

Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Mission: Caddisfly Range Student Notebook

### Lesson 1: Intro Activity for Bioassessment Mission

Essential Question: What can macroinvertebrates tell me about a freshwater body? How can I identify Macroinvertebrates?

After completing this activity, I will be able to...

<b>NGSS Practice 8</b>	<b>Level 1</b>	<b>Level 2: all of level 1 and...</b>	<b>Level 3: all of level 2 and...</b>	<b>Level 4: all of level 3 and...</b>
Obtaining, evaluating, and communicating information	Identify distinguishing characteristics of my macro-invertebrate.	Determine whether my macro-invertebrate is present and use evidence to support my claim.	Combine data with my class to make a claim about the health of Ram pond. Explain how I know Ram pond is or isn't healthy.	Identify areas of uncertainty in the data or reasons why I might not be confident in my decision about Ram Pond.

*Once you have completed the activity, circle the highest level that you achieved. Draw a star next to the evidence in the student notebook that shows that you did this.*

### **My Macroinvertebrate:**

**Prove it!** *Is your species present in the photos at your station? How do you know?*

Found or Not Found? \_\_\_\_\_

Photo # (if not found choose the closest photo to your macroinvertebrate): \_\_\_\_\_

My evidence: *I know I found/did not find it because...*

**Explore the Data:** *Is your species present at Ram pond in Gorham? How many observations of your species have there been?*

Found or Not Found?

Number of Observations:

**Spot the Difference:** *How strong are your identification skills? What do you notice is the same between these two macroinvertebrates at this station? What differences can you find?*

SAME	DIFFERENT

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**Assess:** Is Ram Pond healthy? Circle your decision: YES / NO

What evidence supports your decision? List your evidence below:

**Reflect:** How sure are you?

1	2	3	4
Not sure at all	I have a lot of questions; Pretty unsure	I have some questions; Pretty sure	Confident

Explain why you are or aren't sure:

**Think ahead:** Which macroinvertebrates do you predict you will find if your freshwater body is healthy?

Which will you find if it is polluted?

**Lesson 2: Conduct Background Research**

Essential question: What is the purpose of this investigation? How is this investigation important to people in my community and across the region?

**By the end of this activity I will be able to...**

<b>NGSS SEP 1</b>	<b>Level 1</b>	<b>Level 2: all of level 1 and...</b>	<b>Level 3: all of level 2 and...</b>	<b>Level 4: all of level 3 and...</b>
Asking questions and defining problems.	Define the research question and why it is important.	Describe how my work connects to the research of other students and scientists.	Explain how the data I will collect will help to answer the research question.	Anticipate challenges or questions that might arise in my investigation

*Once you have completed the activity, circle the highest level that you achieved. Draw a star next to the evidence in the student notebook that shows that you did this.*

Read over the Vital Signs Mission: Caddisfly Range. Summarize your investigation below:

**Assess:**

<b>Mission: Caddisfly Range Overview:</b>
<b>My Research Question:</b>
This question is important to the science community because...
This question is important to my local community because...
In order to answer this question my class is going to...
Members of my fieldwork team...

**Research Jigsaw:**

1. Divide the perspectives among your fieldwork team so that each person is responsible for one or two questions.
2. Work with other students in the class that share your same perspective to find helpful resources and share information.
3. Share what you learned with your fieldwork team.
4. Use the information you gathered to form a prediction about the results of your own investigation.

Perspective 1: What's the big deal? Why do we care about caddisflies?

Use these resources to explore the importance of caddisflies in freshwater ecosystems.

- <https://voices.nationalgeographic.org/2012/07/20/caddisflies-freshwater-species-of-the-week/>
- <http://www.maine.gov/dep/water/monitoring/biomonitoring/sampling/bugs/caddisflies.htm>

Conduct your own internet search to find additional information.

Student responsible:

Notes:

Why should we care about caddisflies?

Why are scientists interested in caddisflies?

Sources I used:

Perspective 2: What do I need to know to be able to collect data?

Use the Vital Signs identification resources to learn how to spot caddisflies and what you can look for to distinguish them from other bugs. Compare pictures caddisfly families to find the distinguishing features of each one:

- Macroinvertebrate Identification Sheet:  
[http://vitalsignsme.org/sites/default/files/content/macroinvertebrate\\_identification\\_sheet.pdf](http://vitalsignsme.org/sites/default/files/content/macroinvertebrate_identification_sheet.pdf)
- Caddisfly Larva ID card:  
[http://vitalsignsme.org/sites/default/files/content/fn\\_trichoptera\\_042910.pdf](http://vitalsignsme.org/sites/default/files/content/fn_trichoptera_042910.pdf)
- Caddisfly Family ID cards:  
[http://vitalsignsme.org/sites/default/files/content/vs\\_caddisfly\\_family\\_id\\_guide\\_122117.pdf](http://vitalsignsme.org/sites/default/files/content/vs_caddisfly_family_id_guide_122117.pdf)

Student Responsible:

Notes:

How will you know you have found it?

What makes caddisflies different from other bugs?

What unique features do the two different families have?

Photos or sketches of these identifying characteristics:

Sources I used:

Perspective 3: Ecosystem connections- What are caddisflies' roles in ecosystems?

Caddisflies are decomposers. Watch these videos to find out why decomposers are important in an ecosystem:

- <https://mpbn.pbslearningmedia.org/resource/tdc02.sci.life.oate.decompose/decomposers/#.WgSBPrCnFsY>
- <https://www.youtube.com/watch?v=WLk-9ib00VA>

Read this article to learn more about the role of caddisflies:

<http://dendro.cnre.vt.edu/forsite/studentpages/JenniferAquaticFoodWebsb.htm>

Conduct your own research to find out more!

Student Responsible:

Notes:

What roles do decomposers play in an ecosystem?

What do caddisflies eat? What else do they need to survive?

What other species rely on caddisflies and other decomposers?

Sources I used:

Perspective 4: What data already exists?

Search the Vital Signs database to determine where caddisflies have been found and where they were not found.

Vital Signs database: <http://vitalsignsme.org/explore/search>

'How-to" Guide—Searching the database for a particular species: <http://vitalsignsme.org/map-guide-species>

Student Responsible:

Notes:

What other locations have caddisflies been found? How many were found in these sites?

Do you think caddisflies are more abundant (meaning there are more of them) in northern Maine or southern Maine, close to the coast or in the mountains? Did you find any patterns?

Sources I used:

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**Assess:** How does your investigation connect to work that other students and scientists are doing or have done?

**Reflect:** What did you learn that you think will be most helpful in our investigation? What do we still need to know?

**Think ahead:** Based on your research, do you think you will find caddisflies? How many? From which families?



### Lesson 3: Field Work Skills Stations

Essential question: What makes good data?

After completing this activity, I will be able to...

<b>NGSS Practice 7</b>	<b>Level 1</b>	<b>Level 2: all of level 1 and...</b>	<b>Level 3: all of level 2 and...</b>	<b>Level 4: all of level 3 and...</b>
Engaging in argument from evidence	Identify a claim and supporting evidence from a Vital Signs observation.	List three or more qualities of good supporting evidence.	Plan what I will need to do to collect high quality evidence during my fieldwork.	Make suggestions for improving the quality of evidence.

Once you have completed the activity, circle the highest level that you achieved. Draw a star next to the evidence in the student notebook that shows that you did this.

1. Search the *Vital Signs* database for observations of caddisflies.
  - a. go to the "Explore Data" tab.
  - b. Select "Browse Data."
  - c. Click on the blue "Change Search" button in the top left.
  - d. Find the caddisfly larva in the drop-down menu under "Choose Common Name"
  - e. Click the "Browse it" button at the bottom of the screen.
2. Explore the entries that come up. Once you have looked at a few, write an example claim supported by both written and photo evidence:  
Claim (Found or Not Found?):  
Written evidence:  
  
Photo evidence (describe what is in the photo):

After you have reviewed a variety of evidence, find an example of "great" and "okay" evidence and fill out the following information:

#### GREAT EVIDENCE

Species name:

Username:

What was so great about it?

#### OKAY EVIDENCE

Species name:

Username:

Suggestions to improve next time:

**Fieldwork Skills Stations:**

**Spot the Difference:**

In this station, you will build skills to help you to determine which caddisfly families are present at your study site. You will need keen observation skills to come up with evidence to support your claim.

**Station Instructions**

1. Set the timer to three minutes.
2. Review all the activity instructions and start the timer when the whole group is ready.
3. Compare the photos in front of you. Write down every similar characteristic that you notice. Write down each difference that you notice. Use the *Vital Signs* species ID cards for ideas of characteristics to look for.
4. Put your pen or pencil down when the timer goes off.
5. Compare your lists with others in your group to give yourself a score:
  - **1 point** for every characteristic that you have that no one else in your group wrote down.
  - **No points** for a characteristic that more than one person in the group wrote down.
6. Work together to decide whether these specimens are from the same or different species.

Similarities	Differences

Are these from the same or different family? Explain your answer.

**Species in Focus:**

Through a thoughtful critique of this collection of good and bad species photos, learn what it takes to take great species photographs and create your own list of "what makes a great species photo."

Station Instructions

1. Choose one photo to critique (it does not have to be a good photo).
2. Write a critique of the photo by answering the questions in the student notebook.
3. Share your critique with your group. Work together to generate a list of characteristics of a great species photo.

## Photo Critique:

- What do you like about the photo?
  
- What don't you like?
  
- What does the photo show that would help someone identify the species?
  
- What would you do differently to improve the photo?

Characteristics that make a good photo:

**Preparing for Scientific Observation**

This station will help you look closely at the Vital Signs Caddisfly Family identification resources and familiarize yourself with the family that you are searching for.

Station Instructions

1. Look over the Vital Signs caddisfly family identification resources.
2. Choose one family to focus on.
3. Use the information on that family to fill in the observation tool.

Specific  
Features

+

Distinguishing  
Characteristics

+

Broader Connections  
to the Environment

=

Expert Observation

### SPECIFIC FEATURES

What are the specific characteristics of your plant or animal that you notice?

Example of **specific** features:

*"It is black with white spots."*

*"It has long antennae."*

*"It has six legs."*

Your species' **specific** features:

### DISTINGUISHING CHARACTERISTICS

What makes your plant or animal different from other similar looking plants or animals?

Example of distinguishing characteristics:

*"It is black with white spots with a spot at the base of its head."*

*"It does not have blue legs."*

Your species' **distinguishing** characteristics:

### ENVIRONMENTAL KNOWLEDGE & BROADER CONNECTIONS

Is there other information about the time of year, habitat, life cycle, or expected range of your plant or animal that will help you make your case?

Example of broader connections:

*"It is on a pine tree, and it is earlier in the season than I should see adults of this species."*

Broader **connections** for your species:

**Why Nothing Matters:**

Should you be disappointed if you don't find your target species? Of course not! Nothing REALLY matters to Dr. Andy Pershing - super smart ecosystem modeler shared by GMRI & UMaine. Andy explains the importance of looking for whales in places you may not find them and reporting "not found" data. Understanding where whales are NOT is equally as important as understanding where they ARE.

**Station Instructions:**

1. Watch the "Why Nothing Matters" video.
2. Read the "When NOT FOUND is good. Really Good." Guide.

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**Assess:** Why is it important to have clear evidence to support a claim?

**Reflect:** What were the three most important things that you learned at the stations?

**Thinking ahead:** What do you predict will be the most challenging part of your fieldwork? Why?

## Lesson 4: Collect Data

Essential Question: Are there caddisflies at our freshwater body?

After completing this activity, I will be able to...

<b>NGSS Practice 3</b>	<b>Level 1</b>	<b>Level 2: all of level 1 and...</b>	<b>Level 3: all of level 2 and...</b>	<b>Level 4: all of level 3 and...</b>
Planning and Carrying Out Investigations	Record written and photo observations of caddisflies (or their absence).	Collect evidence that supports my claim of found or not found, highlighting distinguishing features each family.	Use skills that I developed in class to make sure that my evidence is high quality. Collect an accurate count of each caddisfly family.	During my investigation, take note of what is working, and what isn't, and identify potential sources of error.

*Once you have completed the activity, circle the highest level that you achieved. Draw a star next to the evidence in the student notebook that shows that you did this.*

### Prepare for Fieldwork:

1. Read over Mission: Caddisfly and decide who will be responsible for completing each task.

Record the initials of the student responsible next to each task:

\_\_\_\_\_ Watch the time to make sure each group member searches for 10 minutes

\_\_\_\_\_ Take field site photo

\_\_\_\_\_ Record coordinates, substrate type (sandy, rocky, or mucky)

\_\_\_\_\_ Record depth of water

\_\_\_\_\_ Record FOUND/NOT FOUND evidence for both caddisfly families (and any additional caddisflies of unknown families).

\_\_\_\_\_ Take clear photos of the head, abdomen, and casings of type of caddisfly found

\_\_\_\_\_ Record counts of individuals for each caddisfly family found

\_\_\_\_\_ Optional: record water quality information (temperature, pH, salinity, dissolved oxygen)

2. Gather your equipment, including:

- Vital Signs Freshwater Species and Habitat Survey
- Vital Signs Caddisfly larva species ID card
- Vital Signs Caddisfly family ID guide
- Meter stick or measuring tape
- GPS
- Camera/phone/ipad
- Watch, phone, or timer
- Extra pencils
- Boots or waders

- Optional: water quality monitoring supplies: thermometer, pH strips, dissolved oxygen tabs, refractometer, vials to put water in

2. Go to your field site to collect your data. Collect enough information to post a FOUND or NOT FOUND observation for each family of caddisflies.

**Assess:** Have you recorded all of the necessary information? Go through the checklist with your group.

**Reflect:** What surprised you during your fieldwork? What did you find that you did expect?

**Think ahead:** Were there any errors that may influence your results? Describe them. Were you curious about anything else during your investigation? What new questions came up?

## **Lesson 5: Post Data**

Post your observations to Vital Signs. You should post one observation for both caddisfly families and any other unknown caddisflies (remember that “not found” data is important!).

### **Instructions for Posting to Vital Signs:**

- Go to <http://vitalsignsme.org>
- Log in using the team name a password given to you by your teacher.
- Go to the “My Vital Signs” page (the green box in the upper right corner)
- Select from the list of “Unfinished observations”
- Transcribe the written information from your datasheet to the online datasheet.
- In your field note, be sure to include the amount of time spent searching, depth of water, substrate type (sandy, rocky, or mucky), and the count of individuals of each family found.
- Upload your photos from their camera to the online datasheet. For each caddisfly family, include a detailed photo of the head, abdomen, and the casing.
- **Before you submit**, use the “Quality Assurance Checklist” below to check your work.
- Optional: Have a classmate check your observation using “Peer Review Tool” to check your work.
- Once you are satisfied with your work, click “submit”

**Optional:** Compare your observations to other observations in the Vital Sign database.

- Go to <http://vitalsignsme.org/explore/search>
- Click on “Change search”
- Select the species that you were search for from the drop down menu
- Go to “Browse Data”
- Click on an observation that interests you
- Post comments for other students in the comment box beneath each observation



## Quality Assurance Check

Before you publish your data to Vital Signs, do a Quality Check to catch errors. Make sure scientists and others can use your data!

### Data Required for *Species Survey*

	Yes	No	Can't tell
<b>Field Trip Details</b>			
All information about the trip (trip name, date, habitat, etc.) is accurate			
<b>Study Site Details</b>			
Zooming way in shows that the data is in the right place on the map (correct latitude & longitude)			
Study site photo shows the big picture of where the investigation happened (no faces!)			
Study site photo is in focus			
Habitat selection is accurate			
<b>Species You Looked For – complete a checklist for each species you looked for</b>			
The correct species is selected from the pull-down list			
“I think I found it” or “I think I didn’t find it” selection is correct			
Evidence photos are in focus			
Evidence photos show just the species (no faces!)			
Evidence photos are close-up enough to show important identification features			
Evidence photos show the head			
Evidence photos show the abdomen			
Evidence photos show the casings			
Written evidence clearly describes characteristics of species			
Written evidence matches and supports evidence photos			
Appropriate sampling method selected			
Sampling method photo shows how data were collected and is in focus (no faces!)			

### Additional Data Required for *Species & Habitat Survey*

<b>Species Details</b>			
Species details (e.g. count, size, sex, coverage, reproduction) data are filled in and match the paper datasheet			
<b>Habitat</b>			
Habitat details (e.g. species diversity, evidence of vectors, water quality) data are filled in and match the paper datasheet			

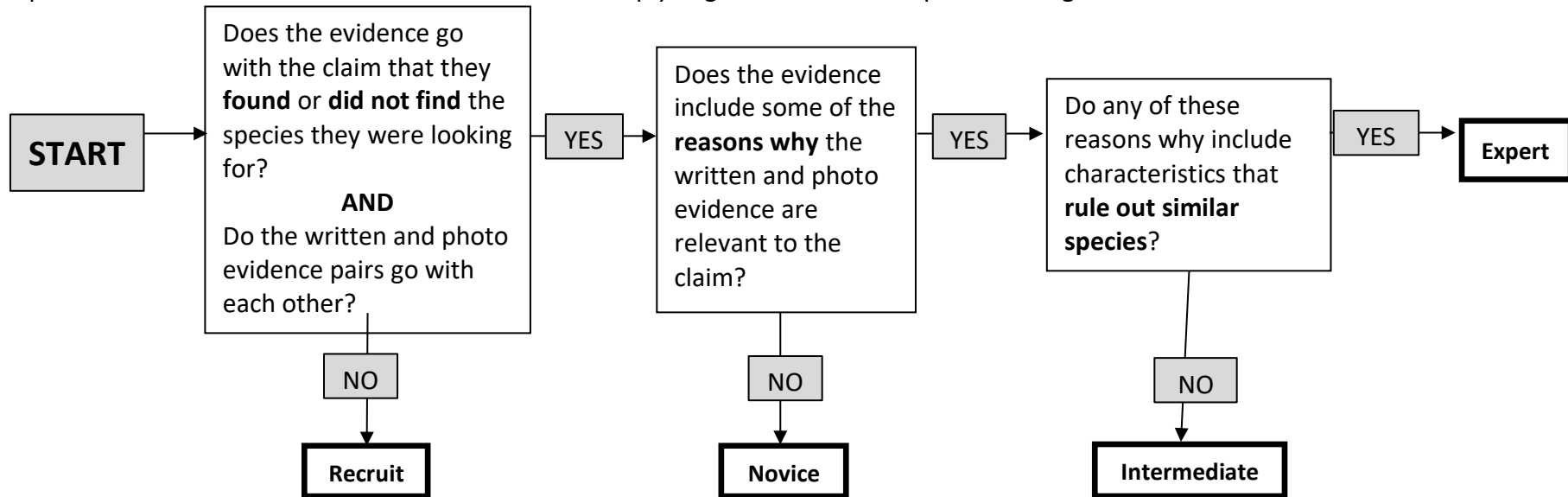
### Additional Data – What other things do you want to check before you publish?

<b>Fieldwork Notes Include:</b>			
Water depth			
Substrate type (rocky, sandy, or mucky)			
Amount of time spent searching			
Count of individuals found in each family			

\*When all of the answers above are “Yes,” you have met the minimum review requirements to publish your data!

## PEER REVIEW TOOL: HOW EXPERT IS THE SCIENTIFIC ARGUMENT YOU'RE REVIEWING?

**FIND OUT!** Examine the FOUND or NOT FOUND claim, field notes, and written and photo evidence to answer the questions below. Use Vital Signs species ID cards or other identification resources to help you give feedback to improve the argument.



### Example of **Recruit**:

CLAIM:

"We think we **DID NOT FIND** invasive honeysuckle."

EVIDENCE:

"The stem is hollow so we **FOUND** it."

### Example of **Novice**:

CLAIM:

"We think we **FOUND** invasive honeysuckle."



EVIDENCE:

"The stem is hollow so we **FOUND** invasive honeysuckle."

### Example of **Intermediate**:

"The stem is hollow. We know that invasive honeysuckle has a hollow stem."

### Example of **Expert**:

"A hollow stem is the feature that helps us distinguish invasive honeysuckle from native honeysuckle. Because the stem is hollow and not solid like the native, we think we found invasive honeysuckle."

What category best describes the argument? (Circle One) Recruit, Novice, Intermediate, Expert

What suggestions do you have to help improve the arguments that were made?

**Lesson 6: Analyze Data:**

Essential Question: Which caddisfly families are most abundant in my lake/pond/marsh?

After completing this this activity, I will be able to...

<b>NGSS Practice 4</b>	<b>Level 1</b>	<b>Level 2: all of level 1 and...</b>	<b>Level 3: all of level 2 and...</b>	<b>Level 4: all of level 3 and...</b>
Analyzing Data	Create graphs to show the combined data from all the leaf bags.	Explain what the data in my graphs mean and how they are organized.	Use my graphs to compare the abundance of different caddisfly families.	Identify aspects of the data that help to understand the data, which could include the range, mean, median, mode, the spread of the data, any interesting points or groups of data, or outliers in the data.

*Once you have completed the activity, circle the highest level that you achieved. Draw a star next to the evidence in the student notebook that shows that you did this.*

In the space below, draw the graphs of your combined class data:

**Family Limnephilidae**

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Count of individuals

**Family Phryganeidae**

---

Count of individuals

**Family Unknown**

---

Count of individuals

Use your graphs to fill in the table below:

Question	Family Limnephilidae	Family Phryganeidae	Family Unknown
How spread out is the data? What is the range?			
Where are groups or clusters of data points?			
What outliers do you see? An outlier is a data point that stands out from the rest.			
What is the mean or average count of individuals?			
What is the median or middle count of individuals?			

**Assess:** What family is most abundant in your lake/pond/marsh? How do you know?

**Reflect:** Did sharing results with your classmates change your thinking? Would your thinking would change if everyone in the school went out to place a leaf bag in a different part of the pond/lake/marsh? Everyone in the town? Explain.

**Think Ahead:** Optional: How do your results compare with results from other classes in different years or locations?

**Lesson 7: Draw Conclusions:**

Essential Question: Which caddisfly families are most abundant in my area?

After completing this activity, I will be able to...

<b>NGSS Practice 7</b>	<b>Level 1</b>	<b>Level 2: <i>all of level 1 and...</i></b>	<b>Level 3: <i>all of level 2 and...</i></b>	<b>Level 4: <i>all of level 3 and...</i></b>
Engaging in argument from evidence	Use the information that I gathered to make a clear claim about my research question.	Support my claim with evidence from the data and explain why I think the data supports my claim. Connect my findings to the background research that I conducted and explain the significance of my claim.	Explain how confident I am in my claim, considering factors that that might have impacted my data, possible sources or error, natural variability in the data, and/or the amount of data collected.	Explain how I ruled out other possible claims. I can pose additional questions for future study to help me investigate further.

*Once you have completed the activity, circle the highest level that you achieved. Draw a star next to the evidence in the student notebook that shows that you did this.*

**Research Question:**

*I am investigating...*

**Claim:** *Through my investigation, I found that...*

**Evidence:**

*The data that supports my claim is...  
My claim is based on the following evidence...  
I observed that...  
I noticed from the data that...*

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*The data that supports my claim is...  
My claim is based on the following evidence...  
I observed that...  
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**Evidence:**

*The data that supports my claim is...  
My claim is based on the following evidence...  
I observed that...  
I noticed from the data that...*

**Reasoning:**

*This evidence supports my claim because...  
This evidence suggests that...  
This evidence connects to what I already know about...*

**Discussion:**

How confident are you in your conclusion? Explain.

*Even though my results are strong, some factors might have impacted my data, like...*

*I do not have enough evidence to make a strong conclusion because...*

Is there evidence to support a different claim? How can you rebut or explain opposing evidence?

*Some people might interpret my evidence to mean... but I ruled out this explanation because...*

Why are your findings important?

*These findings are important because they could impact...*

If you were continuing to investigate this topic, what would your next steps be?

*To further this investigation, I would...*

*As a result of this study, new questions to investigate have come up, such as...*



## Caddisfly Mission Rubric

	<b>Level 1 (Beginning)</b>	<b>Level 2 (Developing)</b>	<b>Level 3 (Meets)</b>	<b>Level 4 (Exceeds)</b>
	<i>I can...</i>	<i>I can do all of level 1 and...</i>	<i>I can do all of level 2 and...</i>	<i>I can do all of level 3 and...</i>
Practice 3: Planning and Conducting Investigations	Describe an investigation that addresses my research question.	Describe the data used to address my research question, the materials needed, and a procedure that is clear and detailed enough to be replicated.	Describe how to record the data, including specific measurements and observations to be collected.	Describe the thinking that went into gathering <i>reliable</i> data, including collecting data from multiple sites or multiple times, controlling variables, or random sampling.
Practice 4: Analyzing and Interpreting Data	Record the data that I collected following the mission protocol.	Create visual representation that makes my data understandable, like a graph, table, or other figure that is scaled, labeled, and accurate.	Choose an appropriate graph, table, or figure that organizes the results in a way that helps address the research question. I can explain the information in that graph, table, or figure.	Identify aspects of the data that help to understand the data, which could include the range, mean, median, mode, the spread of the data, any interesting points or groups of data, or outliers in the data.
Practice 7: Engaging in Argument from Evidence	Use the information that I gathered to make a clear claim about my research question.	Support my claim with evidence from the data and explain why I think the data supports my claim. I can connect my findings to the background research that I conducted and explain the significance of my claim.	Explain how confident I am in my claim, considering factors that that might have impacted my data, possible sources or error, natural variability in the data, and/or the amount of data collected.	Explain how I ruled out other possible claims. I can pose additional questions for future study to help me investigate further.
Practice 8: Obtaining, Evaluating and Communicating information	Gather background information on my topic.	Locate reliable information from multiple sources that connects to my research question and cite my sources accurately.	Use my research to explain how my question builds on or contributes to existing scientific knowledge and to form a prediction about my results.	Explain the importance of my research to me, my local community, or to the larger scientific community.

