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Literacy and Discourse in STEM

April 18, 2021

Critical Reflection of Practice: Claim, Evidence, and Reasoning (CER)

Description of Practice:

I completed these activities with my ninth grade Living Environment classes. As part of our preparation for the Living Environment Regents Exam, students are required to complete four labs that mandated by New York State. Students will have to answer questions specifically about these labs on the exam, so it's extremely important that students understand the content and procedures covered in these labs. As part of the "Design an Experiment" section of the New York State Making Connections Lab, students completed a Claim, Evidence, and Reasoning worksheet. In this lab, students were presented with two claims about the effect of exercise on a person's ability to squeeze a clothespin. After collecting data, each student decided which claim they thought was correct. Students then had to list evidence from the data that they collected that supports this claim. In the Reasoning section of the worksheet, students had to write a paragraph explaining how their evidence supported the claim. Students then discussed their conclusions with members of other lab groups. Overall, I thought the writing portion of this activity went well. Since this was one of the first times that this group of students did an activity like this, I found that using pre-written claims was very helpful. The students seemed to struggle more with the discussion portion because they're not used to critiquing or disagreeing with their classmates. I completed the Making Responsive Instructional Decisions chart below after my students completed this activity.

Several weeks later, my students completed the New York State Relationships and

Biodiversity Lab. In this lab, students were presented with a fictional species of plant (*Botana curus*) that produced a special substance that could cure diseases (Curol). Students then conducted several tests (including looking at DNA and amino acid sequences for each species, paper chromatography, enzyme tests, and gel electrophoresis results) on three other plant species to determine which of these species would most likely also be able to produce Curol. After completing the lab, my students completed another Claim, Evidence, and Reasoning worksheet and discussion. This time, students had to write their own claims about which species was most closely related to *Botana curus* and were provided with sentence starters for each section. I also provided students with discussion norms and sentence starters for their discussions. I have attached copies of each worksheet at the end of this assignment.

Content Connections:

The following NGSS Science and Engineering Practices were addressed by this activity:

- *Constructing Explanations and Designing Solutions*
 - Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
 - Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
- *Engaging in Argument from Evidence*
 - Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
 - Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

The following New York State P-12 Science Learning Standards were addressed by this activity:

- Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
 - Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-LS2-7)
- Engaging in Argument from Evidence Engaging in argument from evidence in 9–12 builds from K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
 - Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-6)
 - Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-8) -

I chose to use the CER worksheets and discussion with these two lab activities because ensuring that students understand the content contained in these labs is crucial to their success on the Regents. In both activities, students collect their own data and answer questions about their analysis of their data. Completing CER worksheets and discussions took what they did in the lab one step further. Students made claims based on their data and then used their data as evidence to support their claims. Students then had to explain, both verbally and in writing, how their data supported their claims. Extending these lab activities with CER worksheets and discussion provided students with the perfect opportunity to practice their argumentation, analysis, and explanation skills.

After completing the CER worksheet and discussion with the Making Connections Lab, it became clear that students had several misconceptions about argumentation in the science classroom. Some students thought that there could only be one correct answer and that anyone with a conflicting claim was automatically wrong, without listening to any of their evidence or reasoning. This caused several small arguments during this activity. Some students also seemed to struggle with connecting their evidence to their claims. Before starting the CER worksheet and discussion with the Relationships and Biodiversity Lab, we had a class discussion about the importance of argumentation in science and looking at data creatively and from different

perspectives. We also discussed norms for small group discussions and verbal argumentation. I also showed students several examples of “Reasoning” sections of these worksheets to show how evidence should be connected to the claim.

Evidence and Reflection: Making Responsive Instructional Decisions

I completed this chart after my students completed the CER Worksheet and Discussion as part of the Making Connections Lab.

What resources did you notice? Specific productive ideas or ways of reasoning from students? Positive group work dynamics? What did you see from students that you think was useful or could be useful moving forward?	What concerns came up for you? Were there aspects of the lesson that didn't go as well as you hoped? Unanticipated difficulties?	How can these inform your instruction? Can you capitalize on particular resources from students? Are there ways of drawing on items in the resources column to address concerns?
<ul style="list-style-type: none"> ○ Students succeeded in identifying evidence that supported the claim that they chose. ○ Almost all students followed instructions and utilized data that was collected during the lab activity. ○ Students were eager to actually talk with their classmates during the discussion portion of the activity. Often, my students will not actually talk in Breakout Rooms. They will only message each other. ○ Many students successfully explained how their data supported the claim that they chose. ○ Most students were supportive of the other members of their discussion 	<ul style="list-style-type: none"> ○ While students did discuss their work with their classmates, I noticed that several discussion groups quickly got off topic. ○ Some students had trouble critiquing their classmates in a constructive way. This caused several "heated discussions" between groups. ○ Students often struggled with the reasoning section of the worksheet. Students did not properly use their evidence to support their claims. ○ In a survey I gave on Microsoft Forms after this activity, students expressed that they were nervous or embarrassed to critique the work of their classmates. They did not want to embarrass or upset 	<p>If you were to teach this same lesson again:</p> <ul style="list-style-type: none"> ○ I would try having students write their own claims instead of selecting from pre-made claims. ○ I would discuss the importance of argumentation and justification of evidence in science. ○ I would again explain that a critique of your work is not a personal attack and that it is important to be respectful of your classmates. ○ I would highlight positive examples of reasoning sections of the CER worksheet. <p>Moving forward instructionally:</p> <ul style="list-style-type: none"> ○ I will provide sentence starters for each section of the worksheet. ○ I will provide sentence

<p>groups.</p> <ul style="list-style-type: none"> ○ In a survey that I gave on Microsoft Forms after this activity, students expressed that they enjoyed hearing the different ways that their classmates analyzed and used the same data they were presented with. ○ Students also expressed that they liked discussing with a small group because it was less pressure than presenting their work in front of the whole class. 	<p>their friends.</p> <ul style="list-style-type: none"> ○ Students also expressed that they did not enjoy responding to their partners' critiques of their work. Some said that they felt awkward justifying their responses. 	<p>starters for the small group discussions.</p> <ul style="list-style-type: none"> ○ I will discuss discussion norms with beach class. ○ I will have students write their own claims. ○ I will provide students with strong examples of reasoning sections on the CER worksheet.
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Several weeks after completing the Making Connections Lab, my students completed the Relationships and Biodiversity Lab. After this lab, students once again completed a CER Worksheet and discussion. I made the changes mentioned above prior to completing this lesson. I felt that this activity went much more smoothly the second time around. Students did a better job of constructing explanations based on the data they collected. They also had deeper and more meaningful discussions. Some students still seemed hesitant to critique their peers, but I think our class discussion about small group discussion norms really helped students to give respectful and constructive critiques. Many students also chose to use the sentence starters, which also improved the quality of their writing and discussions.

Name: _____

Living Environment

Claim, Evidence, and Reasoning Worksheet

Topic:

Making Connections State Lab

Question:

Does exercise affect a person's ability to squeeze a clothespin?

Instructions:

In the chart below, choose a claim that answers the question. In the evidence section of the chart, provide at least two pieces of data that support your claim. Use data that you and your classmates collected during this lab. In the reasoning section of the chart, explain how the evidence you provided supports your claim.

After completing your chart, meet up with your discussion group. You and your partners will each present your claims. Make sure you support your claim with your evidence and reasoning. Then, critique your partner's claim. Work with your partner to create a consensus statement about the effect of exercise on a person's ability to squeeze a clothespin.

Claim: Which student do you agree with? (Circle either A or B).

Student A

If you exercise first, then you should be able to squeeze a clothespin more times in one minute

Student B

If you rest first, then you should be able to squeeze a clothespin more times in one minute.

Evidence: What data proves this claim?

(Include at least two pieces of data)

1.

2.

3.

4.

Reasoning: How does the evidence

support your claim? (At least four sentences)

Partners' Names:

Consensus Statement: After discussing your claims, work together to construct an answer to the question: Does exercise affect a person's ability to squeeze a clothespin?

Name: _____

Living Environment

Claim, Evidence, and Reasoning Template

Topic:

Relationships and Biodiversity Lab

Question:

Which plant species is most likely to produce Curol? Why?

Instructions:

In the chart below, construct a claim that answers the question. In the evidence section of the chart, provide at least three pieces of data that you collected during this lab. In the reasoning section of the chart, explain how the evidence you provided supports your claim.

After completing your chart, meet up with your discussion group. You and your partners will each present your claims. Make sure you support your claim with your evidence and reasoning. Then, critique your partner's claim. Work with your partner to create a consensus statement about which plant is most likely to produce Curol.

Claim: What do you conclude? Which plant species will likely produce Curol?
(At least one sentence)

Evidence: What data proves this claim?
(Include at least three pieces of data)

1.

2.

3.

4.

Reasoning: How does the evidence support your claim? (At least four sentences)

Partners' Names:

Consensus Statement: After discussing your claims, work together to construct an answer to the question: Which plant species is most likely to produce Curol? Why?

Sentence Frames for Argumentation:

I hear you saying that ...

I agree with _____ because...

Despite disagreeing about _____, I agree that...

I see it differently because...

I agree with _____, but we also have to consider that...