Explore the Vital Signs Crab Dataset (two class periods)

Explore Vital Signs crab data from 2003 to 2017 to investigate changing populations of native and invasive crabs over time and space. Use part I to get accustomed to the online tools, part 2 to practice using the data to answer questions, and part 3 to engage with a real research question with complex, unclear answers.

Learning objectives: Students will be able to…

- Use online tools to make sense of large, messy datasets
- Use data to address a research question

Standards alignment:

NGSS	CCSS-Math	MLR
MS-LS 2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.	CCSS.MATH.CONTENT.6.SP.B.4: Display numerical data in plots on a number line, including dot plots, histograms, and box plots. CCSS.MATH.CONTENT.6.SP.A.2: Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.	B1 – The Skills and Traits of Scientific Inquiry: Students plan, conduct, analyze data from, and communicate results of investigations, including simple experiments.

Teacher preparation:

Print the **Data Tools** and **Question Challenge Cards** (included at the end of this document). Make enough sets so that there is one per 2 students.

Print the student handouts.

Preview the dataset and CODAP. Get oriented with the CODAP help page: https://codap.concord.org/help/

Access the dataset here: http://bit.ly/VScrabdata

Lesson steps: Part I: Gat acquainted with the tools

1. Explain to students that other classes from across the state have been collecting data on native and invasive crabs since 2002 and posting that data to Vital Signs. If they are not familiar with the mission, you can have them look at Mission: Native vs. Invasive Crabs: http://vitalsignsme.org/mission-native-vs-invasive-crabs

2. Click on the link to the dataset. Explain that each data point represents an observation, where the crabs either were or were not found. If there are no data points, that means there are no observations *not that there are no crabs.*

3. Briefly go over the data in the table.

a. Show student quickly how to make a graph (by clicking on the icons in the top left corner and dragging attributes into the x and y axes).

b. Click on the data in the table and point out how that same data point on the map and graph become highlighted.

c. Challenge students to think about what they might be able to learn from looking at all that data together. Prompt them to think about how they might be able to compare findings from different locations or see how crab populations have change over time.

4. Let students know that their first challenge is to learn how to use the tools to work with the data.

5. Have students get into pairs.

6. Pass out the **Data Tools challenge cards.** Have pairs of students work together to cut out the rows and fold each row along the center line to create a card with a challenge on one side and a hint on another (instructions are at the top of the challenge cards set).

7. Explain that once students master the challenges, they will have all the tools they need to analyze the data.

8. Pass out the student handout and a sheet of scrap paper for each group. Have students divide the paper into 3 sections "Haven't tried it" "We did it" and "We're stuck."

9. Instruct students to place all the cards in the "Haven't tried it" pile.

10. Have each pair of students take out one computer or ipad. Give students 10 to 15 minutes to try out the tools in CODAP, using the instructions on the student handout and the challenge cards to guide them.

11. At the end of 10 minutes, have all students pause and combine into groups of four.

12. Give the groups 3 minutes to share tricks that they learned and challenges they are having.

13. Have students divide back into their pairs and give them 10 to 15 minutes to work with the tools.

Part II: Get acquainted with the data

1. Keeping the Data Tools challenge cards out for reference, explain to students that they are going to shift focus to what they can find out from the data.

2. Explain that they are going to use the data to answer a series of questions, using "Question" challenge cards. In order to move the card to "We did it" they will need to create a graph or

map that addresses the question. Let students know they will be sharing their graphs with the class.

3. Pass out the **Question Challenge Cards** and have students cut and fold them.

4. Give students time to work through the question cards in the same way they did with the "Data tools" cards. Make sure they label each graph or map they make s they know which question it addresses.

5. As in part 1, combine student pairs into larger groups to share challenges and successes part-way through their work.

6. When students have gone through the cards, make sure they follow the instructions in the handout to choose one question and graph to share.

7. Instruct students to leave their annotated graphs or maps on their computer so others can see them.

8. Hand out one sticky note to each student. Have them write at the top of the note "I learned from your map/graph that …"

9. Give students two minutes to walk around the room to look at the different graphs and maps. Have them choose one map or graph, use to complete the sentence on the sticky note, and then leave the completed sticky note on the screen.

Part III: The big challenge

1. Explain or remind students that the purpose for the Vital Signs mission is to try and figure out how crab populations compare across different locations in Maine. Researchers and students alike have been working together to try and get a sense what is happening to native and invasive crabs in Maine, investigating the question:

How do the populations of green crabs, Asian share crabs, and native crabs compare up and down the coast of New England?

2. Show the same Vital Signs crab dataset. Ask students how they could use the data they have to try and answer these questions. Give students a minute to talk through some ideas with a partner.

3. Invite students to share ideas. A few points to draw out about the data:

- Some observations have "Counts of individuals" which tell you how many crabs were found. This is a good measure of the number of crabs in a place, but not all observations have this data.
- All observations contain information about whether the crab that was looked for was "FOUND" or "NOT FOUND" If all the observations in a particular place are

"FOUND" we might assume there are a lot of crabs. If all the observations are "NOT FOUND" we might think there aren't very many. So, by comparing the amount of "FOUND" vs. NOT FOUND" we can get a vague idea if there are a lot or a few crabs present (or none at all).

4. Assign students to groups of 3. Within each group, 1 or 2 students should investigate each type of crab (Asian shore, green, or native).

NOTE: in order for students to make maps that show only 1 species, they will need to "hide" the rest of the data. See if a student volunteer knows how to do this and can show the rest of the class.

Modifications: There are maps already created in the CODAP document that are minimized in the bottom right corner of the screen. If students are not able to create their own maps to answer the questions, they can use the ready-made ones.

5. Give students time to investigate their question, focusing on their type of crab only, following the prompts on the student handout.

6. After 10 to 15 minutes, have groups share their findings on each type of crab with each other. They should combine the information they gathered on each type of crab to form a tentative claim in response to the question.

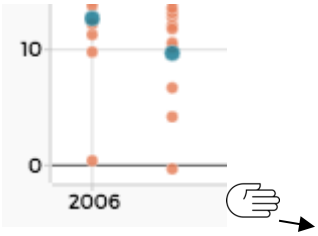
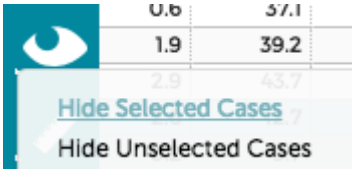
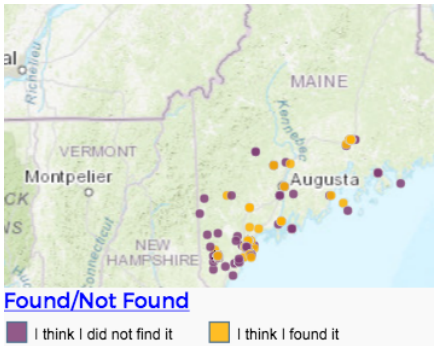
7. Have the different groups share out their tentative claims. Here are a few points to draw out about the data:
Overall, there are more observations on southern Maine than down east. This does NOT mean there are more crabs in these areas, just more students collecting data.

- Asian shore crabs are predominantly found along the southwest part of the coast, whereas they are mostly "NOT FOUND" down east.
- Green crabs are found all over the map.
- Native crabs FOUND and NOT FOUND observations are spread pretty evenly up and down the coast.
- Challenge students to explain why there might be more observations around the Portland area (more people to go out and collect data).
- Challenge them also to think about what factors might cause most of the Asian shore crabs to be found in the south but not as much in other areas (it may be too cold for them to survive in those regions).

8. This existing data does not offer clear information about the number of crabs in a given location. Invite students to share what they *can't* learn from this data or ideas for what kind of data they wish they had.

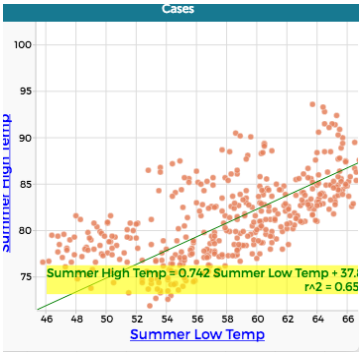
Challenge Cards-- Data Tools

Print out the cards. Cut out each row and fold along the center line so that the challenge is on one side and the hint is on the other

Data Tool- Change the scale of the axes Change your x or y axis to zoom way in on the data in your graph.	**Data Tool- Change the scale of the axes** **Hint:** Hover the cursor over the axis until the hand is pointing in the direction you want to drag the numbers. Click and drag. 
Data Tool- Hide Data Hide some of the data on your graph or map.	**Data Tool- Hide Data** **Hint:** ● Highlight a few data points either on the table, map or graph. ● Click on the eye on the sidebar of the map or graph. ● Select “hide selected” and watch them disappear. Try hiding “unselected” cases, too! 
Data Tool- Add a Layer Add a layer to your graph or map to color code the data. Example: 	**Data Tool- Add a Layer** **Hint:** Drag the attribute that you want to be your layer to the middle of your map or graph.

Data Tool- Trend Line

Add a line that helps you see the trend in your data.



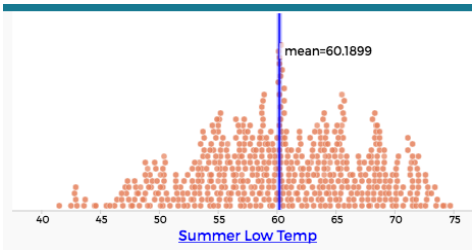
Data Tool- Trend Line

Hint:

- Go to the ruler at the side of the graph and look for the “Least squared line”
- The steeper the line, the stronger the relationship between the two attributes.

Data Tool- Find the Mean

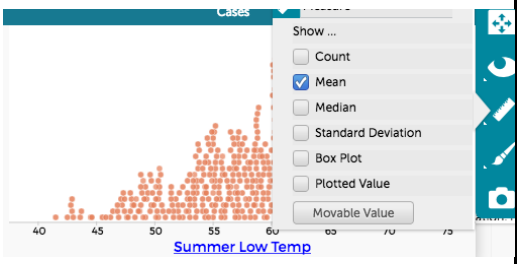
Find the average value for one attribute. For example, find the average summer low temperature:



Data Tool- Find the Mean

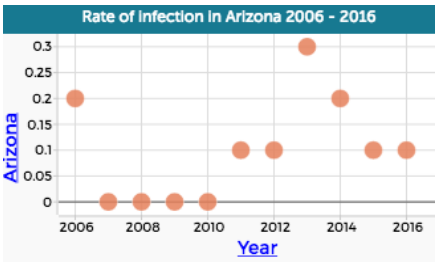
Hint:

- Make a graph with the attribute you are interested in on the x axis and nothing in the y axis.
- Select “Mean” from the options listed under the ruler.



Data Tool- Add a Title

Add a title to a map or graph that you have made. Example:

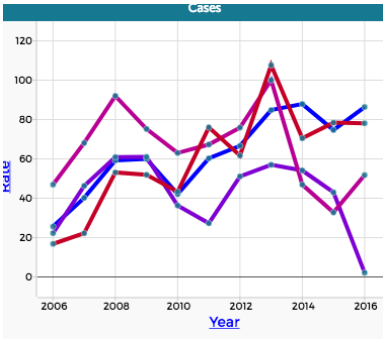
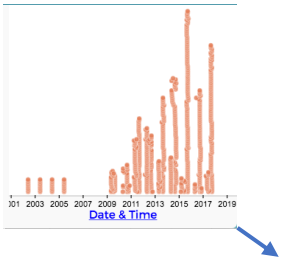
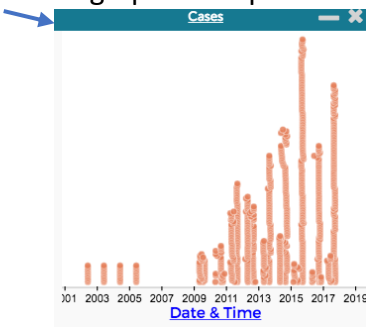


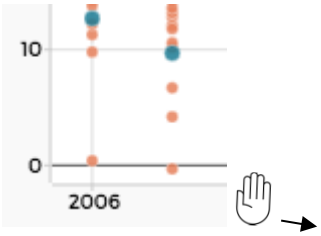
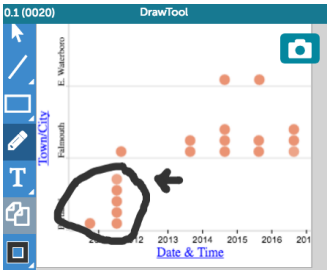
Data Tool- Add a Title

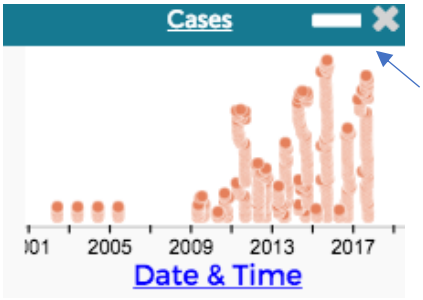
Hint:

Click on the blue-green bar at the top of the map or graph.

Write a title that helps explain what the graph or map is showing.

Data Tool- Connecting Line Add “connecting” lines to a graph to show change over time.  	**Data Tool- Connecting Line** **Hint:** ● A graph that shows change over time should have “Year” on the x axis ● Once you have made your graph, find “connecting lines” under the ruler icon.
Data Tool - Change the Size Make your map or graph really big on the screen, so you can see lots of detail. Make it small to leave room for other data visualizations.	**Data Tool - Change the Size** **Hint:** Hold the cursor the bottom left corner of the graph or map. When you see the diagonal arrow, click down and drag. 
Data Tool - Move it Move your graph or map off to the side of your screen, so you will have room to make a new one.	**Data Tool - Move it** **Hint:** Click on the blue green bar at the top of the graph or map and then drag. 

Data Tool - Move the Axes Move either the x or y axis without changing the scale.	**Data Tool - Move the Axes** **Hint:** Hover the cursor over the axis until the hand is pointing toward the middle of the graph. Click and drag from side to side. 
Data Tool - Remove an attribute Remove an attribute from either the x or y axis.	**Data Tool - Remove an attribute** **Hint:** Click on the name of the attribute in the graph. Scroll down to the bottom of the list, and select “Remove Y” or “Remove X” 
Data Tool - Annotate a graph Take a snapshot of your graph and then circle, star, or underline interesting data points. 	**Data Tool - Annotate a graph** **Hint:** Go to the camera icon and select “open in draw tool.” Click on the pencil icon in the draw tool and then annotate away!

Data Tool- Minimize a graph or map Minimize your map or graph in order to get it out of the way and allow you to go back to it later.	**Data Tool- Minimize a graph or map** **Hint:** Find the minus sign ("--") at the top right corner of the map or graph. 
Data Tool- Change the order of the categories Change the order of the categories on either the x or y axis so that they make sense (for example, 0-2 cm should come *before* 2-5cm)	**Data Tool- Change the order of the categories** **Hint:** Click on the categories on the axis and drag them around. 
Bonus challenge: Write your own data tool	**Bonus challenge – Write your own data tool** **Hint:**

Answer a Question Challenge Cards

Print out the cards. Cut out each row and fold along the center line so that the challenge is on one side and the hint is on the other

Question 1: How do the number of FOUND observations compare to the number of NOT FOUND?	**Hint:** You will only need to fill in one axis on your graph. Look in the question for a hint about what that should be.
Question 2: How does the number of observations of native crabs compare to the number of observations of invasives?	**Hint** Keep "Found/Not Found" as your X axis so you can see all the data points. Look in the question for a hint about what your Y axis should be.
Question 3: Which town has the most data?	**Hint** Make your graph big so that you can see all the town names. You don't need a y axis for this graph.
Question 4: Which part of the state has the most data?	**Hint** Use a map, rather than a graph to answer this question.
Question 5: How has the total number of observations changed over time?	**Hint** To look at change over time, make a graph with Time/Date as your x axis. You don't need a y axis for this graph.

Question 6: What size are most crabs?	**Hint** Check to make sure the size categories are in the right order (0-2cm should be first, then 2-5cm, etc.)
Question 7: How does the size of native crabs compare to the size of invasive crabs?	**Hint** You will need X and Y axes for this graph. Look in the question for clues about what these should be.
Question 8: What can you say about the ratio of male to female crabs?	**Hint** How does the “Can’t tell” data influence your answer?
Bonus challenge: Write your own question	**Hint:**
Bonus challenge: Write your own question	**Hint:**