Lesson 1 - Initial Engagement Activity (This lesson might take more than one day)

NGSS	Materials:	Thinking Logs…p.1-2	**At the end of the lesson students will...**
4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features. This would be two 30 minute lessons - over the course of two days each day 30 minutes and then the groups would swap and do the other activity.	Plastic tub would be helpful if they are slanted for the activity (put books under one side if you cannot find slanted tub) - 2 per class Sand Rocks (handful) Quarter size Jawbreaker (2 per class) Tiny fossils to layer in the sand (about 3 per class)		Understand how water and weather can change landscapes on earth over time.

Instructional Slides	Science and Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
P.1	Asking Questions and Defining Problems	**Earth Systems**	**Cause and Effect**
	Students will…. Ask questions and making observations based on what they saw in the activity	Students will….Be able to interpret the role of water in earth's processes.	Students will….Observe the effect of wind, water, ice, and vegetation on the earth's surface

Instructional Sequence- *The purpose of this lesson is to have students share their initial ideas and think about questions they want to investigate.*

Initial Question: What are some observations you make about the sand and other materials when playing with it/making observations? Same with the video? Videos: Time Lapse NASA

Teacher Set Up: The "Sand" group requires two set-ups. A Fossil dig and water erosion table. **FOSSIL DIG:** There are two ways you can set this up. You could have 3 or 4 large plastic trays of 3 layers of sand and have the kids work in groups or you could have around 12-15 cups (depending on the size of your class) and you could have students explore the sand in groups.

Layer your sand so you can bury different fossils (if possible purchase different colored sand or mix in some dirt to differentiate the layers of sand- dinosaurs on the bottom, fish, and the dog (most recent object) on the top. **EROSION TABLE**: Put rocks on the top of the sand and a quarter size jawbreaker in the sand as well - this will show erosion and where the water deposits the material (Jawbreaker).

Activity: Divide your class into two groups. One group will watch the two videos and write reflections and the other group will be doing the sandbox engagement activity.

Video Students: Students in the video group will watch and then write their understanding and thoughts in their journal along with any questions they have from the videos as well.

Sandbox students: The students will be given the sandbox, water cups, jawbreakers, rocks, and fossils then play in the sand and see what they observe. Would be a favorable suggestion to use the water as the last thing they observe. Students will pour water into the sand and watch as the water makes a pathway - this is why it is important to have an angle/slant of the sandbox. *might want to put sandbox outside or in a sink for water spillage* After about 20 minutes the students will write what they observed in their journal. They will also be able to dig and find the fossils within the sand.

Have students fill out page 1-2 in their thinking logs. Tell them we are not worried about the "right" answer, we just want them to write down their ideas about what happened.

Next Lesson: Students will analyze the patterns in layers of rocks over time.

Lesson 2` Develop the Big Idea and question for Investigation #1

NGSS	**Materials** Items from the Initial Engagement Activity	Thinking Logs…p.4	**At the end of the lesson students will…** Develop a Big Idea for the unit a list of questions to possibly test.
4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.			

Instructional Slides	Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
P.2-3	Asking Questions and Defining Problems	**Earth Systems**	**Cause and Effect**
	Students will ... review what they observed in the previous lesson and formulate questions to investigate and the Big Idea.	**Students will ..**.Be able to interpret the role of water in earth's processes.	**Students will ...**Observe the effect of wind, water, ice, and vegetation on the earth's surface

Instructional Sequence- *The purpose of this investigation is to develop the big idea and design investigation #1*

Negotiation #1

- Start out by having the students discuss what they observed in the IEA from the previous day. The goal of this lesson is NOT to tell students the answers to their questions, but rather to guide them to the Big Idea of the unit and to think about constructing their own questions.
- The teacher and students will co-create the Big Idea based on the IEA and discussion from yesterday. The Big Idea is "The Earth is always changing."
- Next, the teacher will guide the students to the question: *"How are fossils formed? or What do fossils tell us about the past?"*
- *Note- You can decide on how to do this, but make your students' questions public (sticky notes, write on the board, etc.) In the next lesson you will pick one question and design an investigation to test it.
- If time permits you can set out the materials for the fossil model in the next lesson and have the students begin to brainstorm ideas about how to set up a fossil model.

Next Lesson: Investigation #1

Lesson 3 Investigation #1 Model					
NGSS 4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.			**Materials**: 1 cup, 2 chocolate oreos, 2 vanilla oreos, and 6 teddy grahams. Also pass out 3 swedish fish, 3 dinosaur gummies, and 3 gummy bears	Thinking Logs…p.1-3	**At the end of the lesson students will…** Students will be writing their claims based on the evidence
Instructional Slides	Science and Engineering	Disciplinary Core Ideas	Cross Cutting Concepts		
P.1-5	**Obtaining, evaluating, and information**	Earth Systems	Cause and Effect		
	Students will…. Communicate clearly and generate ideas in a collaborative setting.	Students will ...Understand the structure and properties of matter.	Students will ...Understand the way different rocks are shaped and how that determines the different properties within them.		

Instructional Sequence

- You will start this lesson by asking students to think about the fossils they found in the IEA. Ask them: **"How long ago do you think dinosaurs lived on Earth? How do you think scientists know that dinosaurs and other animals lived so long ago?**
- Have a short discussion with the students and then tell them that we are going to create a model of how fossils are made and we are going to try and figure out how we know which animals and plants are older than others.
- **CREATE THE FOOD MODEL:** Give all students 1 cup, 2 chocolate oreos, 2 vanilla oreos, and 6 teddy grahams. Also pass out 3 swedish fish, 3 dinosaur gummies, and 3 gummy bears to each student.
- Pass out chocolate pudding two spoonfuls for each student to put in their cups to represent the first layer.
- Have students crush their chocolate oreos and put it in their cup, then instruct them to put their dinosaur gummies
- Next, give students two spoonfuls each of banana/tapioca pudding to represent the next layer. Then instruct them to crush the Teddy Grahams on top of the pudding. After they have crushed their teddy grahams on the pudding they can put in the sweedish fish to represent the animals on the next layer.
- After students have their fish in the cup, pass out vanilla pudding (2 spoonfuls each). Then students may again crush their golden oreos into the cup and place their gummy bears on top of the crushed oreos. This represents the final layer.
- Tell students they must fill out p. 3 in their Thinking Logs before they eat their fossil treat. The question to ask the students before they fill out p.3 is **Which fossils do you think are the oldest and which ones are the youngest? Why do you think this?**
- INSTRUCTION NOTE - Take a picture of one of the cups so you can use it during your claims and evidence in the next lesson.
    - THIS IS IMPORTANT - Later after the check with the experts you will explain that the banana/tapioca soil is actually the oldest. There is a common misconception that the layer on the bottom is the oldest but that isn't always true. Scientists can actually determine how old the rocks that the fossils are.

Next Lesson: Claims and evidence

Lesson 4 Claims and Evidence`

NGSS	Materials		At the end of the lesson students will… develop their initial claims.
4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.	Thinking logs	Thinking Logs…p.4-5	

Instructional Slides	Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
P.1-5	Engaging in Argument from Evidence	**Earth Systems**	**Cause and Effect**
	Students will…. Make claims based on their observations.	Students will….Be able to interpret the role of water in earth's processes.	Students will….Observe the effect of wind, water, ice, and vegetation on the earth's surface

Instructional Sequence- *Students will negotiate their understanding and make an initial claim based on the data collected and observations.*

NEGOTIATION DAY

In this lesson students will attempt to make sense of the data they collected in the investigation in the previous lesson. The most important part of this lesson is to get kids to discuss their ideas why they think some fossils are older than others.

Tell students that their model is supposed to represent fossils that scientists found when they dug into the ground.

Attempt to get kids to describe their understanding in their own words. Your goal is to be a dialogic teacher during this lesson, meaning you shouldn't tell the students if they are right or wrong, but instead continue to probe them with questions about their evidence.

Start the lesson by reviewing the negotiation rules and then starting with a question about which fossil they think is the oldest. When a student makes a claim ask them what their evidence is and then ask other kids if the agree or disagree. " Ideally, you would like to have students raise two competing ideas, but if they don't you can pose the following wedge question.

WEDGE QUESTION:

Last year my students had different ideas about which fossils were the oldest. Some students thought that the fossils on the bottom of the rock were the oldest because they were on the bottom. Other students thought the oldest fossils were the ones in the oldest rock around it no matter where it was at. What do you think?

Do a quick review of claims, evidence, and reasoning. Then, at the end of the lesson have every student open to page 3 in their thinking log and first draw a picture attempting to explain which fossils are the oldest. Finally, have them write out their claims, evidence and reasoning. Below is what an answer might look like

Claim: *I think the fossils on the bottom are the oldest*

Evidence: *When we looked at our model and the dinosaurs were at the bottom.*

Reasoning: *It makes sense because old things would get covered up by lots of dirt and rocks over a long period of time.*

Next Lesson: Check With the Experts

Lesson 5 **Check with the Experts, learn about science, update claim, and Formative Assessment**				
NGSS 4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.			**Materials** Thinking Logs Check With the Experts	Thinking Logs…p.6-9	**At the end of the lesson students will…**compare their understanding of how fossils are formed to the experts.
Instructional Slides	Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts	
P.11-14	Engaging in Argument from Evidence	**Earth Systems**	**Cause and Effect**	
	Students will…. Students will compare their understanding of where our energy comes from to the experts.	Students will….Be able to interpret the role of water in earth's processes.	Students will….Observe the effect of wind, water, ice, and vegetation on the earth's surface	

Instructional Sequence-*In the lesson students will learn about how science works, read the check with the experts, and show what they learned.*

START WITH MINI-LESSON ABOUT FINDING A RELIABLE SOURCE

- Begin, you will teach students a mini lesson about finding a reliable source. Have the students look at page 17-19 on the instructional slides and p. 6 in the thinking logs, ask them
    a. "We found an author. Let's decide if he is trustworthy.
    b. Point out that the author has expertise (he has worked in the field for over 30 years and has led successful excavations), he has integrity (he works with other experts from all over the world) and he is sharing her information for free and to help young people learn science. These factors correlate with research about how people trust science. There are three major factors that play into trust:
    c. **Expertise-** The person has an advanced degree or is a professional in the field.
    d. **Integrity-** The person's work has been recognized by other experts in the field as high quality work.
    e. **Benevolence -** The person is sharing their work to advance the field (scientists work together to push science forward).
- Next, teach a mini-lesson about how science works (use p. 13 in the instructional slides).
    a. This mini-lesson is about how scientific claims are based on observations and evidence.
- Next, read the check with the experts and ask the students to think about how the text helped answer the question.
- Next, have the students open to page 7 and read each line of evidence helps us answer the question.

Next, have the students open to p. 8 and explain their understanding of the question.

Finally, have them complete the formative assessment on p. 9 and 10. Remind students to go back to the check with the experts if they are struggling to write out their story on p. 10. Tell them to use multiple sources of evidence (the place the fossils were found - lowest is usually the oldest and the more advanced carbon dating) to back their claim.

*Note- this is a different negotiation than some of the others because technically both ideas have merit. Typically, fossils found lower in the ground are older and tell a story about the past. However, strange things happen and sometimes fossils move around or something for a much earlier time falls into an area where older fossils are. This check with the experts explains it but it also is important to show kids that MULTIPLE forms of evidence are important. We can assume that fossils that are lower in the ground are older, but scientists can now do more advanced testing like carbon dating to get a better understanding.

Next Lesson: Investigation #2

Lesson 6 Investigation #2					
NGSS 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.			**Materials-** Sand, soil, rocks, plastic water bottle (bring your own), grass clippings, rocks, plastic tray, small digital scale.	Thinking Logs…p.11-12	**At the end of the lesson students will be able t...** Design the investigation.
Instructional Slides	Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts		
P.15-16	Developing and using models	**Earth Systems**	**Cause and Effect**		
	Students will…. Understand how to design an erosion model	Students will ...Be able to interpret the role of water in earth's processes.	Students will ...Observe the effect of wind, water, ice, and vegetation on the earth's surface		

Instructional Sequence- The purpose of this lesson is to present a problem to the students and have them design an investigation to collect data.

This investigation begins with a mini engineering challenge, but ultimately becomes an experimental design.

- In this investigation you will present students with a challenge - they will pretend to be real estate developers and they must decide where to build a neighborhood of homes. Present the scenario to your students on p.11. Explain that you will have three scenarios, one where it rains a lot but has lots of grass, one where it rains very little but has almost no vegetation, and a third that has little vegetation.
- Ask students to draw the model home and where they think they should build the homes. Tell students that in order to make an educated decision they will need to run a test to see which environment produces less erosion because people do not want to build a home in an area where there might be a mudslide. Use p. 12 in the thinking logs to design the investigation.

The *independent variable* is the composure of the soil (grass, sand and rocks, soil)
The *controls* are: Amount of water (you might need to try this out before you do the investigation with students, but around 16 ounces should cause erosion). Same angle of the bottles, same size bottles, same amount of soil (you will need to measure this on the scale).
The way you will collect data: weigh the amount of soil that falls into the cups after the water is poured in.

Next Lesson: Investigation #2

Lesson 7 Investigation #2

NGSS	Materials		
4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.	**Materials**- Sand, soil, rocks, plastic water bottle, grass clippings, rocks, plastic tray, small digital scale.	Thinking Logs…p. 13	**At the end of the lesson students will be able t...** Design the investigation.

Instructional Slides	Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
P.17-18	Using Mathematics and Computational Thinking	**Earth Systems**	**Cause and Effect**
	Students will…. Understand how to design an erosion model	Students will ...Be able to interpret the role of water in earth's processes.	Students will ...Observe the effect of wind, water, ice, and vegetation on the earth's surface

Instructional Sequence

This lesson might take two days. During the first day students will be in charge of setting up the experiment (with your help). Set up two or three stations (so you can get multiple sources of data).

This is a picture of a similar set up to you experiment, however, you will have one with sand, one with vegetation, and one with only soil. Here is another example of how a teacher set this up.

Materials:
(Teacher do this before the lesson) cut 9 water bottles (this might change depending on how many groups you want to test. You could have only 3 water bottles and have all the students observe the one set up).
Have students fill the half water bottle with filled them with the same amount of soil, sand, and soil/vegetation.
Have students weigh the soil on the digital scale and record this on page 13 of the thinking log.
Set up bowls under the bottom of the water bottles to catch the sediment.
Pour 16 ounces of water on the soil near the top of the water bottle.
After all of the water has filtered through weigh the cup again and record the weight in your thinking log (p.13).

Next Lesson: Claims and Evidence

Lesson 8 Claims and Evidence`

NGSS	Materials		
4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.	Thinking Logs	Thinking Logs…p.14	**At the end of the lesson students will…Make their initial claim based on their observations.**

Instructional Slides	Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
P.19-24	Engaging in Argument from Evidence	**Earth Systems**	**Cause and Effect**
	Students will…. Develop their initial claims based on observations.	Students will ...Be able to interpret the role of water in earth's processes.	Students will ...Observe the effect of wind, water, ice, and vegetation on the earth's surface

Instructional Sequence- *Students will negotiate their understanding and make an initial claim based on the data collected and observations.*

NEGOTIATION DAY

In this lesson students will attempt to make sense of the data they collected in the investigation in the previous lesson. The most important part of this lesson is to get kids to discuss their ideas why they think certain interventions will help prevent erosion.

Attempt to get kids to describe their understanding in their own words. Your goal is to be a dialogic teacher during this lesson, meaning you shouldn't tell the students if they are right or wrong, but instead continue to probe them with questions about their evidence.

Start the lesson by reviewing the negotiation rules and then starting with a question about which fossil they think is the oldest. When a student makes a claim ask them what their evidence is and then ask other kids if the agree or disagree. " Ideally, you would like to have students raise two competing ideas, but if they don't you can pose the following wedge question.

WEDGE QUESTION:

Last year my students had different ideas about which type of intervention would slow down erosion the most. Some students thought it was vegetation and others thought rocks would slow it down the most. Which idea do you support; vegetation or rocks? Please explain why.

Do a quick review of claims, evidence, and reasoning. Then, at the end of the lesson have every student open to page 3 in their thinking log and first draw a picture attempting to explain which fossils are the oldest. Finally, have them write out their claims, evidence and reasoning. Below is what an answer might look like

Claim: *I think vegetation is the best way to prevent erosion.*

Evidence: *When we looked at our data we could see that the soil that had plants had the least amount of erosion.*

Reasoning: *It makes sense because the roots grab the soil and hold some of it in place.*

Next Lesson: **Check with the Experts, learn about science, update claim, and Formative Assessment**

Lesson 9 **Check with the Experts, learn about science, update claim, and Formative Assessment**					
NGSS 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.			**Materials** Thinking Logs Check With the Experts	Thinking Logs…p.15-18	**At the end of the lesson students will…**compare their understanding of how deposition, erosion, and deposition to the experts.
Instructional Slides	Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts		
P.26-27	Engaging in Argument from Evidence	**Earth Systems**	**Cause and Effect**		
	Students will…. Develop their initial claims based on observations.	**Students will ...**Be able to interpret the role of water in earth's processes.	**Students will ...**Observe the effect of wind, water, ice, and vegetation on the earth's surface		

Instructional Sequence-*In the lesson students will learn about how science works, read the check with the experts, and show what they learned.*

START WITH MINI-LESSON ABOUT FINDING A RELIABLE SOURCE

- Begin, you will teach students a mini lesson about finding a reliable source. Have the students look at page 26 on the instructional slides and p. 15 in the thinking logs, ask them
    a. "We found an author. Let's decide if he is trustworthy.
    b. Point out that the author has expertise (she has worked in the field for a long time and won awards),s he has integrity (he works with other experts from all over the world) and he is sharing her information for free and to help young people learn science. These factors correlate with research about how people trust science. There are three major factors that play into trust:
    c. **Expertise-** The person has an advanced degree or is a professional in the field.
    d. **Integrity-** The person's work has been recognized by other experts in the field as high quality work.
    e. **Benevolence -** The person is sharing their work to advance the field (scientists work together to push science forward).
- Next, read the check with the experts and ask the students to think about how the text helped answer the question.
- Next, have the students open to page 16 and read each line of evidence helps us answer the question.

Next, have the students open to p. 17 and explain their understanding of the question.

Finally, have them complete the formative assessment on p. 19. Remind students to go back to the check with the experts if they are struggling to write out their report.

Remind students to insert pictures and describe the pictures (these could be done online and they could upload digital pictures of the experiment or they could draw pictures to show which set up worked the best. Also, have the students add information they learned in the check with the experts.

Next Lesson: Investigation #3

Lesson 10 Design Investigation #3 (This lesson will probably take two days)					
NGSS 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.			**Materials**- Potatoe (bring your own), plastic knife,	Thinking Logs…p.18	**At the end of the lesson students will be able to...** Design the investigation.
Instructional Slides	Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts		
P.28	Developing and using models	**ESS2.B: Plate Tectonics and Large Scale System Interactions**	**Patterns**		
	Students will…. Understand how to design an erosion model	**Students will ..**.Be able to interpret the role of water in earth's processes.	**Students will ..**.Observe the effect of wind, water, ice, and vegetation on the earth's surface		

Instructional Sequence- *Students will develop a model to interpret different types of maps including topographical.*

- Begin the lesson by handing out the materials (potatoes, plastic knives, plastic gloves, and possibly something to put on the desks to keep them clean).
  - Use teacher discretion to decide if you want to give every student a potato or if you want 2 or 3 students to carve a potato.
- The teacher can decide if they want to let kids carve their own potato or if they want to carve in the way on p. 28 of the instructional slides or this document
  - Note- Another option is you could carve one potato on your own and let all of the students observe your potato.
- You can either show the students the potato that you carved and ask them to draw a picture of it from the top view on p. 18 or you could have them draw a top view picture of their potato.
- If you have a document camera put the potato under the camera showing an overhead view.
  - The purpose of this activity is for students to imagine how to draw a 3-D shape on a piece of paper.
  - This is also a way to introduce the idea of a topographical map.
- Review their drawings and discuss with them what a topographical map. Here is a mini-lesson on topographical maps that you could use (*This is not in the thinking logs)

- If time permits show the students the following topographical maps of

California
World
Google Maps

Have students fill out page 20 and ask students to tell us what patterns they notice.

Next Lesson: Claims and Evidence

Lesson 11: Investigation #3 (continued)					
NGSS 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.			**Materials-** Potatoe (bring your own), plastic knife,	Thinking Logs…p.20-21	**At the end of the lesson students will be able to...** Design the investigation.
Instructional Slides	Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts		
P.29-30	Developing and using models	**ESS2.B: Plate Tectonics and Large Scale System Interactions**	**Patterns**		
	Students will…. Understand how to design an erosion model	**Students will ..**Be able to interpret the role of water in earth's processes.	**Students will ..**make connections between the places where tectonic plates meet and locations of of earthquakes and volcanoes.		

Instructional Sequence- *Students will develop a model to interpret different types of maps including topographical.*

- If you did not finish this part of the previous lesson begin by doing a quick review of what a topographical map is. Next, have the students look at these document (either print them off or just project them on your screen and talk through the lesson)
  - California
  - World
  - Google Maps (this is to look at different areas of the world and to zoom into the areas where plates meet).
- Next, have the students open to p. 21 in the thinking log and p. 30 in the instructional slides and have them work out the math problem.
  - This will all lead to a negotiation day where students will attempt to answer the question: "Why do you think mountains,earthquakes, and volcanoes are located where they are?"

Next Lesson: Claims and Evidence

Lesson 12 Claims and Evidence`

NGSS	Materials		At the end of the lesson students will…
4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.	Thinking Logs	Thinking Logs…p.22	Make their initial claim based on their observations.

Instructional Slides	Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
P.31-37	Engaging in Argument from Evidence	**Earth Systems**	**Cause and Effect**
	Students will…. Develop their initial claims based on observations.	Students will ...Be able to interpret the role of water in earth's processes.	Students will ...Observe the effect of wind, water, ice, and vegetation on the earth's surface

Instructional Sequence- *Students will negotiate their understanding and make an initial claim based on the data collected and observations.*

NEGOTIATION DAY

- In this lesson students will attempt to make sense of the data they collected in the investigation in the previous lesson. The most important part of this lesson is to get kids to discuss why they think mountains and volcanoes are located where they are.
- Attempt to get kids to describe their understanding in their own words. Your goal is to be a dialogic teacher during this lesson, meaning you shouldn't tell the students if they are right or wrong, but instead continue to probe them with questions about their evidence.
- Start the lesson by reviewing the negotiation rules and then starting with a question about which fossil they think is the oldest. When a student makes a claim ask them what their evidence is and then ask other kids if the agree or disagree. " Ideally, you would like to have students raise two competing ideas, but if they don't you can pose the following wedge question.

WEDGE QUESTION:

Last year my students had different ideas about why mountains, volcanoes, and earthquakes are located where they are. Some students thought mountains, volcanoes, and earthquakes only happen by the water. Other students thought they can happen anywhere, including underwater.

Do a quick review of claims, evidence, and reasoning. Then, at the end of the lesson have every student open to page 22 in their thinking log and first draw a picture attempting to explain where mountains, volcanoes, and earthquakes will most likely occur.. Finally, have them write out their claims, evidence and reasoning. Below is what an answer might look like

Claim: *I think earthquakes can happen anywhere*

Evidence: *I saw on the news that an earthquake happened in Las Vegas*

Reasoning: *Las Vegas isn't by the ocean.*

Next Lesson: **Check with the Experts, learn about science, update claim, and Formative Assessment**

Lesson 13 **Check with the Experts, learn about science, update claim, and Formative Assessment** `				
NGSS 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.			**Materials** Thinking Logs	Thinking Logs…p.23-26	**At the end of the lesson students will…**compare their understanding of how deposition, erosion, and deposition to the experts.
Instructional Slides	Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts	
P.38-40	Engaging in Argument from Evidence	**Earth Systems**	**Cause and Effect**	
	Students will…. Develop their initial claims based on observations.	**Students will ...**Be able to interpret the role of water in earth's processes.	**Students will ..**.Observe the effect of wind, water, ice, and vegetation on the earth's surface	

Instructional Sequence- *In the lesson students will learn about how science works, read the check with the experts, and show what they learned.*

START WITH MINI-LESSON ABOUT FINDING A RELIABLE SOURCE

- Begin, you will teach students a mini lesson about finding a reliable source. Have the students look at page 39 on the instructional slides and p. 23 in the thinking logs, ask them
    a. "We found an author. Let's decide if he is trustworthy.
    b. Point out that the author has expertise (he has worked in the field for a long time and won awards),s he has integrity (he has provided map to soldiers who are active in duty) and he is sharing his information for free and to help young people learn science. These factors correlate with research about how people trust science. There are three major factors that play into trust:
    c. **Expertise-** The person has an advanced degree or is a professional in the field.
    d. **Integrity-** The person's work has been recognized by other experts in the field as high quality work.
    e. **Benevolence -** The person is sharing their work to advance the field (scientists work together to push science forward).
- Next, read the check with the experts and ask the students to think about how the text helped answer the question.
- Next, have the students open to page 24 and read each line of evidence helps us answer the question.

Next, have the students open to p. 25 and explain their understanding of the question.

Finally, have them complete the formative assessment on p. 26.

Next Lesson: Engineering Challenge

Lesson 14 Engineering Challenge

NGSS

4-ESS3-2.Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*

Materials
Gummy bears
Toothpicks
Ping pong balls
Earthquake Machine

Thinking Logs…p.27-29

Engineering Design Report

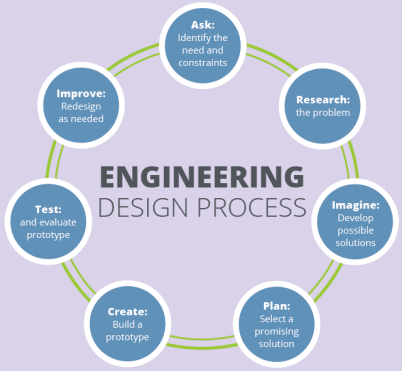
At the end of the lesson students will…demonstrate their understanding of fossils.

Instructional Slides	Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
P.41-42	Obtaining, Evaluating, and Communicating Information	**Earth Systems**	**Cause and Effect**
	Students will…. Communicate their understanding about creating an earthquake proof home. .	Students will ...Be able to interpret the role of water in earth's processes.	Students will ...Observe the effect of wind, water, ice, and vegetation on the earth's surface

Instructional Sequence

In this engineering challenge you will ask your students to create an earthquake proof home. Tell your students that they will have limits of:
35 toothpicks, 18 Jelly beans , 1 egg (optional), 1 cup (optional)
Put students in groups of 3 or 4 and have them fill out p. 29 together and design a plan. If you want you can add the challenge of an egg and cup. If you choose to add this you will need to plan on cleanup and towels because some eggs will fall off and break.
Put together the shake table and have the students test their designs one at a time.

You will ask the students to utilize the **Engineering Process Design** →



*NOTE- This is a different design than the investigations we have done.
In this one we will have them research designs first and then test them out.*
ASK: What is the best design for building an earthquake proof home

RESEARCH: Read the Engineering Design Report

IMAGINE/Plan: Fill out p. 29, design your house.

CREATE: Build the house

TEST: Shake the house (Time how long it takes before the model fails). Use the Earthquake Machine

IMPROVE: Discuss the results of the test with the class. If time permits have the students rebuild the houses and retest.

Next Lesson: Multimodal Writing

Lesson 15 Multimodal Writing					
NGSS 4-ESS3-2.Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*			**Material** Write-to-learn Rubric	Thinking Logs…p.30-33	**At the end of the lesson students will…**Collect data from the investigation and if time permits graph the data.
Instructional Slides	Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts		
NA	Obtaining, Evaluating, and Communicating Information	**Earth Systems**	**Cause and Effect**		
	Students will…. Communicate their understanding about creating an earthquake proof home. .	Students will ...Be able to interpret the role of water in earth's processes.	Students will ...Observe the effect of wind, water, ice, and vegetation on the earth's surface		

Instructional Sequence

This lesson will take multiple days and could be done during your language arts time.

This final writing project will tie together multiple sources of content that the students learned in the unit. They will create some type of communication where they will try to "sell" their home. They will discuss how the home is earthquake proof using the information that they learned in the engineering challenge. Students will be asked to explain why the structure should hold up in an earthquake due to the multiple diagonals in the design.
Next, they will explain why location is important (connect back to investigation #2 where they tested erosion).
Their homes will be built in a valley and students can explain why living in a valley with lots of vegetation will help protect the home from potential landslides.

This lesson could be completed during your language arts time. You will ask students to present their machine that they made the marble move to the class or to another class, write about their project, or make an iMovie about their project (teacher's or students' choice).

Make sure you have the students communicate about how they built their earthquake proof home, why diagonals help absorb force, and how we need safe homes because the world is always changing.

This assignment does not have to be a writing sample, but if you want students to write there is a multimodal template on pages 23 and 24 of the thinking log. Student should brainstorm ideas on page 22 and can use the template on pages 23-24 if they want.

Next Lesson: NA