

Supporting Students in Science Thinking and Writing

Workshop #3: Teaching Strategies & Assessment

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Agenda

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- Activity - Discuss Teaching Strategies
- Discussion - Lessons Learned & Questions
- Activity – Analyze erosion and deposition transcripts
- Activity – Analyze student writing from erosion and deposition lesson
- Presentation - Developing Assessment Tasks
- Activity – Use rubrics to analyze student writing on force and motion
- Presentation - Providing Student Feedback

Activity: Discuss Teaching Strategies

- Work in groups from the previous workshop
- Share samples of student writing
- Discuss the writing and the lesson:
  - What teaching strategy did you use?
  - What went well during the lesson?
  - What challenges arose?
  - What were the strengths and weaknesses of your students' writing?
  - What did you learn that you hope to address or apply in using CER in the future?

Discussion: Lessons Learned and Questions

- What did you learn that you hope to address or apply in using CER in the future?
  - Challenges? Successes?
- What did you learn from your discussion with your colleagues?
- What remaining questions do you have?

Classroom Talk

- Science is a way of knowing - writing, talking, doing, thinking and reasoning (Michaels et al, 2008).
- Scientific inquiry requires students to play an active role and engage in science talk (Duschl et al., 2006)
- Traditionally science classrooms have been dominated by teacher talk and in an IRE pattern (Crawford, 2005).
  - I = Initiate (Teacher)
  - R = Respond (Student)
  - E = Evaluate (Teacher)
- Creating a classroom culture around CER where it becomes part of the norms of classroom talk supports students in producing stronger science writing (McNeill, 2009).

Classroom Talk

- Science discussions classrooms often consist of a discourse pattern (IRE) where the teacher <u>initiates</u> a question, the student <u>responds</u>, and then the teacher <u>evaluates</u> (Lemke, 1990).
- Example:
  - Teacher: What does reflection mean? Jane.
  - Jane: When light bounces.
  - Teacher: Good. Light bouncing. What is an example of reflection we saw in our experiment? Sam.
  - Sam: When the light bounced off the mirror.
  - Teacher: Ok. When the light bounced off the mirror. Did the light travel in a straight line or did it bend? Carlos.
  - Carlos: It was straight.
  - Teacher: Good. The light traveled in a straight line.

Activity: Analyze Classroom Talk

- Read the two examples of classroom talk
- Analyze the two transcripts in terms of IRE versus student-to-student interactions.
- Analyze the transcripts in terms of supporting CER.
- What are the strengths and weaknesses of the two discussions?

Activity: Analyze Student Writing

- Read the two examples of student writing
  - The 5th graders wrote their CER in groups. These are from two different groups.
- Analyze the student writing in terms of claim, evidence and reasoning.
  - What are the strengths?
  - What are the weaknesses?
- Considering the student work and the transcripts, what suggestions would you have about teaching this lesson next time?

Creating Assessment Tasks

- Step 1: Identify and unpack the content standard
- Step 2: Select scientific explanation level of complexity
- Step 3: Create learning performance
- Step 4: Write the assessment task
- Step 5: Review assessment task
- Step 6: Develop specific rubrics

Step 1: Identify and Unpack Content Standard

- Select standard that targets the key science concept
- Break down into different ideas
  - Identify the different concepts
  - Clarify the different concepts
  - Consider how each concept is related to the other concepts
- Consider common student misconceptions
  - Identify possible misconceptions
- *The unpacking process can clarify what key ideas to include in the assessment as well as what common student misconceptions you may want to incorporate*

Step 2: Select scientific explanation level of complexity

Level of Complexity	Framework Sequence
Simple	Variation #1 1. Claim 2. Evidence 3. Reasoning
	Variation #2 1. Claim 2. Evidence • Appropriate • Sufficient 3. Reasoning
	Variation #3 1. Claim 2. Evidence • Appropriate • Sufficient 3. Reasoning • Multiple components
Complex	Variation #4 1. Claim 2. Evidence • Appropriate • Sufficient 3. Reasoning • Multiple components 4. Rebuttal

Step 3: Create Learning Performance

- Develop Learning Performance
  - Combines from the science content and the CER framework

Content Standard	Practice	Learning Performance
A substance has characteristic properties, such as density, a boiling point, and solubility, all of which are independent of the amount of the sample (NRC, 1996, B:1A/ 5-8).	Develop…explanations… using evidence. (NRC, 1996, A: 1/4, 5-8) Think critically and logically to make the relationships between evidence and explanation. (NRC, 1996, A: 1/5, 5-8)	Students construct a scientific explanation that includes a claim about whether two items are the same substance or different substances, evidence in the form of density, melting point (boiling point), solubility, color and hardness of the substances, and reasoning that different substances have different properties.

Step 4: Write the Assessment Task

Learning Performance

Students construct a scientific explanation that includes a claim about whether two items are the same substance or different substances, evidence in the form of density, melting point (boiling point), solubility, color and hardness of the substances, and reasoning that different substances have different properties.

Assessment Task

Examine the following data table:

	Density	Color	Mass	Melting Point
Liquid 1	0.93 g/cm^3	no color	38 g	-98 °C
Liquid 2	0.79 g/cm^3	no color	38 g	26 °C
Liquid 3	13.6 g/cm^3	silver	21 g	-39 °C
Liquid 4	0.93 g/cm^3	no color	16 g	-98 °C

Write a **scientific explanation** that states whether any of the liquids are the same substance.

Step 5: Review Assessment Item

- Is the knowledge needed to correctly respond to the task?
- Is the knowledge enough by itself to correctly respond to the task or is additional knowledge needed?
- Is the assessment task and context likely to be comprehensible to students?

(George Deboer, Project 2061)

Step 6: Develop Specific Rubric
Example below is the Base Rubric

LEVEL	Claim	Evidence	Reasoning	Rebuttal
	A statement or conclusion that answers the original question/problem.	*Scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.*	*A justification that connects the evidence to the claim. It shows why the data counts as evidence by using appropriate and sufficient scientific principles.*	*Recognizes and describes alternative explanations, and provides counter evidence and reasoning for why the alternative explanation is not appropriate.*
0	Does not make a claim, or makes an inaccurate claim.	Does not provide evidence, or only provides inappropriate evidence (Evidence that does not support claim).	Does not provide reasoning, or only provides inappropriate reasoning.	Does not recognize that alternative explanation exists and does not provide a rebuttal or makes an inaccurate rebuttal.
VARIES FROM 1 to 5	Makes an accurate but incomplete claim.	Provides appropriate, but insufficient evidence to support claim. May include some inappropriate evidence.	Provides reasoning that connects the evidence to the claim. May include some scientific principles or justification for why the evidence supports the claim, but not sufficient.	Recognizes alternative explanations and provides appropriate but insufficient counter evidence and reasoning in making a rebuttal.
	Makes an accurate and complete claim.	Provides appropriate and sufficient evidence to support claim.	Provides reasoning that connects the evidence to the claim. Includes appropriate and sufficient scientific principles to explain why the evidence supports the claim.	Recognizes alternative explanations and provides appropriate and sufficient counter evidence and reasoning when making rebuttals.

Activity: Assess Students' Writing

- Score the four student responses using the specific rubric. For each student give them a separate score for:
  - Claim - 0, 1 or 2
  - Evidence - 0, 1, 2, 3, or 4
  - Reasoning - 0, 1, 2, or 3
- Provide feedback and strategies
  - What feedback would you provide this student? Why would that feedback be helpful?
  - What strategies might you use to help this student construct a stronger explanation?

Student Example A

does the weight of the washer change the vehicle. I claim yes the weight of the washer change the speed of the vehicle. When you first put to washer on the clip. it did not move. We put 4 more washer on and then the vehicle started to move. then we put 8 washer on the clip and it was fast. then we made it more farther by putting 16 more washer on the vehicle or a whole washer. then I started to tell that the force. it pushing the vehicle to make it move. the more harder the force push the more faster it go.

Student Example B

Yes, the weight of the washers changes the speed of the vehicle. Because when my team put 2 washers on the paper clip it was starting to move. Then we put 4 washers on the paper clip and it went faster. Then we put 8 washers on the paper clip and it went faster. That's when I noticed the more weight of the washers the more force. Which makes the vehicle go faster. But if there is not so much weight from the washers there is not so much force. Which makes the vehicle go slow. Thats the reason the weight of the washers does change the speed of the vehicle.

Student Example C

Yes, it changes the speed of the vehicle. I know it changes the speed of the vehicle. If not then why when you add washers to your vehicle it moves faster and farther? Which is why I say yes. The weight of the washers can change the speed of the vehicle.

First, I attached 2 washers on a paperclip attached to string and connected on our vehicle. 2 washers only made it move slowly then stop. Then I put 4 washers on the paperclip and my vehicle moved a bit farther and faster then with 2 washers. After that I put 8 washers on the paperclip and our vehicle moved a lot faster and farther and ended slowly. Last, but certainly not least, when I put 16 washers on the paperclip our vehicle went really fast, flew off the table and stopped when it hit a chair. That's why I think the weight of the washers can change the of the vehicle.

The reason the weight of the washers change the speed of the vehicle is because of the force. Newton's law states an object at rest stays at rest and an object in motion unless pushed or pulled, or forced in a different direction. And our vehicle was being as an act of force. With the more washers the more force was being added. Which is why I think the weight of the washers change the speed.

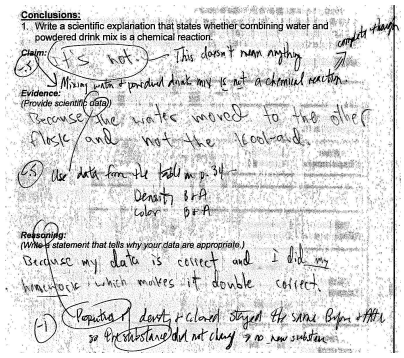
Student Example D

Yes the weight of the washers change the speed of the vehicle. When we first put the washers on the car it moved a little bit. When we put more washers on the car the car moved faster. When we did Eight washers the speed increased more. When we put sixteen washers it increased the speed to five. Newton's law states the more weight you put on the car the faster it goes.

Providing Students Feedback

- What to Comment on:
  - Inclusion and quality of the claim, evidence, reasoning and potentially rebuttal
  - Accuracy and thoroughness of the science content
  - Holistic quality of the scientific explanation
- How to Comment:
  - Explicit and clear feedback
  - Point out strengths and weaknesses
  - Provide suggestions on how to improve
  - Ask questions to promote deeper thinking

Providing Students Feedback


Conclusions:
1. Write a scientific explanation that states whether combining water and powdered drink mix is a chemical reaction.

Claim: It's not. This doesn't mean anything

Evidence: (Provide scientific data)
Because the water moved to the other flask and not the lead-and.

Reasoning: (Write a statement that tells why your data are appropriate.)
Because my data is correct and I did my homework which makes it double correct.

Conclusions

- Make the CER framework explicit
- Identify places in your curriculum where it makes sense to include CER and design learning tasks.
- Incorporate different teaching strategies
- Include CER in your science talk to make it a part of your classroom culture.
- Use rubrics to evaluate student writing
- Provide students with explicit and clear feedback

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