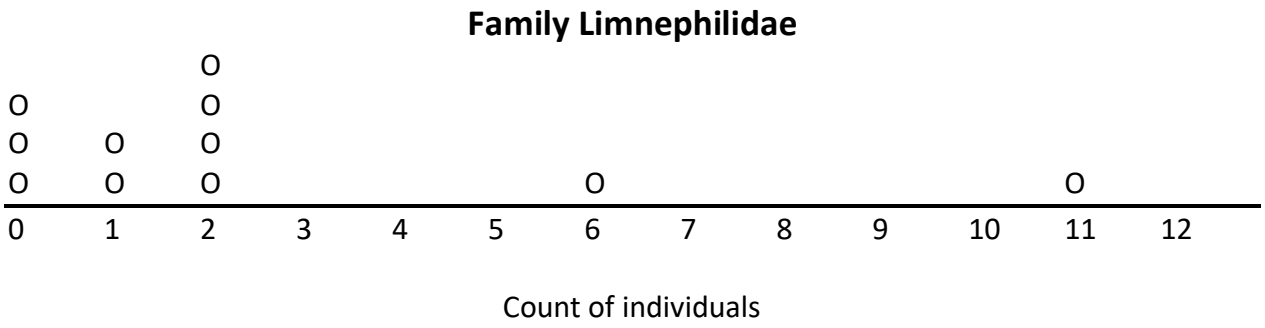
If the class did *NOT* find caddisflies: have students look back to their background research to form a hypothesis as to why caddisflies were not found. What does the "not found" data say about the caddisflies and their range? What does it say about the water body being investigated? Have students explore other observations in which caddisflies were found and not found. Can they find any common factors?

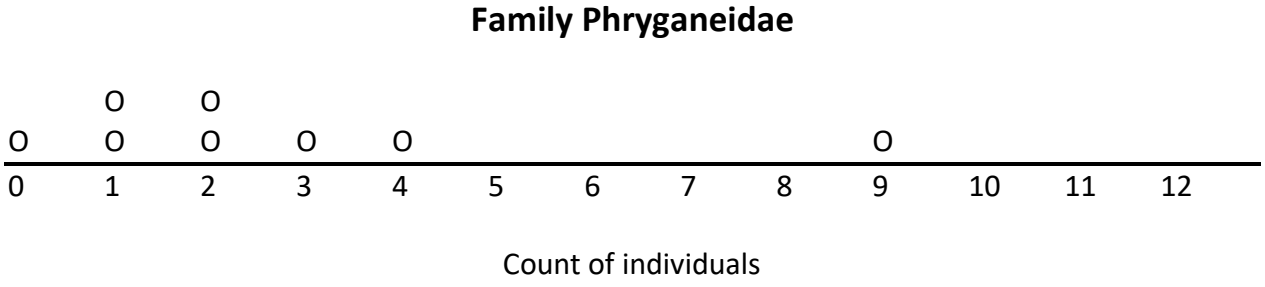
See this how-to guide to support students in searching the Vital Signs database: http://vitalsignsme.org/map-guide-species

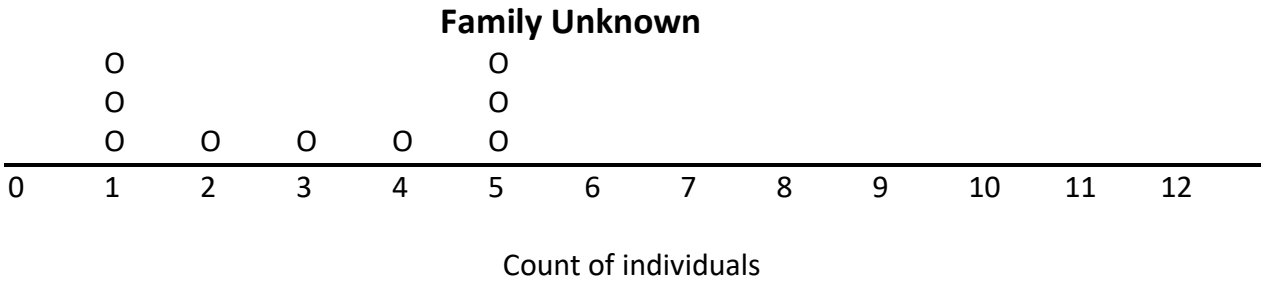
If the class *did* find caddisflies: create class graphs of the counts of individuals from both families (incluing a graph for unidentified caddisflies) and then compare them to determine which family is most abundant in your area.

If you are unfamiliar with dot plots, watch this short video from Khan Academy: https://www.khanacademy.org/math/cc-sixth-grade-math/cc-6th-data-statistics/dot-plot/v/frequency-tables-and-dot-plots

Example Graphs:







Notes on modeling data analysis:

1. Set up a dot plot for each family of caddisfly on chart paper. Set counts of individuals on the x axis.

2. Have each fieldwork team place a dot over the place on the X axis showing the count of individuals that they found. Make sure that students place their data on the graph representing the appropriate family.

*Note: if you have multiple classes, have them each add to the *same* graphs. This will allow for much better data analysis.

Once all the data is placed, you should have 3 distributions of data that students can analyze. Each graph should have the same number of data points as the number of fieldwork teams.

3. Look at the data for just one graph at a time:

    a. Look at the spread of the data: What was the highest count? The lowest? Are the data points spread out or close together?

    b. Talk about *why* these points might be different. Why might some teams have found different numbers? Were there differences in locations the different teams were searching? Were there any differences in the ways the teams collected their data?

    c. Look at common points and at outliers: Are there any particular clusters of data? Are there any points that stand out? That seem questionable?

    d. Optional: Find the mean, median, and mode. Mark them on the graph.

    e. Work together to pull together some tentative ideas based on this information. For example, "*Most teams found around __ individuals in this family"* or "*The counts of this family varied a lot in different locations.*

4. Have students work together to repeat the same process for the remaining graphs. Assign each group one particular graph to focus on, and then report out their findings to the class.

5. Once all groups have shared, go back to the question: *Which caddisfly families are most abundant in our area?* Collect ideas from students. Make sure that students draw ideas from the data in graphs instead of from general ideas or inferences.

Extension:

<u>Compare data to look at change over time:</u>

Pull out data from years past. Assign student groups to compare the data from each year for one family. For example, one group would be responsible for comparing counts of Phryganeidae in 2017, 2018, and 2019.

Challenge students to explore: is there a change in abundance over time? It is a significant change? Is it consistent? Is there enough information to draw a conclusion?

Have students report out to the class.

Compare data across regions:
Reach out to Vital Signs to see if there is data from other schools completing this mission. Assign student groups to compare the data from different locations for one family. For example, one group would be responsible for comparing counts of Phryganeidae in Dedham, Gorham, and Bridgeton (reach out to Vital Signs, and we will let you know of other schools contributing to Mission: Caddisfly Range).

Have students use the data to construct a dot plot for their family in each region.

Challenge students to explore: Is there a significant difference across regions in counts of individuals in this family? What might account for these differences? Is there enough information to draw a conclusion?

Lesson 8: Draw conclusions (one class period)*
Have students write scientific arguments based on their results. For resources, see: http://vitalsignsme.org/formal-science-writing-and-revision-tools-discussion-and-conclusions

A graphic organizer is also provided in the student notebook.

Lesson 9: Share Findings*
Check out the resources around *Findings from the Field: A Middle School Journal of Scientific Research* to see if creating and submitting articles of authentic research would be right for your class http://vitalsignsme.org/findings-field-middle-school-journal-science-research

Look through the Vital Signs Project Bank for additional ideas for communicating results: http://vitalsignsme.org/best-projects. Students will need to use their Vital Signs account to post their project to the project bank.

Consider additional options for sharing student work with the community:

- Have students present their work to other classes in the school. Invites families and community members to come, too.
- Host a community night where students make presentations to community members.
    - Issue a press release to announce the event: http://vitalsignsme.org/how-write-press-release
- Have students put their writing into a flyer or brochure and distribute to the community.
- Post the work on the school website.
- Gather additional ideas from the class

Whatever you choose, please let Vital Signs know about it!