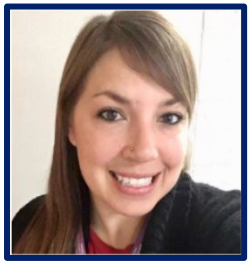
Arizona Department of Education

# CER or ERC?
# Constructing Explanations & Arguing From Evidence

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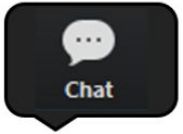
Arizona Department of Education

# Welcome!


- Name
- Current Position

# Webinar Resource Dashboard

## CER or ERC? Constructing Explanations & Arguing From Evidence Webinar Dashboard

**Facilitators: Rebecca Garelli:** Rebecca.Garelli@azed.gov | **Sarah Sleasman:** Sarah.Sleasman@azed.gov

ADE Science Standards Page | ADE Science Resource Page | ADE Science & STEM Webinars

| | | |
|---|---|---|
| 1 | General Resources | Presentation PDF: PDF of Slides<br>Helping Students Make Sense of the World Book |
| 2 | 3 Categories of Science & Engineering Practices | Assessing Practices Along a Continuum Article from NSTA<br>The Wonder of Science 3-D Cards |
| 3 | Bozeman Science Videos with Paul Anderson from the Wonder of Science | Constructing Scientific Explanations<br>Engaging in Argumentation<br>The Wonder of Science |
| 4 | K-12 Science and Engineering Practices Progression Matrix of Elements | SEP Progression Doc |
| 5 | Arguing from Evidence vs. Constructing Explanations Resources | Argumentation and Explanation-Tools for Using Them Together While Keeping Them Separate Article by Brian Flaig<br>STEM Teaching Tool #1-Is it important to distinguish between the explanation and argumentation practices in the classroom? |
| 6 | Argumentation Toolkit Website | http://www.argumentationtoolkit.org/ |

**MAKE A FORCED COPY**


**Gray- means we will open and use**

# Goals for Today

- Explore the differences and connections between two of the Science & Engineering Practices (SEPs)- Constructing Explanations & Arguing from Evidence

- Learn how to engage students in speaking and writing like scientists through using a strategy called “Claims, Evidence, Reasoning (CER)” using scaffolds & supports.

- Deepen understanding of additional ways to engage and assess students on the SEP Arguing from Evidence

# Community Norms/Shared Agreements

- We honor each other and all our voices
- We actively and respectfully listen and speak to one another
- We commit to the group by contributing to the learning of others through active participation in this web seminar.

*Adapted from NSTA's Webinar- Transforming Science Learning: Acting, Thinking and Talking as Scientists. Engaging Students in Science and Engineering Practices on 8/12/20*

# Recommended Book

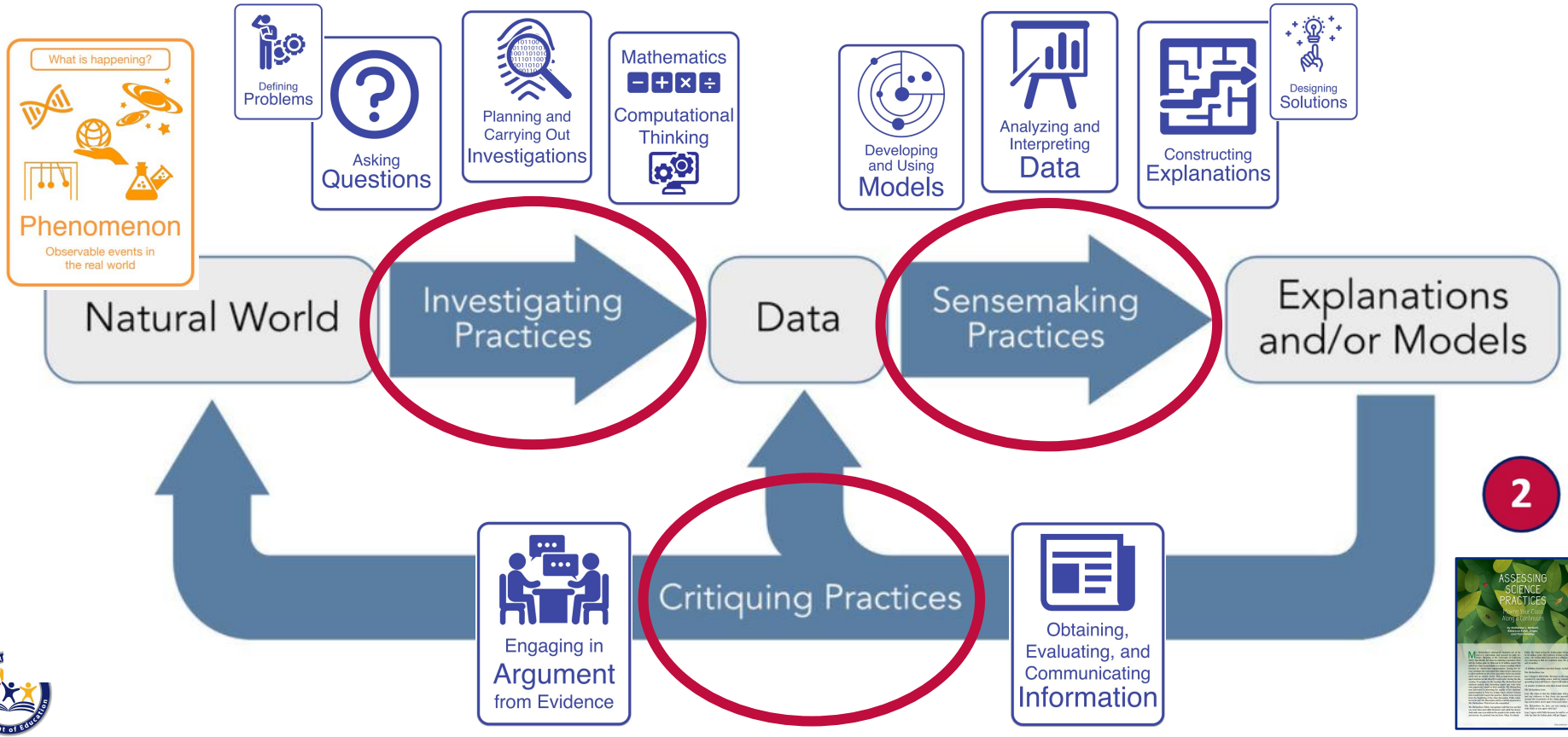

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

1 K-12

# Science & Engineering Practices (SEPs)

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

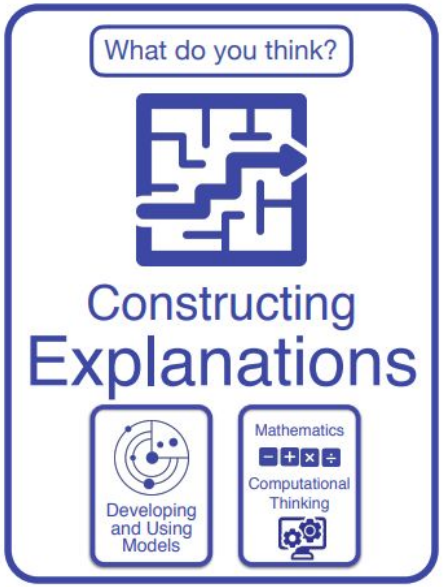
# Grouping the Practices

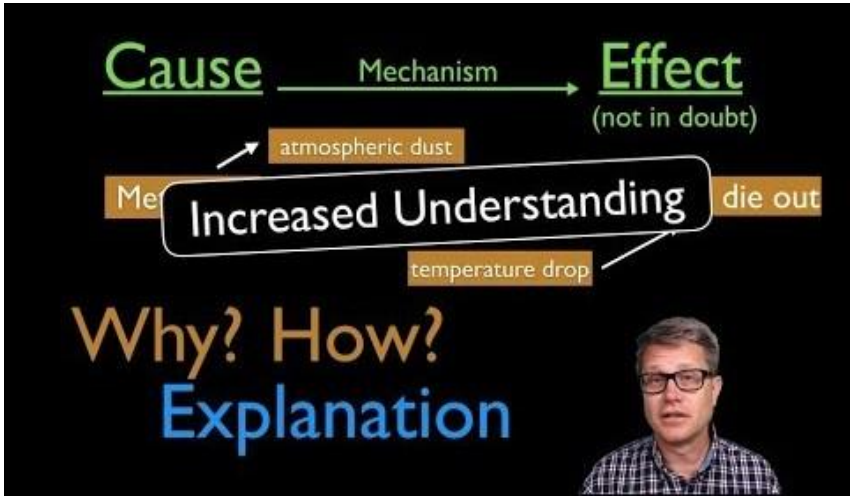


# 3 Categories of Science & Engineering Practices

| Investigating Practices | Sensemaking Practices | Critiquing Practices |
| --- | --- | --- |
| 1. Asking Questions | 2. Developing & Using Models | 7. Engaging in Argument from Evidence |
| 3. Planning & Carrying Out Investigations | 4. Analyzing & Interpreting Data | 8. Obtaining, Evaluating, & Communicating Information |
| 5. Using Mathematical & Computational Thinking | 6. Constructing Explanations | |

# SEP 6: Constructing Explanations Video


Chat

**What resonated with you MOST about this SEP?**
**What *new* learning occurred for you?**

3

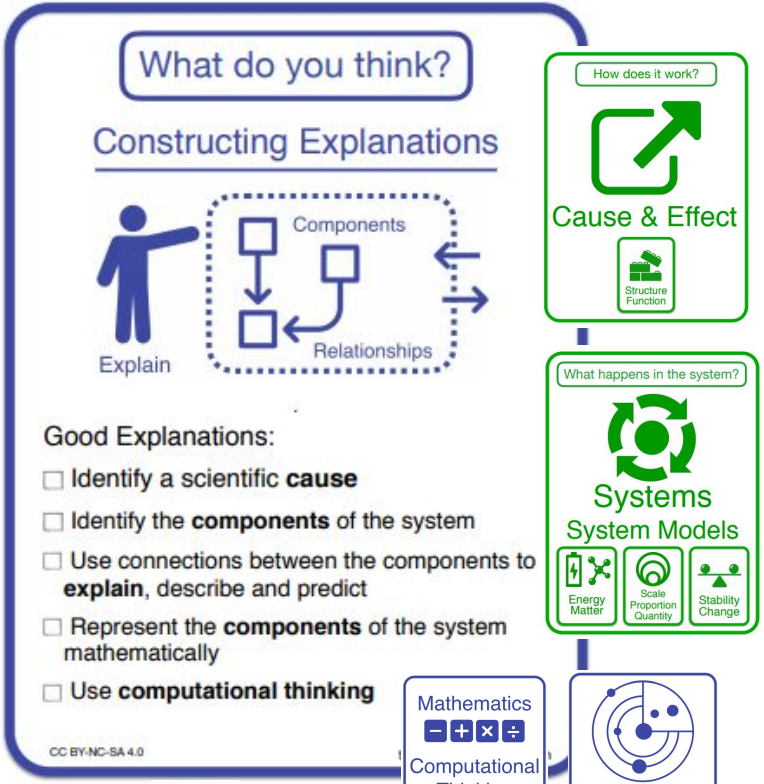
**Sensemaking Practices**

2. Developing & Using Models

4. Analyzing & Interpreting Data

6. Constructing Explanations

# SEP 6: Constructing Explanations Summary





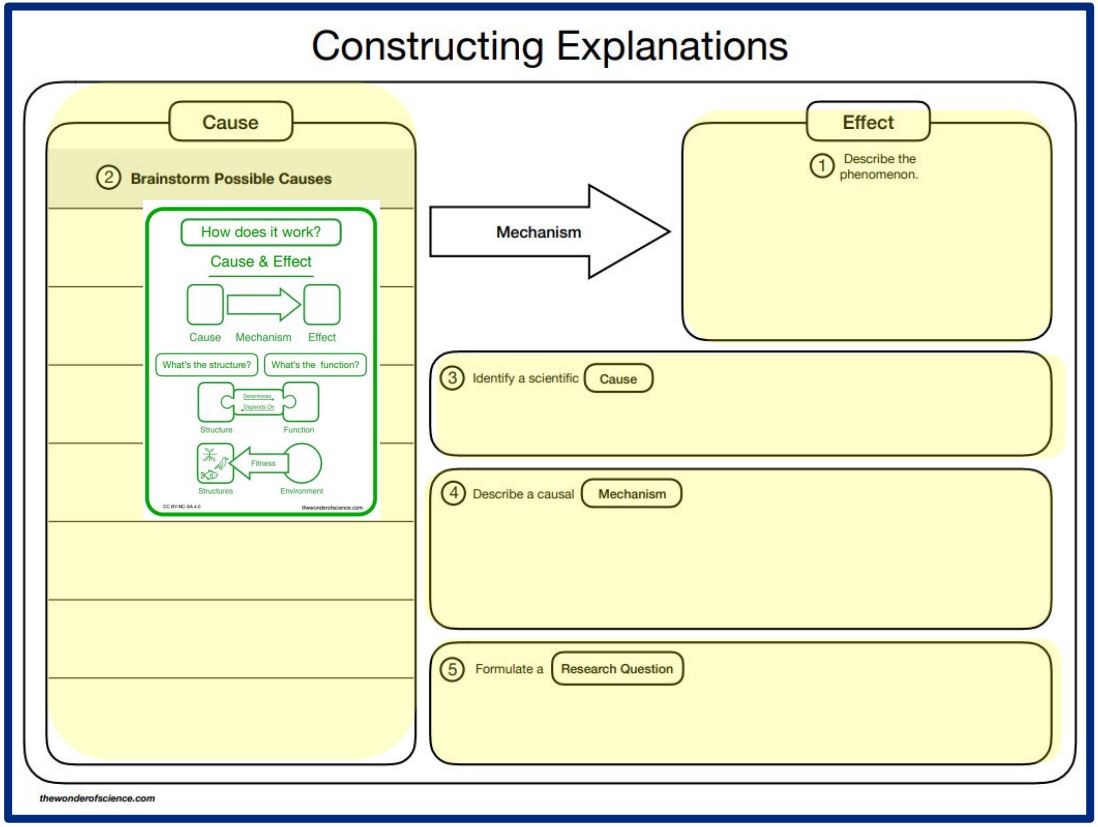










# SEP: Constructing Explanations & Designing Solutions

4

**Elements:**

**Specific pieces of knowledge and skill that make up the practice at each grade band.**

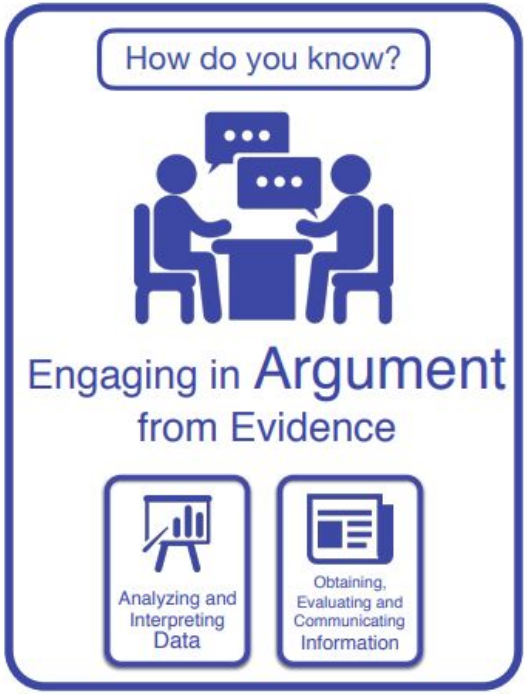
## K-12 Science and Engineering Practices* Progression Matrix of Elements

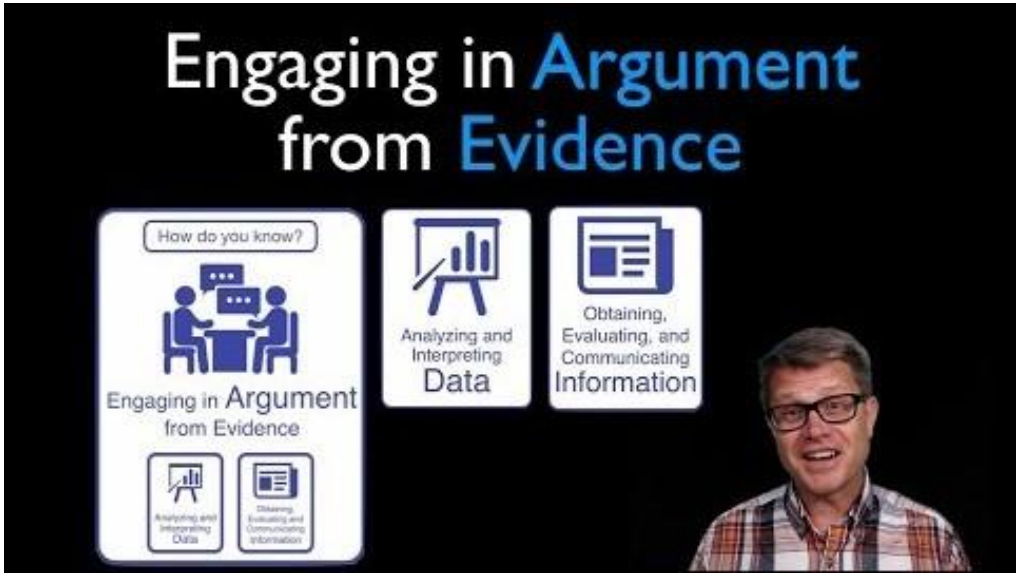
For use with *Arizona Science Standards*

| Science and Engineering Practices | K–2 Condensed Practices | 3–5 Condensed Practices | 6–8 Condensed Practices | 9–12 Condensed Practices |
|---|---|---|---|---|
| **Constructing Explanations and Designing Solutions**<br><br>*The end-products of science are explanations and the end-products of engineering are solutions.*<br><br>The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories.<br><br>The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints. | Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence or ideas in constructing explanations and designing solutions.<br><br>• Use information from direct or indirect observations to construct explanations.<br>• Use tools and materials provided to design a device or solution to a specific problem.<br>• Distinguish between opinions and evidence in one's own explanations.<br>• Generate and compare multiple solutions to a problem. | Constructing explanations and designing solutions in 3–5 builds on prior experiences in K–2 and progresses to the use of evidence in constructing multiple explanations and designing multiple solutions.<br><br>• Construct explanations of observed quantitative relationships (e.g., the distribution of plants in the back yard).<br>• Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation or design a solution to a problem.<br>• Identify the evidence that supports particular points in an explanation.<br>• Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.<br>• Apply scientific knowledge to solve design problems.<br>• Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the problem. | Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.<br><br>• Construct explanations for either qualitative or quantitative relationships between variables.<br>• Apply scientific reasoning to show why the data are adequate for the explanation or conclusion.<br>• Base explanations on evidence obtained from sources (including their own experiments) and the assumption that natural laws operate today as they did in the past and will continue to do so in the future.<br>• Undertake design projects, engaging in the design cycle, to construct and implement a solution that meets specific design criteria and constraints.<br>• Apply scientific knowledge and evidence to explain real-world phenomena, examples, or events.<br>• Construct explanations from models or representations.<br>• Apply scientific knowledge to design, construct, and test a design of an object, tool, process or system.<br>• Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing. | 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 knowledge, principles, and theories.<br><br>• Make quantitative and qualitative claims regarding the relationship between dependent and independent variables.<br>• Apply scientific reasoning, theory, and models to link evidence to claims to assess the extent to which the reasoning and data support the explanation or conclusion.<br>• Construct and revise explanations based on evidence obtained from a variety of sources (e.g., scientific principles, models, theories, simulations) and peer review.<br>• Base causal explanations on valid and reliable empirical evidence from multiple sources and the assumption that natural laws operate today as they did in the past and will continue to do so in the future.<br>• Apply scientific knowledge and evidence to explain phenomena and solve design problems, taking into account possible unanticipated effects.<br>• 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. |

**Increasing sophistication**

# SEP 7: Engaging in Argument from Evidence Video




Chat

**What resonated with you MOST about this SEP?**
**What is one take-away you have?**

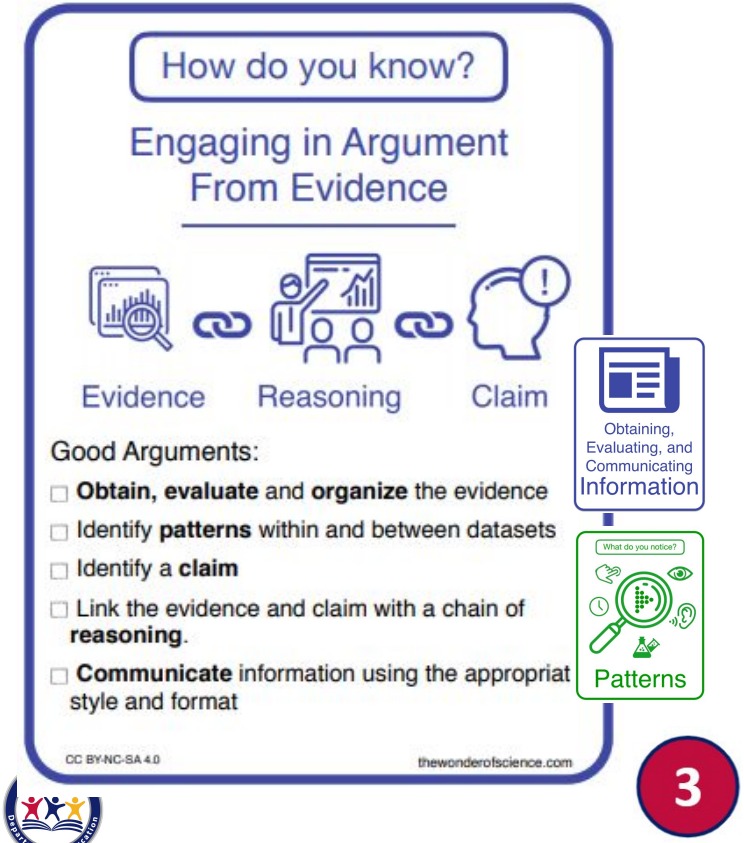
3

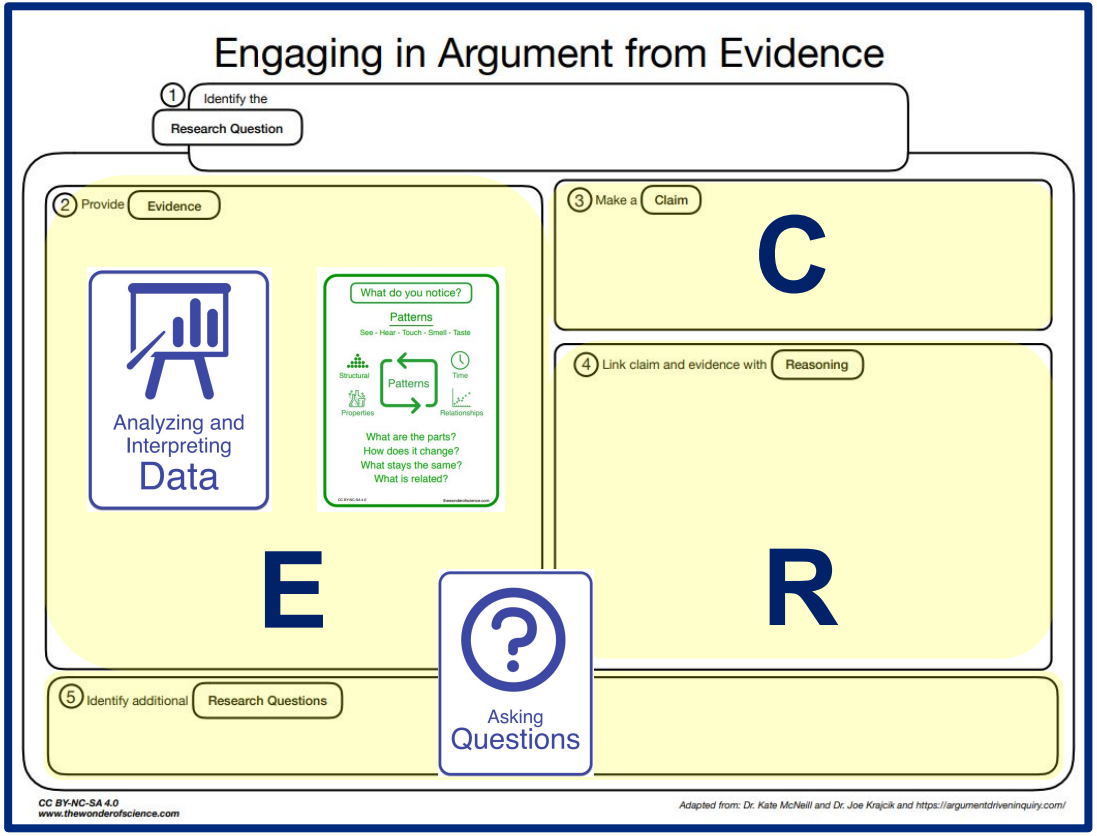
**Critiquing Practices**

7. Engaging in Argument from Evidence

8. Obtaining, Evaluating, & Communicating Information

# SEP 7: Engaging in Argument from Evidence Summary- ECR



# SEP: Engaging in Argument from Evidence

## K-12 Science and Engineering Practices* Progression Matrix of Elements

For use with *Arizona Science Standards*

| Science and Engineering Practices | K–2 Condensed Practices | 3–5 Condensed Practices | 6–8 Condensed Practices | 9–12 Condensed Practices |
|---|---|---|---|---|
| **Engaging in Argument from Evidence**<br><br>*Argumentation is the process by which explanations and solutions are reached.*<br><br>In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem.<br><br>Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits.<br><br>Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to identify strengths and weaknesses of claims. | Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world.<br><br>- Identify arguments that are supported by evidence.<br>- Listen actively to others' explanations and arguments and ask questions for clarification.<br>- Make a claim about the effectiveness of an object, tool, or solution that is based on relevant evidence. | Engaging in argument from evidence in 3–5 builds from K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world.<br><br>- Construct and/or support scientific arguments with evidence, data, and/or a model.<br>- Compare and refine arguments based on the strengths and weaknesses of the evidence presented.<br>- Respectfully provide and receive critiques on scientific arguments with peers by citing relevant evidence and posing specific questions.<br>- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. | Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.<br><br>- Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation for a phenomenon or a solution to a problem.<br>- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.<br>- Respectfully provide and receive critiques on scientific arguments by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail.<br>- Compare two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts.<br>- Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system, based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints. | 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. Arguments may also come from current scientific or historical episodes in science.<br><br>- Critique and evaluate competing arguments, models, and/or design solutions in light of new evidence, limitations (e.g., trade-offs), constraints, and ethical issues.<br>- Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.<br>- Construct a counter-argument that is based on data and evidence that challenges another proposed argument.<br>- Make and defend a claim about the natural world or the effectiveness of a design solution that reflects scientific knowledge, and student-generated evidence.<br>- Evaluate a claim for a design solution to a real-world problem based on scientific knowledge, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). |

4

# Key Differences Summary

| | | | | |
|---|---|---|---|---|
| 6. Constructing Explanations | Students do not create scientific explanations. | Students attempt to create scientific explanations, but students' explanations are descriptive instead of explaining how or why a phenomenon occurs. Students do not use appropriate evidence to support their explanations. | Students construct explanations that focus on explaining how or why a phenomenon occurs. Students do not use appropriate evidence to support their explanations. | Students construct explanations that focus on explaining how or why a phenomenon occurs and use appropriate evidence to support their explanations. |

**Sensemaking Practice**

| | | | | |
|---|---|---|---|---|
| 7. Engaging in argument from evidence | Students do not engage in argumentation. | Students engage in argumentation where they support their claims with evidence or reasoning, but the discourse is primarily teacher-driven. | Students to engage in student-driven argumentation. The student discourse includes evidence and reasoning to support their claim. Students also agree and disagree, but rarely engage in critique. | Students engage in student-driven argumentation. The student discourse includes evidence, reasoning that links the evidence to their claim and critique of competing arguments during which students build on and question each other's ideas. |

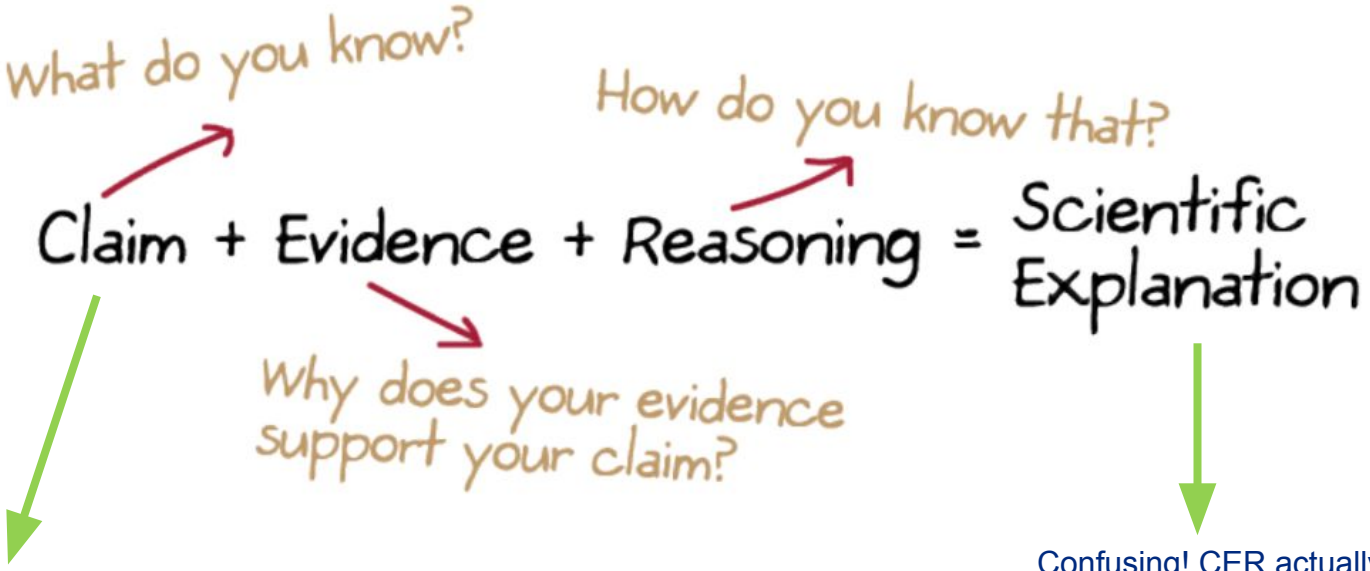
**Critiquing Practice**

2


**FIGURE 4** Science Practices Continuum assessment tool

| | Science practices | Level 1 (Not Present) | Level 2 (Emergent) | Level 3 (Proficient) | Level 4 (Exemplary) |
|---|---|---|---|---|---|
| Sensemaking science practices (continued) | 6. Constructing Explanations | Students do not create scientific explanations. | Students attempt to create scientific explanations, but students' explanations are descriptive instead of explaining how or why a phenomenon occurs. Students do not use appropriate evidence to support their explanations. | Students construct explanations that focus on explaining how or why a phenomenon occurs. Students do not use appropriate evidence to support their explanations. | Students construct explanations that focus on explaining how or why a phenomenon occurs and use appropriate evidence to support their explanations. |
| | 2. Developing and Using Models | Students do not create models. | Students create models. Students' models focus on describing natural phenomena rather than predicting or explaining the natural world. Students do not evaluate the merits and | Students create models focused on predicting or explaining the natural world. Students do not evaluate the merits and limitations of the model. | Students create models focused on predicting or explaining the natural world. Students do evaluate the merits and limitations of the model. |
| Critiquing Science Practices | 7. Engaging in argument from evidence | Students do not engage in argumentation. | Students engage in argumentation where they support their claims with evidence or reasoning, but the discourse is primarily teacher-driven. | Students to engage in student-driven argumentation. The student discourse includes evidence and reasoning to support their claim. Students also agree and disagree, but rarely engage in critique. | Students engage in student-driven argumentation. The student discourse includes evidence, reasoning that links the evidence to their claim and critique of competing arguments during which students build on and question each other's ideas. |
| | 8. Obtaining, evaluating, and communicating information | Students do not read text for scientific information. | Students read text to obtain scientific information, but do not evaluate this information. Students also do not compare or combine information from multiple texts considering the strengths of the information and sources. | Students read and evaluate text to obtain scientific information. Students do not compare or combine information from multiple texts considering the strengths of the information and sources. | Students read and evaluate text to obtain scientific information. Students compare and combine information from multiple texts considering the strengths of the information and sources. |

# The Basics of C-E-R & Misconceptions




Claim is not an opinion- it is any idea- from investigation designs, questions, models, interpretations of data- that the students are supporting and can be questioned or revised

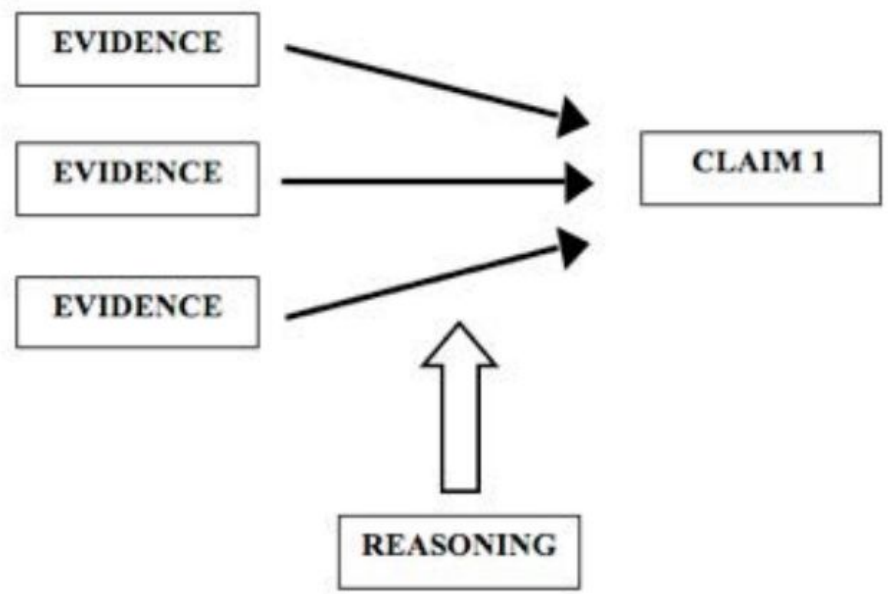
Confusing! CER actually reflects **only** the practice of Engaging in Arguing from Evidence (not constructing **explanations**)

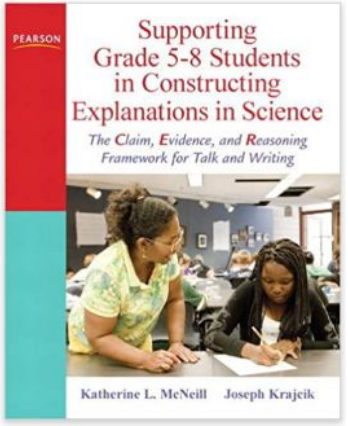
see p. 212 for more info---------

# The C-E-R Framework is Really E-R-C

## C-E-R Framework

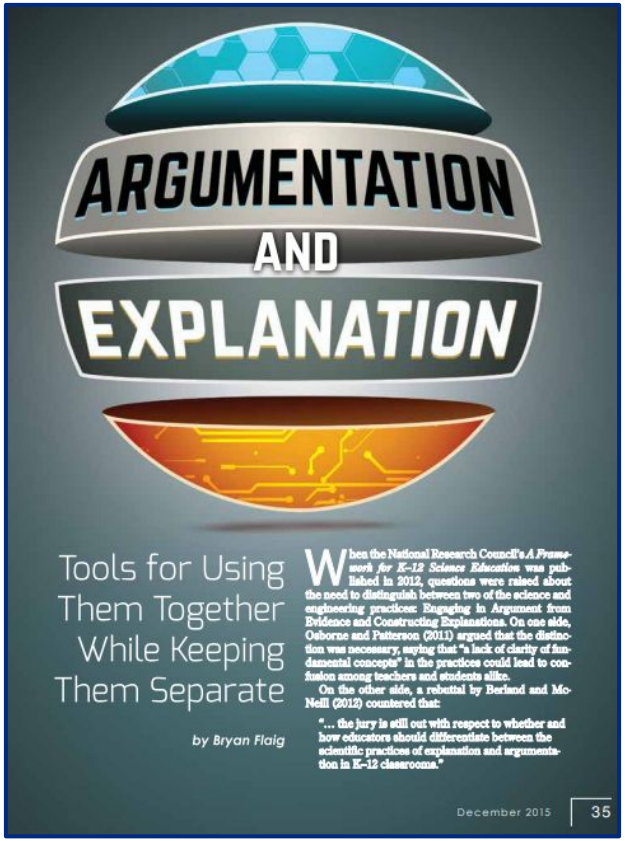
*McNeill & Krajcik (2012)*




Borrowed from Katherine McNeill's NSTA Presentation- Beyond CER

# Resources on Argumentation vs Explanation

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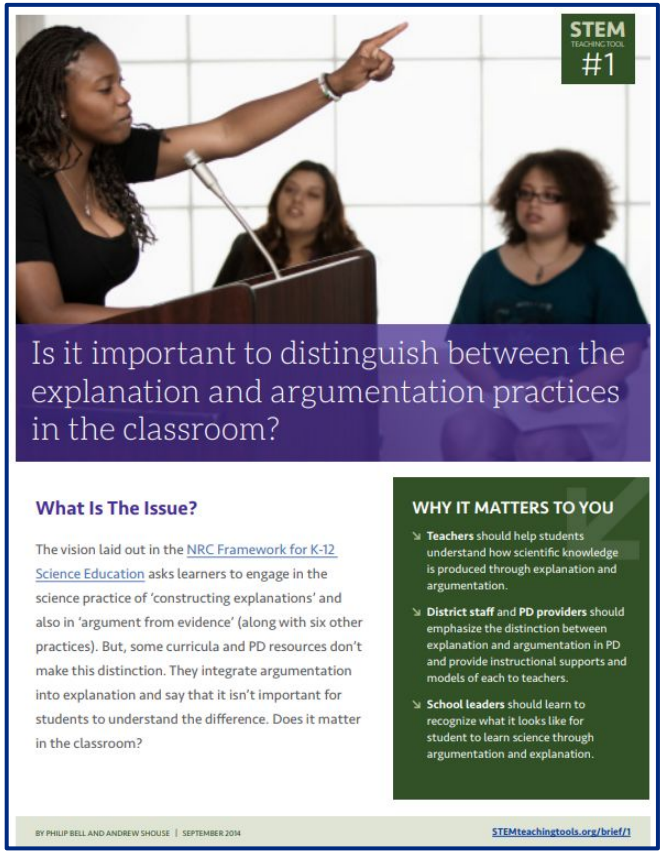
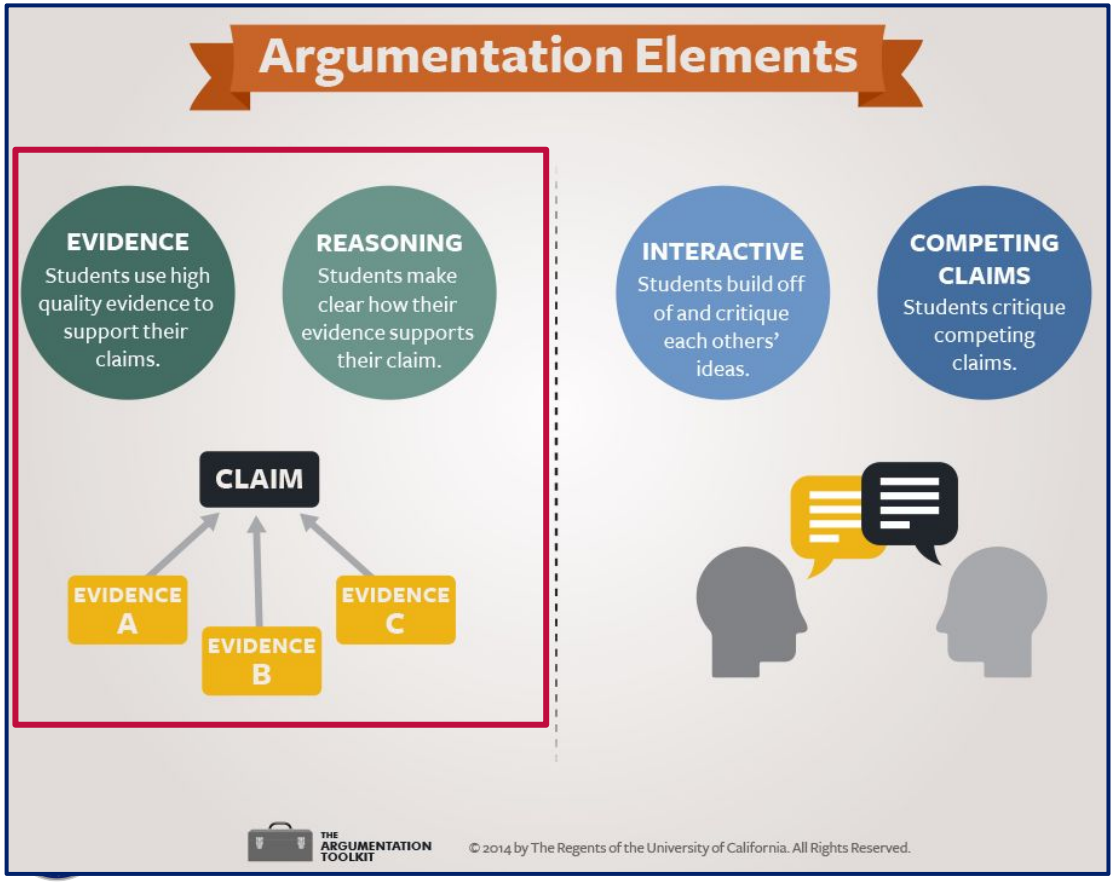


# Argumentation Elements




# Let's Try It: To GMO or Not?

BL BetterLesson | Search | Home | Professional Learning | Instructional Strategies | Lesson Plans

Science | High School Biology (Mitchell Smith) | Unit 5 | Lesson 4

- Objective
- Learner Goals
- Anticipatory Set ("Hook")
- Instructional Input/Student Activities
- Closure: What did we learn? Where do we go from here?

## To GMO or not? That is the question... (Day #1 of 3)

Favorited

**Essential HS.L3U3.26**
Engage in argument from evidence regarding the ethical, social, economic, and/or political implications of a current genetic technology.

### Objective

Students will make and defend a claim stating their position (i.e. argue) regarding the creation and use of genetically modified organisms with consideration of its pros and cons.


### Big Idea

Biotechnology (and genetic engineering in particular) can produce changes that are helpful or harmful.

# To GMO or NOT?


TEDxNextGenerationAsheville • August 2010 | 2.4M views

Like (73K) Share Add

## What's wrong with our food system

Read transcript

Birke Baehr

At a TEDx event, 11-year-old Birke Baehr presents his take on a major source of our food -- far-away and less-than-picturesque industrial farms. Keeping farms out of sight promotes a rosy, unreal picture of big-box agriculture, he argues, as he outlines the case to green and localize ...

YouTube

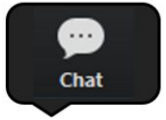
# Waterfall Chat

## Alone Zone- 1 minute

Think about what you saw and heard in the TED talk.

## Whole Group Waterfall Chat - 30 seconds

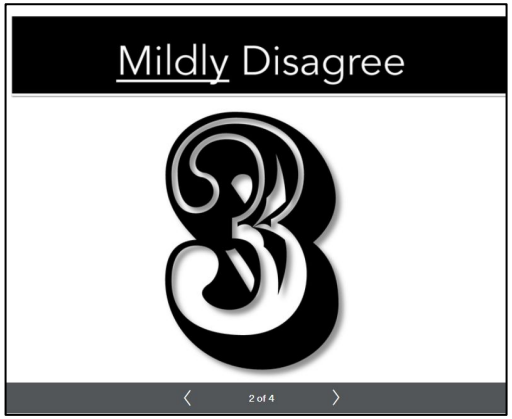
Type one main point in the chat that resonated most with you from the TED talk.

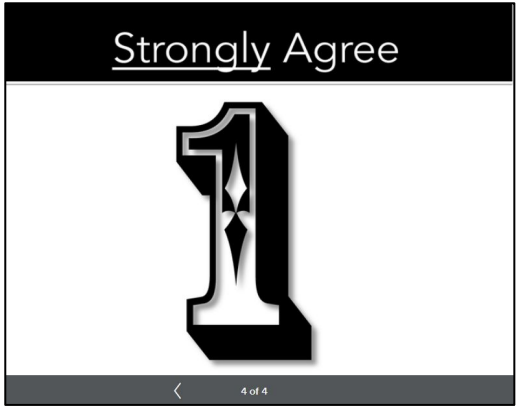



Type in chat box, but DO NOT HIT ENTER!

(wait for countdown- 3,2,1..waterfall!)

# 4 Corners Discussion Talk Through

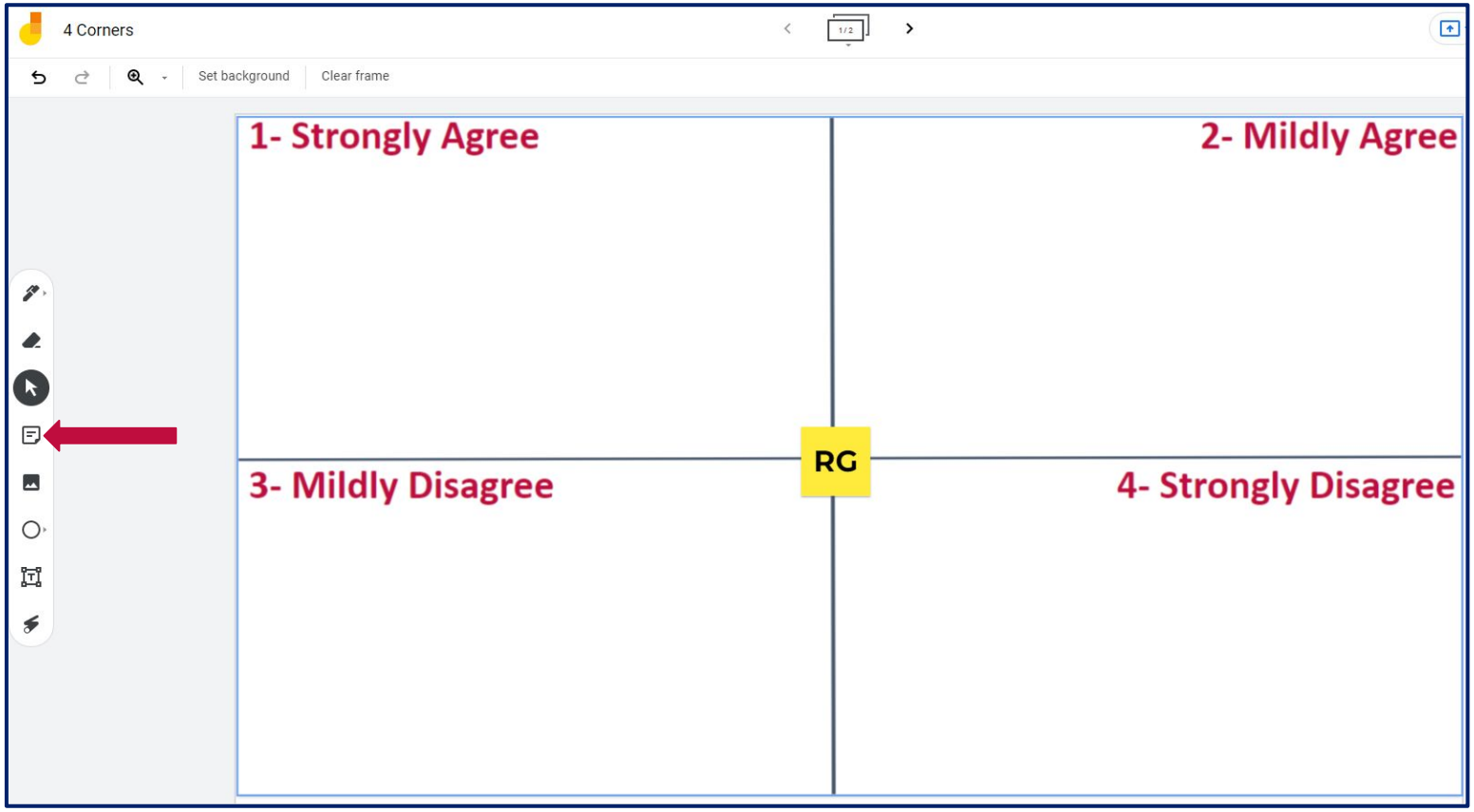


BL BetterLesson

# 4 Corners Jamboard Frame 1

8

Make a sticky note with your initials and move it to the corner that best matches [Bierke's view](#).

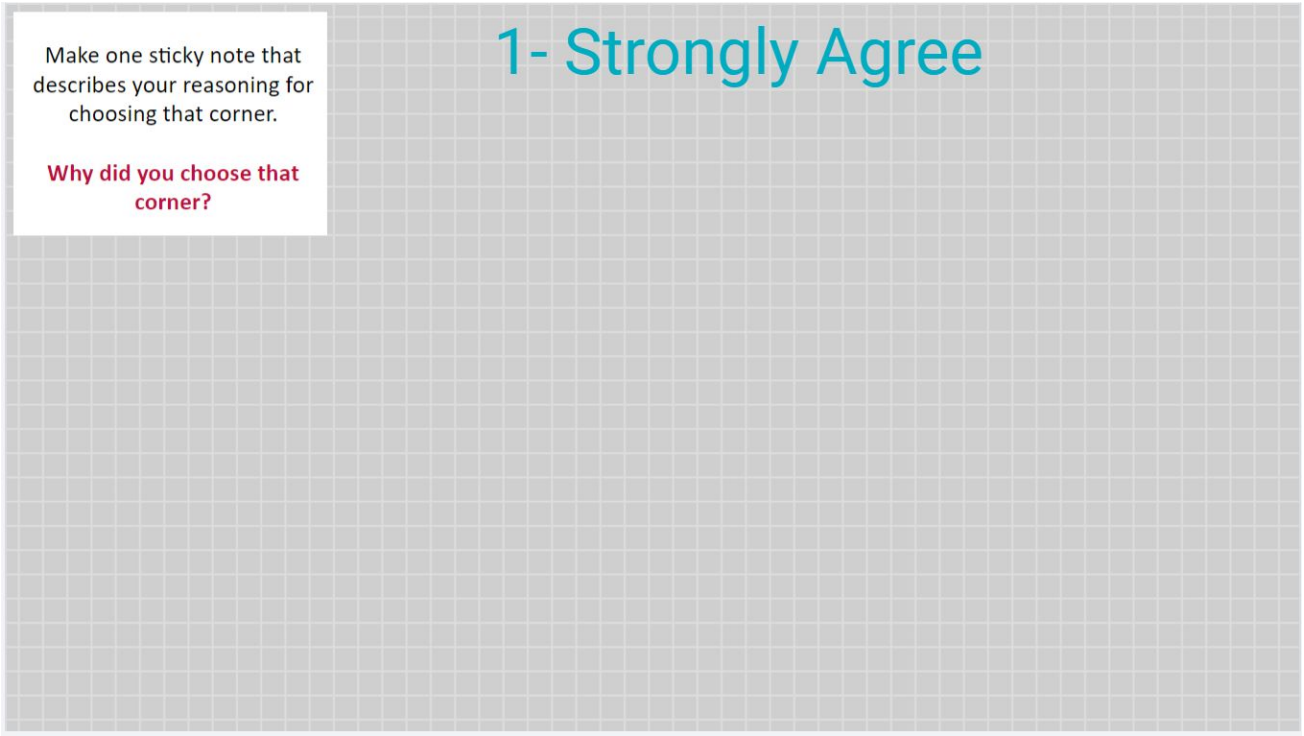


# 4 Corners Jamboard- Frames 2, 3, 4, 5

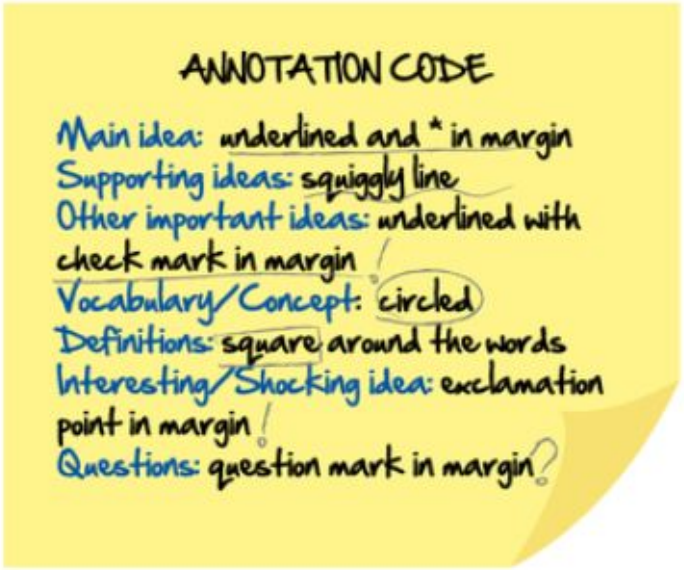
Make one sticky note that describes your reasoning for choosing that corner.

**Why did you choose that corner?**

8



# Gather Evidence- Read & Annotate Pros vs Cons




**9**

**Alone Zone- 7 minutes**

CSA **Discovery Guides-** Click here for the original article with citations

**Genetically Modified Foods: Harmful or Helpful?**

Deborah B. Whitman

Genetically-modified foods (GM foods) have made a big splash in the news lately. European environmental organizations and public interest groups have been actively protesting against GM foods for months, and recent controversial studies about the effects of genetically-modified corn pollen on monarch butterfly caterpillars[1,2] have brought the issue of genetic engineering to the forefront of the public consciousness in the U.S. In response to the up swelling of public concern, the U.S. Food and Drug Administration (FDA) held three open meetings in Chicago, Washington, D.C., and Oakland, California to solicit public opinions and begin the process of establishing a new regulatory proce- dure for government approval of GM foods.[3] I attended the FDA meeting held in Novem- ber 1999 in Washington, D.C., and here I will attempt to summarize the issues involved and explain the U.S. government's present role in regulating GM food.

**What are genetically-modified foods?**

**Annotating Strategy- use highlighter or other strategy to identify**

- **Pros**
- **Cons**

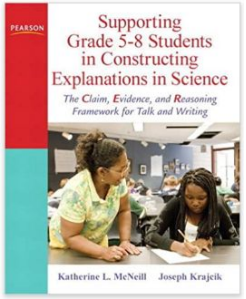
# CER(R)- Claims, Evidence, Reasoning, Rebuttal

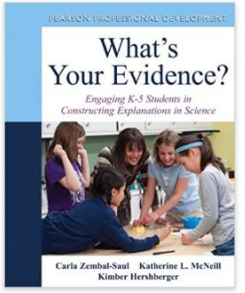
**Claim**: A statement that expresses the answer or conclusion to a question or problem.

**Evidence**: Scientific data that supports the claim.

**Reasoning**: Provides a justification that links the evidence to the claim and explains why the evidence supports the claim using scientific principles.

**(Rebuttal)**: Recognizes and describes alternative explanations and provides counter evidence and reasoning for why the explanation is not appropriate.

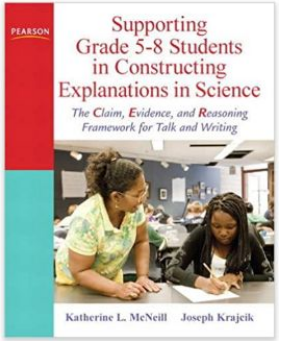


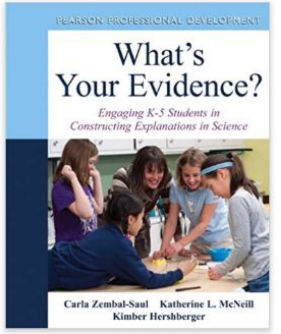



# Variations of C-E-R

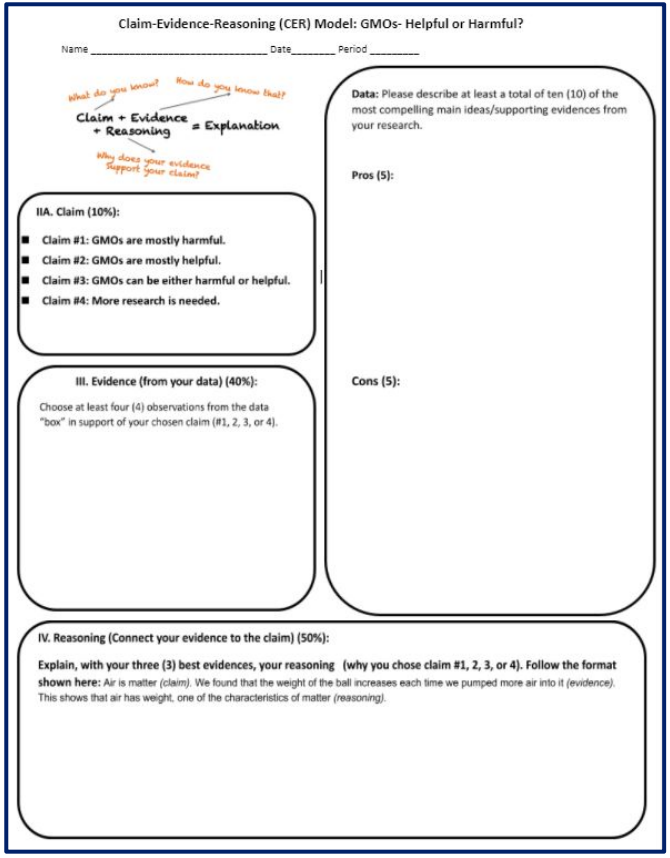
| Variation | Grade Level | Description |
|---|---|---|
| Variation 1 | K-2 (perhaps completed verbally) | 1. Claim<br>2. Evidence |
| Variation 2 | K-2, 3-5 | 1. Claim<br>2. Evidence<br>• Multiple Pieces |
| Variation 3 | 3-5, 6-8 | 1. Claim<br>2. Evidence<br>• Multiple Pieces<br>3. Reasoning |
| Variation 4 | 6-8, 9-12 | 1. Claim<br>2. Evidence<br>• Multiple Pieces<br>3. Reasoning<br>4. Rebuttal |

Table adapted from *What's Your Evidence* pg. 119



# Develop an Initial C-E-R Graphic Organizer



Claim-Evidence-Reasoning (CER) Model: GMOs- Helpful or Harmful?

Name _____ Date_____ Period _____

What do you know? How do you know that?

Claim + Evidence + Reasoning = Explanation

Why does your evidence support your claim?

**IIA. Claim (10%):**

- **Claim #1: GMOs are mostly harmful.**
- **Claim #2: GMOs are mostly helpful.**
- **Claim #3: GMOs can be either harmful or helpful.**
- **Claim #4: More research is needed.**

**III. Evidence (from your data) (40%):**

Choose at least four (4) observations from the data "box" in support of your chosen claim (#1, 2, 3, or 4).

**Data:** Please describe at least a total of ten (10) of the most compelling main ideas/supporting evidences from your research.

**Pros (5):**

**Cons (5):**

**IV. Reasoning (Connect your evidence to the claim) (50%):**

**Explain, with your three (3) best evidences, your reasoning (why you chose claim #1, 2, 3, or 4). Follow the format shown here:** Air is matter *(claim)*. We found that the weight of the ball increases each time we pumped more air into it *(evidence)*. This shows that air has weight, one of the characteristics of matter *(reasoning)*.

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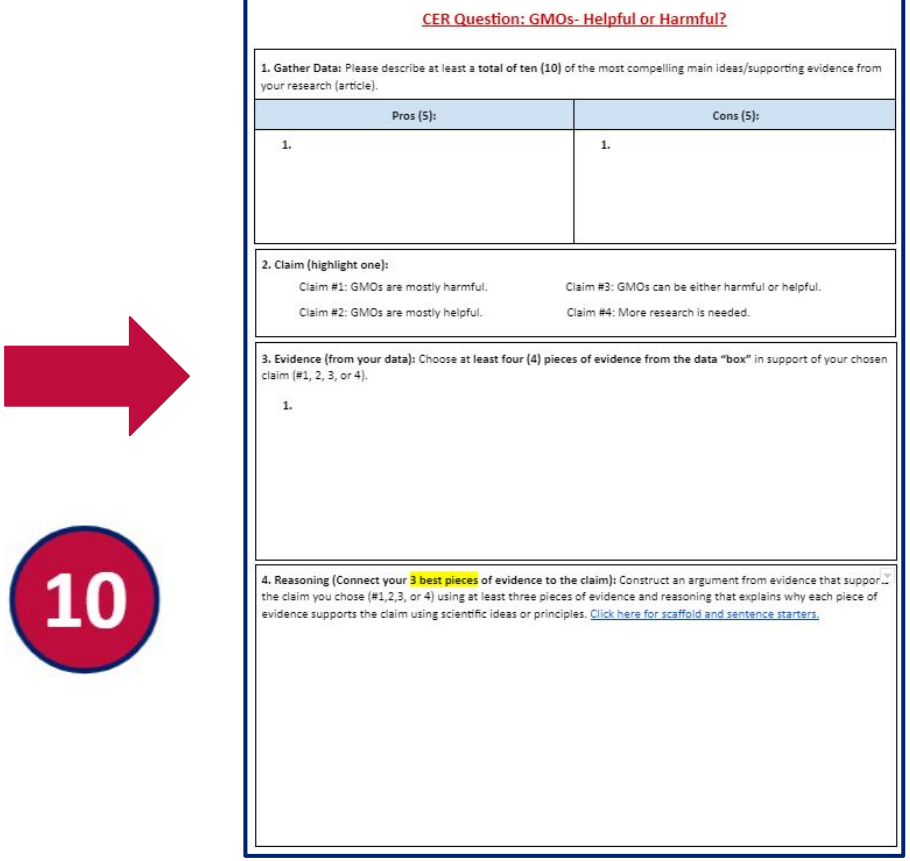


**CER Question: GMOs- Helpful or Harmful?**

**1. Gather Data:** Please describe at least a **total of ten (10)** of the most compelling main ideas/supporting evidence from your research (article).

| Pros (5): | Cons (5): |
|---|---|
| 1. | 1. |

**2. Claim (highlight one):**

Claim #1: GMOs are mostly harmful. Claim #3: GMOs can be either harmful or helpful.

Claim #2: GMOs are mostly helpful. Claim #4: More research is needed.

**3. Evidence (from your data):** Choose at least four (4) pieces of evidence from the data "box" in support of your chosen claim (#1, 2, 3, or 4).

1.

**4. Reasoning (Connect your 3 best pieces of evidence to the claim):** Construct an argument from evidence that suppor... the claim you chose (#1,2,3, or 4) using at least three pieces of evidence and reasoning that explains why each piece of evidence supports the claim using scientific ideas or principles. Click here for scaffold and sentence starters.

# Develop a Rebuttal

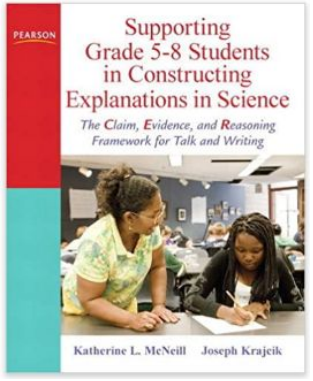
Base Rubric for Claims, Evidence, Reasoning, Rebuttal

*Taken From Supporting Grade 5-8 Students in Constructing Explanations in Science: The Claim, Evidence, and Reasoning Framework for Talk and Writing by Katherine McNeill and Joseph Krajcik (2012).*

| Component | Level | | |
|---|---|---|---|
| | 0 | 1 | 2 |
| **Claim** A statement or conclusion that answers the question asked or the problem posed. | Does not make a claim, or makes an inaccurate claim. | Makes an accurate but incomplete claim. | Makes an accurate and complete claim. |
| **Evidence** Scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim. | Does not provide evidence, or only provides inappropriate evidence that does not support claim. | Provides appropriate, but insufficient evidence to support claim. May include some inappropriate evidence. | Provides appropriate and sufficient evidence to support claim. |
| **Reasoning** A justification that connects the evidence to the claim. It shows *why data counts as evidence* by using appropriate and sufficient scientific principles. | Does not provide reasoning, or only provides reasoning that does not link evidence to the claim. | Provides reasoning that links the claim and evidence. Repeats the evidence and/or includes some scientific principles, but not sufficient. | Provides reasoning that links evidence to claim. Includes appropriate and sufficient scientific principles. |
| **Rebuttal** Recognizes and describes alternative explanations, and provides counter evidence and reasoning for why the alternative explanation is not appropriate. | Does not recognize that an alternative explanation exists and does not provide a rebuttal or makes an inaccurate rebuttal. | Recognizes alternative explanations and provides appropriate but insufficient counter evidence and reasoning in making a rebuttal. | Recognizes alternative explanations and provides appropriate and sufficient counter evidence and reasoning when making rebuttals. |

## Rebuttal

- Create another **C-E-R** but for an alternative or counter-claim
- What would the opposing side argue?



# Rubrics for CER

| Level | Description | | |
|---|---|---|---|
| | Claim | Evidence | Reasoning |
| Level 4<br>Complete and correct | The student's claim is clear and relevant. | The student's evidence supports the claim, is accurate and sufficient, and student evaluates the strength of the evidence in supporting the claim. | The student's reasoning is appropriate, logically connected to the claim, and sufficient. |
| Level 3<br>Almost there | The student's claim is relevant but incomplete. | The student's evidence is relevant, accurate, and sufficient. | The student's reasoning is appropriate and logically connected to the claim, BUT is not sufficient. |
| Level 2<br>On the way | The student's claim seems relevant but is unclear. | The student's evidence is relevant BUT is incomplete and/or contains inaccuracies. | The student's reasoning is scientific BUT is incomplete or not logically connected to the claim. |
| Level 1<br>Getting started | The student provided an irrelevant claim. | The student's evidence is irrelevant or does not support the claim. | The student's reasoning is nonscientific, does not logically support the claim, or does not connect the claim to the evidence. |
| Level 0 | The student provided no claim. | The student provided no evidence. | The student provided no reasoning. |
| x | The student had no opportunity to respond. | The student had no opportunity to respond. | The student had no opportunity to respond. |

Claims, Evidence and Reasoning Rubric

**Name:** _____

| Category | N/A | Beginning | Approaching | Meeting |
|---|---|---|---|---|
| Claim<br>A conclusion that answers the original question. | Does not make a claim. | Makes an inaccurate claim. | Makes an accurate, but incomplete claim. | Makes an accurate and complete claim. |
| Evidence<br>Scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim. | Does not provide evidence. | Evidence is inappropriate or it does not support the claim. | Provides appropriate, but insufficient evidence. May include some inappropriate evidence. | Provides appropriate and sufficient evidence to support claim. |
| Reasoning<br>A justification that links the claim to the evidence. It shows why the data counts as evidence by using appropriate scientific principles. | Does not include reasoning. | Reasoning is not appropriate or does not link the claim to the evidence. | Provides reasoning that links claims to evidence. Repeats evidence and/or includes some scientific principles, but not sufficient. | Provides accurate and complete reasoning that links evidence to the claim. Includes appropriate and sufficient scientific principles. |

Adapted from:
McNeill, K.L. & Krajcik, J. (2008). Assessing middle school students' content knowledge and reasoning through written explanations. In Assessing science learning: Perspectives from research and practice, eds. J. Coffey, R. Douglas, and C. Stearns, 101–116. Arlington, VA: NSTA Press

# Arguing from Evidence is More than C-E-R Writing- Try a Card Sort!

## Surface of Mars Before and After


## Argumentation Sentence Starters for Partner Discussion

- I think this piece of evidence supports this claim because . . . .
- I don't think this piece of evidence supports this claim because . . . .
- I agree because . . . .
- I disagree because . . . .
- Why do you think that?

## Setup: Object on Mars Claim and Evidence Cards

**Question:** What is this object that the *Opportunity* rover photographed on the surface of Mars and how did it get there?

**Claim:** The jelly donut object found on Mars is a rock that was moved by the Mars' rover *Opportunity*.

| relevant evidence | irrelevant evidence |
|---|---|
| | |
| | |
| | |
| | |

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The Argumentation Toolkit — Strategy Guides

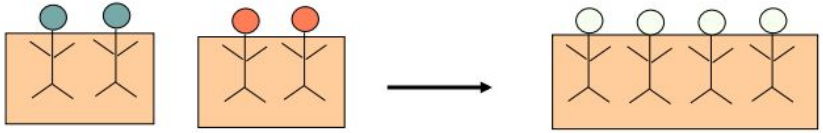
Home | Intro | Argument Elements | Resources | Teacher Learning | About

# Different Claims

## Group Work With Different Claims

- Goal is to create a situation where students in a group have different claims, which encourages them to question and critique each other's claims

Example Approach:



- **Argument Jigsaw:** 2 pairs of students converge to agree on a single explanation or model

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Borrowed from Katherine McNeill's NSTA Presentation- Beyond CER

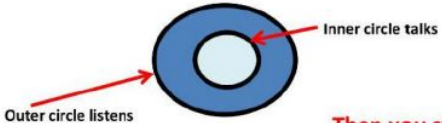
# Science Seminar

## Science Seminar

### Science Seminar Roles

Class Arrangement:.

- Half the class sits in the inner circle
- The other half of the class sits in the outer circle.



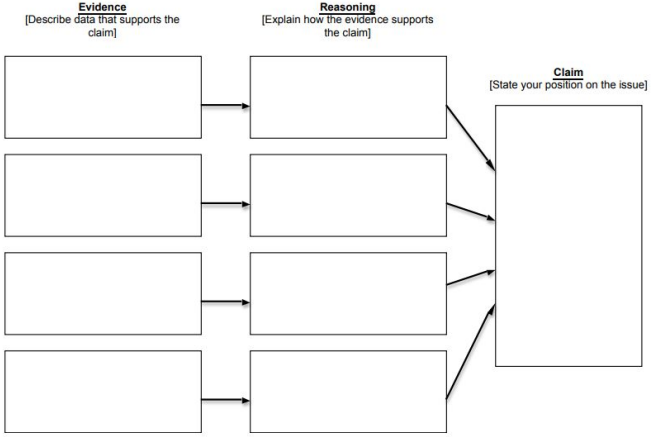

Then you switch.

The Argumentation Toolkit

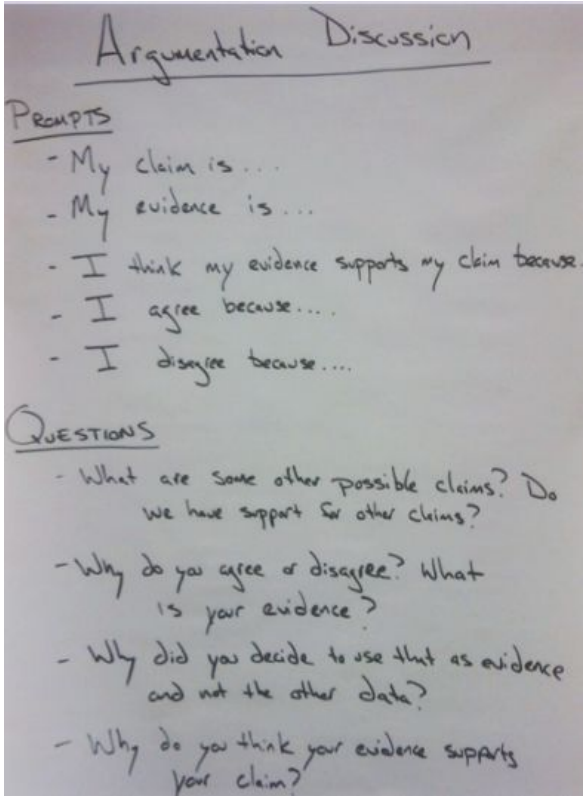
Borrowed from Katherine McNeill's NSTA Presentation- Beyond CER

# How to Successfully Begin to Engage Students in Arguing from Evidence

- Scaffolds
- Graphic Organizers
- Discussion Sentence Starters
- Writing Sentence Starters
- Time and Modeling!

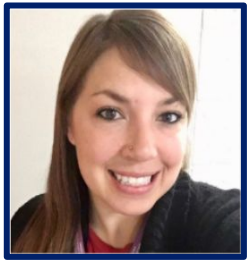



| Component | Sentence Starters (choose one per component) |
|---|---|
| **Claim** *(Highlight one)* | • Claim #1: GMOs are mostly harmful.<br>• Claim #3: GMOs can be either harmful or helpful.<br>• Claim #2: GMOs are mostly helpful.<br>• Claim #4: More research is needed. |
| **Evidence #1** *(Provide data to support your claim from the article)* | • From the_____article, evidence to support my claim is_____.<br>• According to the article, _____<br>• The first piece of evidence is _____<br>• One piece of evidence to support my claim is_____from the ___article. |
| **Reasoning #1** *(How does your evidence support your claim?)* | • This is important because_____.<br>• This shows that_____.<br>• This proves that_____.<br>• This supports my claim because_____.<br>• This evidence suggests that_____, which means_____. |
| **Evidence #2** *(Provide data to support your claim)* | • Another piece of evidence from the_____article is_____.<br>• Additionally, _____<br>• The second piece of evidence is _____ |
| **Reasoning #2** *(How does your evidence support your claim?)* | • This is important because_____.<br>• This shows that_____.<br>• This proves that_____.<br>• This supports my claim because_____.<br>• This evidence suggests that_____, which means_____. |
| **Evidence #3** *(Provide data to support your claim)* | • Another piece of evidence from the_____article is_____.<br>• Additionally,_____.<br>• The final (or third) piece of evidence is_____. |
| **Reasoning #3** *(How does your evidence support your claim?)* | • This is important because_____.<br>• This shows that_____.<br>• This proves that_____.<br>• This supports my claim because_____.<br>• This evidence suggests that_____, which means_____. |
| **Conclusion** *(Restate the Claim)* | • In conclusion, _____.<br>• In sum, _____.<br>• Therefore, _____. |



Arizona Department of Education

# Thank you for sharing this space!
# Please contact us for support!

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