Off-the-Shelf Lesson:
Claim, Evidence, Reasoning, and Argument

Teaching Time: 3-4 Class Periods (assuming 50 minute periods)

Instructional Setting:
- Classroom with a computer and projector

Lesson Discovery Questions:

- How do scientists and engineers settle arguments?
- How can we use claim, evidence, and reasoning to build arguments?

Gotta Have Checklist: Student explanations will include:

- How reasoning supports a claim
- How scientific principles support the reasoning of a claim
- How an explanation is different than an argument

Lesson Key Concepts	● Reasoning supports a claim by combining evidence with scientific principles. ● Including scientific principles in reasoning makes it possible to assess and critique your reasoning. This helps others provide feedback leading to stronger arguments. ● Considering counterclaims and the strength of reasoning are key features of argumentation.
Lesson Key Practices	● Make a claim about a given explanation ~~or model~~ for a phenomenon ● Identify and describe evidence to support the claim ● Use reasoning to connect evidence to the claim and construct or evaluate an argument

Learning Performances

1. Students will be able to make a claim, supported by evidence, reasoning, and scientific principles to construct an explanation.
2. Students will be able to use reasoning to evaluate the connection of evidence to a claim in order to construct or evaluate an argument.

NGSS Connections Primary Subcomponents		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence ● Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation~~ or a model for a phenomenon~~.	**none**	**none**

Lesson Introduction:

This Off-the-Shelf lesson is designed to get students familiar with the Claim, Evidence, and Reasoning (CER) and Claim, Evidence, Reasoning, and Argumentation (CERA) frameworks. CERs are a way to organize ideas for answering a question or formulating an argument. In a CER, the **claim** is the answer to the question being asked or investigated. The **evidence**, in the form of data, is linked to the particular claim through reasoning. Evidence can take the form of quantitative and/or qualitative data. Finally, **reasoning** shows how the evidence supports the claim by using scientific understandings. **Argumentation** takes this one step further, acknowledging alternative explanations while arguing that one explanation is superior, based on evidence and reasoning.

 Additional Resources to Support Teacher Background Knowledge

Science Words
Claim **Principle** **Evidence** **Reasoning** **Constructing an Explanation** **Arguing from Evidence**

Advance Preparation

- Prepare copies of student resources as needed (see phase summaries). **Note:** This lesson has a combined Student Guide for the Uncover/Share 1, Uncover/Share 2, and Connect phases, with a separate Check phase Student Guide.

Safety Considerations

- None for this lesson.

Mi-STAR Lesson Structure

Anchoring Experience

Phase Summary:

Students express their prior knowledge of argumentation by watching a video clip of two people arguing over a parking spot.

Resources Needed for this Instructional Phase:

- Per Class
    - Seinfeld The Parking Space (YouTube video)

Student Steps:

1. Students are introduced to an example of argumentation gone poorly using Seinfeld The Parking Space (YouTube video) to provide them with a common initial experience of settling disagreements through argumentation.

2. Students discuss the questions below to demonstrate their prior knowledge and misconceptions about settling disagreements through argumentation.

Example Guiding Questions
What was the problem they were trying to solve?
How were the two men trying to figure out who was right?
What reasons were each of the men giving to support that they were right?
Do you think that yelling at each other and name-calling are good ways to figure out who is right?
What kind of disagreements do you think scientists or engineers might have?
Do you think engineers should yell at each other, like the men in the video, when they are arguing over the best design? Do you think scientists should yell at each other, like the men in the video, when they are trying to figure out the answer to a problem?

Teacher Note: For more information on how to conduct productive talk, see the Mi-STAR Teacher Library: Pedagogy and Strategies document.

3. Students describe their own experiences, relevant to the phenomenon of settling a disagreement.

Example Guiding Questions
Example questions that elicit student experiences from outside the classroom: ● Have you ever had a disagreement like in the video? How was it resolved? ● Have you tried to convince someone you were right? What did you do? Did it work?

4. Students are introduced to the first Lesson Discovery Question:
    - *Example Introduction:*
      Scientists and engineers argue all the time - they argue about who is right, what is the best way to measure something, which criteria is most important, …

      In fact, you could say that their whole job is about arguing with other scientists and engineers!

      Typically scientists' arguments do not involve yelling and finger pointing like the video. Instead they construct their arguments in a very particular way that explains why they are right and others must be wrong. This way of arguing helps scientists and engineers to work together and figure out who is right. I think if we spend some time practicing learning like a scientist, it will help us have better conversations. Today's lesson question is:
        i. *How do scientists and engineers settle arguments?*

Uncover Your Ideas 1

Phase Summary:

In this activity, students create an argument for whether or not a girl's dad is an alien. They watch an Audi ad in which a young girl claims her dad is an alien. They list evidence for her claim, along with why the evidence proves he's an alien. Students express their prior knowledge for how to construct sound reasoning. Students will build on this experience in the Share Your Ideas 1 phase to discover how combining evidence with scientific principles leads to better reasoning.

Resources Needed for this Instructional Phase:

- Per Class
  - My Dad's an Alien (YouTube video)
- Per Student
  - OTS_CERA_Student_Guide
- Teacher Resources
  - OTS_CERA_Teacher_Guide

Student Steps:

1. Students are introduced to the investigation they will conduct and the purpose of the investigation.
   - *Example Introduction:*
     Before we get bogged down by science, let's practice making a more fun argument. This girl thinks her dad is an alien. You will first look at her statement, consider her facts and why they prove her statement, and then make one of your own.

     We will figure out if this dad is an alien!

2. Students watch My Dad's an Alien (YouTube video) twice - once, to get an overall impression and again to focus on evidence.

   Teacher Note: If your students are already familiar with this video, you may consider the "Dog buries cat" Doritos commercial (What happened to the cat?) instead.

3. In small groups, students complete as much as they can of the Part 1 CER scaffold in the OTS_CERA_Student_Guide.

   Teacher Note: Students should **not** consider as a class how they would know someone is an alien at this point. During the Share Phase, they will come to consensus that defining the principles (what does an alien do or look like?) is an important part of the reasoning process.

Share Your Ideas 1

Phase Summary:

Students share their small groups' evidence and reasoning, and come to consensus that good reasoning requires connecting evidence to commonly accepted principles.

Teacher Note: In the Student Steps we outline the basic goals of the Share phase; there are many ways to accomplish these goals that teachers may choose for their own classrooms. Some routines may be found in the Mi-STAR Visible Thinking and Discussion Routines document, as well as in the Phase 2 Productive Talk Canvas or virtual courses.

Resources Needed for this Instructional Phase:

- Per Class
  - Poster paper or whiteboard to record class evidence and reasoning
- Per Student
  - OTS_CERA_Student_Guide
- Teacher Resources
  - OTS_CERA_Teacher_Guide
  - Mi-STAR Teacher Resources: Strategies and Pedagogy

Student Steps:

1. Student groups share their initial findings from the Uncover Your Ideas 1 phase and reach a common understanding that good reasoning requires connecting evidence to commonly accepted principles through a facilitated whole-class discussion detailed in the steps below.

2. Students share their group's claims and evidence, looking for commonalities, and agree on some or all of the evidence presented in the video:
   - He speaks a weird language
   - He drinks green stuff
   - He says he's from Albuquerque
   - He dresses oddly (biking gear)
   - He drives a spaceship

   Teacher Note: You may wish to record a list of evidence on a class CER chart to make student thinking visible during this phase.

3. Students contrast evidence and reasoning, and then reflect on the role principles play in good reasoning through a guided productive talk.

Example Guiding Question	Example Student Answers

Did all groups in the class come up with the same supports for the girl's facts?	*No, some of the groups had different reasoning for some of the facts. Some groups couldn't write support statements for some of the facts.*
Which facts were hard to use as support?	*Drinking green stuff - humans do that too. Speaking other languages, dressing to ride a bike, driving a car with computer screens are all things humans do. Plenty of people are from Albuquerque and are not aliens.*
What things would we need to agree on before we could use her facts to support the statement that her dad is an alien?	*What is the definition of a space alien?* *How are they different from humans?*
How does agreeing upon ideas or definitions help someone convince others that their statement is correct?	*Knowing what an alien is and how they might be different from humans helps connect the facts to the statement and helps to see if the facts are not going to support the statement.*

4. Students formalize their common understanding by engaging with the following Science Words (**Claim, Principle, Evidence, Reasoning**).

   Claim: A statement or a position that answers a question.
   Principle: Ideas agreed upon by the community.
   Evidence: Facts, information, or data.
   Reasoning: Explaining the claim by using scientific principles to interpret evidence.

Example Guiding Question	Example Student Answers
How is supporting the facts (reasoning) different from listing the facts (evidence)?	*Evidence is the observations or data; reasoning should connect the observations to the claim, based on truths (principles) we agree on ahead of time.*

Uncover Your Ideas 2

Phase Summary:

Students practice using principles in their reasoning by constructing an argument about which of their two children most deserves a raise in their weekly allowance. In the Share Your Ideas 2 phase, students reflect on these arguments to see how including a principle helps make a position more clear, and can help you argue for or against the claims made by others.

Resources Needed for this Instructional Phase:

- Per Class
  - OTS_CERA_Uncover/Share2_Slides
- Per Student
  - OTS_CERA_Student_Guide
  - OTS_CERA_Uncover2_Student_ClockAppointments
- Teacher Resources
  - OTS_CERA_Teacher_Guide
  - Mi-STAR Teacher Resources: Strategies and Pedagogy

Student Steps:

1. Students are introduced to the activity they will do and the purpose of the activity.
   - *Example Introduction:*
     When we looked at the discussion of the girl's dad being an alien, we discovered that good reasoning has a claim that answers the question, is supported by evidence, and explains how the evidence supports the claim. We also found out that good reasoning is based on principles that we think everyone will agree with. We are well on our way to arguing like scientists and engineers!

     However before we dive into science examples, I think we should practice arguing a little more with something familiar, like arguing for a raise in an allowance.

2. Students share with the class common household chores that kids might have to do and the amount of time each chore takes. Students should share a few abstract "chores" as well, which don't require a time. Some examples might include:
   - Taking out the trash: 10 minutes
   - Walking the dog: 20 minutes
   - Studying/getting good grades (abstract)

3. As students share out chores, the teacher records each chore and time to complete (when applicable) in a two-column list on a whiteboard or projected document so that all students can see. A total of eight to ten chores should be shared.

   Teacher Notes:
   - The two columns should be as "even" as possible, with a mixture of chores that are easy vs. hard and quick vs. time-consuming. The goal is to have a discussion in which students disagree with one another, so the lists should not be too uneven.
   - The two columns will be chore lists for each of the children (see "Uncover scenario" step below). Students should not know that the list will be divided between the two children. Once the two columns are finalized, draw a line down the middle and label the columns with two names. The names can be two students in the class, two random names, etc. Consider using the OTS_CERA_Uncover/Share2_Slides as support through this Uncover/Share process.

4. Students are introduced to the Uncover scenario:
   - *Example Introduction:*
     Two siblings both want a raise in their allowance. Their parents are only going to give one of them a raise. Who should it be?

   Teacher Note: If receiving an allowance is not a relatable context for your students, consider swapping a different reward into the scenario such as: extension of curfew, choice of what to eat for dinner - e.g. special Sunday dinner, selection of where to order fast food - or permission to do a special activity or visit a special place.

5. Individually, students use the OTS_CERA_Student_Guide to record their initial **claim** as to which child should get the raise. Students list the **principles** they believe are involved in determining the value of various chores.

   Teacher Note: Students should not complete evidence, reasoning, or argument sections yet!

6. Students make 3 "clock appointments" with other students using the OTS_CERA_Uncover2_Student_ClockAppointments template to discuss various steps in the activities.

   Teacher Note: Clock Buddies is a routine in which students pre-plan different partners for different activities, designated as times on a clock (ex. Sarah is my 1 o'clock partner, Jay is

my 2 o'clock partner) or using other labels (ex. Sarah is my Red Wings appointment, Jay is my Tigers appointment). Any other strategy that involves students partnering with multiple students could be substituted here.

7. Students "trade papers" with their first clock appointment. After reviewing their partner's claim and principles, students should discuss with their partners:

Example Guiding Questions	Example Student Answers
Does your claim agree with your partner's? Is it okay if it doesn't?	*Student answers will vary.*
Do your principles agree with your partner's? Is it okay if they don't?	*Student answers will vary.*
Do you want to change your claim at all?	*Student answers will vary.*
Do you want to change your principles at all?	*Student answers will vary.*

Teacher Note: Note any use of reasoning or argumentation in student conversations throughout the phase.

8. Students are provided the opportunity to make any revisions to their claim or principles.

9. Then students record their **evidence** to support their revised claim and principles. They are reminded that evidence should only consist of facts that are recorded on the board. Their evidence should not include any opinions or interpretations of the evidence.

   Teacher Note: Students should not complete reasoning or argument sections yet!

10. Students meet with their second clock partner to discuss their evidence and how it can be used to support the claim. Students may make revisions based on their conversation.

11. Next, students record their **reasoning** in the OTS_CERA_Student_Guide. They are reminded that the reasoning involves applying their principles and evidence to their claim and explaining why they are right.

    Teacher Notes:

    - If your students need scaffolding in writing reasoning statements, consider adding these sentence starter prompts in the reasoning section of OTS_CERA_Student_Guide:
      - We know that… (state the principle)
      - We saw that… (describe the evidence)

- Therefore… (tie the principle and evidence together)
- Students should not complete the argument section yet!

12. Finally, students meet with their third clock appointment to discuss and debate their reasoning. Students make any changes or edits to their reasoning based on feedback or discussion with their partner.

Share Your Ideas 2

Phase Summary:

Students share their small groups' evidence and reasoning, and come to consensus that good arguments not only have good reasoning, but also address the opposing claim.

Teacher Note: In the Student Steps we outline the basic goals of the Share phase; there are many ways to accomplish these goals that teachers may choose for their own classrooms. Some routines may be found in the Mi-STAR Visible Thinking and Discussion Routines document, as well as in the Phase 2 Productive Talk Canvas or virtual courses.

Resources Needed for this Instructional Phase:

- Per Class
  - OTS_CERA_Uncover/Share2_Slides
- Per Student
  - OTS_CERA_Student_Guide
- Teacher Resources
  - OTS_CERA_Teacher_Guide
  - Mi-STAR Teacher Resources: Strategies and Pedagogy

Student Steps:

1. Students use their evidence and reasoning to engage in a teacher-facilitated class discussion (argument) about which kid should get the raise. Students share how their discussions with their partners differ from what they initially wrote in their CER, namely, how they had to address the opposing claim.

   Teacher Note: Consider using the OTS_CERA_Uncover/Share2_Slides as support through this Uncover/Share process.

Example Guiding Questions	Example Student Answers

Which sibling should get the raise? Why should your choice get the raise over their sibling?	*Sibling A because they do x, y, z, which takes ___ more minutes each week (or other principle) than a, b, c which is what their sibling does.*
How did having clock partners affect your evidence and reasoning? (What did you learn from others about evidence and/or reasoning?)	*Student answers may vary.*
Did your clock partners agree with your principles? What happens to the statements if the parties don't agree? Why is it important to include your principles in your reasoning?	*If the people involved don't agree on the principles, the reasoning doesn't make sense to them.* *It's important to include your principles in your reasoning so people know where you're coming from.*
What if a brother and sister are arguing for the raise, and the brother used "boys rule, girls drool" as his principle in deciding who gets the raise?	*"Boys rule, girls drool" is not a principle that everyone agrees on, so it would not be useful in the argument. An argument based on principles that aren't accepted by most people can be a bad argument.*

2. Students construct their "defense of their choice" (their **argument**) in the OTS_CERA_Student_Guide.

3. When finished, they trade their argument with a partner for feedback.

Example Guiding Questions	Example Student Answers
Did your partner's defense of their choice (their argument) convince you their choice is best? Why or why not?	*Student answers will vary.*

4. Students formalize their common understanding by engaging with the following Science Words (***Constructing an Explanation, Arguing from Evidence***).

   Constructing an Explanation: Supporting a claim using evidence and reasoning.
   Arguing from Evidence: Using evidence and reasoning to persuade others to accept a claim.

Example Guiding Questions	Example Student Answers
What does it mean to make an argument?	*Arguments use evidence and reasoning to persuade or convince someone else.*
Do arguments always involve strong emotions, or can they be conducted calmly with civility?	*When arguments are based on evidence, with commonly held principles, they can be civil and productive.*
How is **Arguing from Evidence** different from **Constructing an Explanation**?	*Constructing an explanation is explaining why the evidence supports your claim. Arguing from evidence is convincing someone else why the evidence supports your claim better than another claim.*

Connect Your Ideas to Science

Phase Summary:

Students connect what they've learned about argumentation using every day arguments with an example focusing on a **science** context. Students evaluate competing scientists' arguments and assess which is the stronger argument about how polar bears are able to survive harsh arctic conditions.

Resources Needed for this Instructional Phase:

- Per Class
  - OTS_CERA_Connect_Slides
- Per Group
  - Whiteboards or poster paper and markers
- Per Student
  - OTS_CERA_Student_Guide

- Teacher Resources
  - OTS_CERA_Teacher_Guide
  - Mi-STAR Visible Thinking and Discussion Routines
  - Mi-STAR Teacher Resources: Strategies and Pedagogy

Student Steps:

1. Students are introduced to the Connect Question, which relates the lesson content to scientific explanations and argument:
   - What are the attributes of strong ***scientific*** explanations and arguments?

2. Students review the claim, evidence, reasoning, and arguments presented in the OTS_CERA_Connect_Slides about polar bears being adapted to live in the Arctic. In this example, two scientists have written arguments to support the same claim.

3. With partners or in small groups, students use their OTS_CERA_Student_Guide to analyze the two scientific arguments, choose which is the better argument, and explain why.

   Teacher Note: Students are provided with the complete CERA from each scientist, but should begin by focusing on the final argument. After they analyze each scientist's final argument, they use the provided claim, evidence, and reasoning to help decide which argument is stronger and to explain why.

4. Students display their findings on whiteboards or poster paper for a class gallery walk. (Other options for making student thinking visible are available in the Mi-STAR Visible Thinking and Discussion Routines document.)

5. Through a consensus discussion, students come to a conclusion about the attributes of a good scientific argument, with guiding questions such as:

Example Guiding Questions	Example Student Answers
What was the scientific principle in this argument?	*Adaptations allow an animal to live in its environment.*
Where do you think that scientific principle came from?	*Student answers may vary - in this case, the principle came from the NGSS standards.*

What would be some reliable sources of scientific principles?	*Science textbooks, scientific journals, an expert in the field, etc.*
What would NOT be a reliable source of scientific principles?	*A random blog, an opinion newspaper article, a for-profit company's claim, etc.*
Even though the scientists used the same claim and principle, their arguments were not equally well-written. Which argument was better?	*Scientist 2*
What was better about Scientist 2's argument?	*They listed evidence of adaptations, and connected the evidence to the principle about adaptation in their reasoning. They did it in a persuasive voice.*
What was lacking in Scientist 1's argument?	*It just focused on what polar bears like, not how they are adapted to survive. It lacked detail and reasoning to connect the principle to the evidence.*

Check Your Progress

Phase Summary:

Students check their understanding by supporting a claim that matter is conserved in a chemical reaction with evidence and reasoning from a scenario in which a student mixes baking soda and vinegar in a baggy.

Resources Needed for this Instructional Phase:

- Per Student
  - OTS_CERA_Check_Student_Guide
- Teacher Resources
  - OTS_CERA_Check_Teacher_Guide

Student Steps:

1. Students use OTS_CERA_Check_Student_Guide to complete the CER framework for a scenario in which a student tests to see if matter is conserved in a baking soda and vinegar chemical reaction.

2. Students may revisit the Lesson Discovery Questions in an exit ticket or science notebook entry:
    - *How do scientists and engineers settle arguments?*
    - *How can we use claim, evidence, and reasoning to build arguments?*

Sources

1. McNeill, K. L., & Krajcik, J. S. (2012). *Supporting grade 5-8 students in constructing explanations in science: The claim, evidence, and reasoning framework for talk and writing*. Boston: Pearson, pp. 79-82.

