

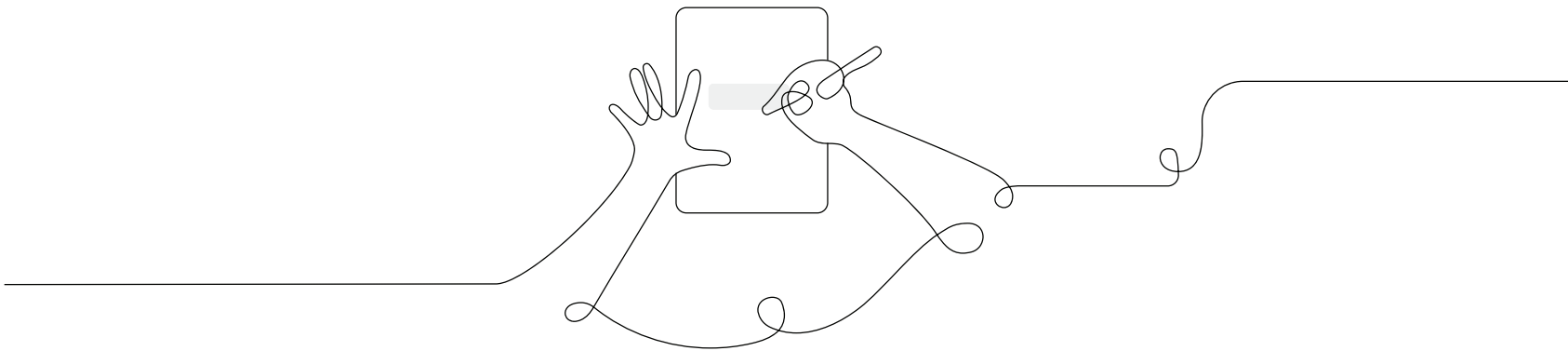
Amplify Science

Participant Notebook

Deep-dive and Strengthening Workshop

Force and Motion

Grade 8



Welcome to the workshop

This Participant Notebook will serve as a resource during today's workshop.

Force and Motion Grade 8

Unit-specific workshop agenda

Introductions

Framing and reflection

- Reflecting on our teaching
- Scenario challenge

Experiencing the unit

- Model experiences from Force and Motion
- Reflecting on coherence

Science Seminar modeling and analysis

Targeted small group work time

- Analyzing the End-of-Unit Assessment
- Deepening understanding of content
- Formative assessment and differentiation
- Internalizing the upcoming unit

Closing

- Questions
- Survey

Demo account for your workshop:

URL: learning.amplify.com (Log in with Amplify)

Temporary account (teacher): _____@tryamplify.net

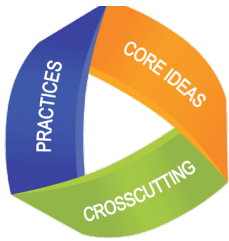
Temporary account (students): _____@tryamplify.net

_____@tryamplify.net

_____@tryamplify.net

Password (for all): **AmplifyNumber1**

Three dimensions of NYSSLS reference



3-D learning engages students in using scientific and engineering practices and applying crosscutting concepts as tools to develop understanding of and solve challenging problems related to disciplinary core ideas.

Science and Engineering Practices

- | | |
|---|--|
| <ol style="list-style-type: none">1. Asking Questions and Defining Problems2. Developing and Using Models3. Planning and Carrying Out Investigations4. Analyzing and Interpreting Data | <ol style="list-style-type: none">5. Using Mathematics and Computational Thinking6. Constructing Explanations and Designing Solutions7. Engaging in Argument from Evidence8. Obtaining, Evaluating, and Communicating Information |
|---|--|

Disciplinary Core Ideas

Earth and Space Sciences:

- ESS1: Earth's Place in the Universe
- ESS2: Earth's Systems
- ESS3: Earth and Human Activity

Life Sciences:

- LS1: From Molecules to Organisms
- LS2: Ecosystems
- LS3: Heredity
- LS4: Biological Evolution

Physical Sciences:

- PS1: Matter and its Interactions
- PS2: Motion and Stability
- PS3: Energy
- PS4: Waves and their Applications

Engineering, Technology and the Applications of Science:

- ETS1: Engineering Design
- ETS2: Links among Engineering Technology, Science and Society

Crosscutting Concepts

- | | |
|---|--|
| <ol style="list-style-type: none">1. Patterns2. Cause and Effect3. Scale, Proportion, and Quantity4. Systems and System Models | <ol style="list-style-type: none">5. Energy and Matter6. Structure and Function7. Stability and Change |
|---|--|

Reflecting on Amplify Science implementation

1. What was a positive moment from teaching your first unit(s)? What was particularly effective in your classroom?

2. What was a challenge you experienced in your first few units? What was an “aha” moment you had while planning or teaching that helped you overcome that challenge?

3. Amplify Science uses a multimodal approach — students **do, talk, read, write,** and **visualize** as they construct explanations of phenomena. Describe a time when the multimodal approach helped a particular student or students in your classroom.

Self-assessment: How comfortable are you teaching Amplify Science?

Directions:

After each group shares the solution to their scenario, rank your comfort level with the scenario's category using the statements along the top of the table.

Scenario	I am starting to understand this	I can do this (with a little help)	I've got this! I feel confident	I can teach this to a peer
<p>Scenario 1 Using program resources to deepen content knowledge and find information to answer content questions</p>				
<p>Scenario 2 Using formative assessment to inform instruction</p>				
<p>Scenario 3 Analyzing student work on the End-of-Unit Assessment</p>				
<p>Scenario 4 Understanding the 3-D nature of standards in the unit</p>				
<p>Scenario 5 Understanding how ideas build across a chapter and unit</p>				
<p>Scenario 6 Preparing to teach a lesson</p>				



Unit Map

What happened in the missing seconds when the space pod should have docked with the space station?

In the role of student physicists, students help solve a physics mystery from outer space. A pod returning with asteroid samples should have stopped and docked at the space station. Instead it is now moving back away from the station, and the video feed showing what happened in the seconds during which it reversed direction has been lost. Did the pod reverse before it got to the space station or hit the station and bounce off? Students explore principles of force, motion, mass, and collisions as they solve this mystery.

Chapter 1: What caused the pod to change direction?

Students figure out: The pod could have exerted either too little or too much force. A force is required to change the velocity of an object. The type of velocity change depends on the direction of the force on the object. A stronger force can cause a greater change in an object's velocity. Perhaps the pod's thrusters fired more strongly than usual, causing it to reverse rather than stop. Or perhaps the thrusters fired too weakly, causing the pod to hit the station and bounce off.

How they figure it out: They explore ways to change the motion of objects, and test the effect of forces of different strength, using physical materials (spring-launchers, balls, jar lids) and the Simulation. They read a short article about friction. They discuss a common confusion—the conflation of force and velocity—using key vocabulary. They write and create visual models showing possible causes of the pod reversing direction.

Chapter 2: The thrusters on the ACM pod exerted the same strength force as thrusters on other pods, so why did this pod move differently?

Students figure out: Data shows that the pod's thrusters fired as usual—neither too strong nor too weak. Exerting the same amount of force on two objects with different masses will cause a greater change in velocity for the object with less mass. The pod's mass was greater than usual, so the normal thruster force did not slow the pod as much as usual. It must have hit the station and bounced off.

How they figure it out: They test the effects of changing the mass of an object on which a force acts, in both physical experiments and in the Sim. They read an article about a wheelchair engineer; some wheelchairs, such as racing wheelchairs, require low-mass and others, such as chairs for wheelchair rugby, require higher mass. They make visual models showing what would have happened if the pod were more or less massive than usual.

Chapter 3: After the collision, how does the pod's motion compare to the motion of the space station?

Students figure out: The pod is moving faster than the station is. When two objects collide, a force is exerted on each object. The two forces are in opposite directions but the same strength. Even though the force on each object in a collision is the same strength, the objects will have different velocity changes if their masses are different. The pod is less massive than the station, so the force from the collision affected the velocity of the pod more than the velocity of the station.



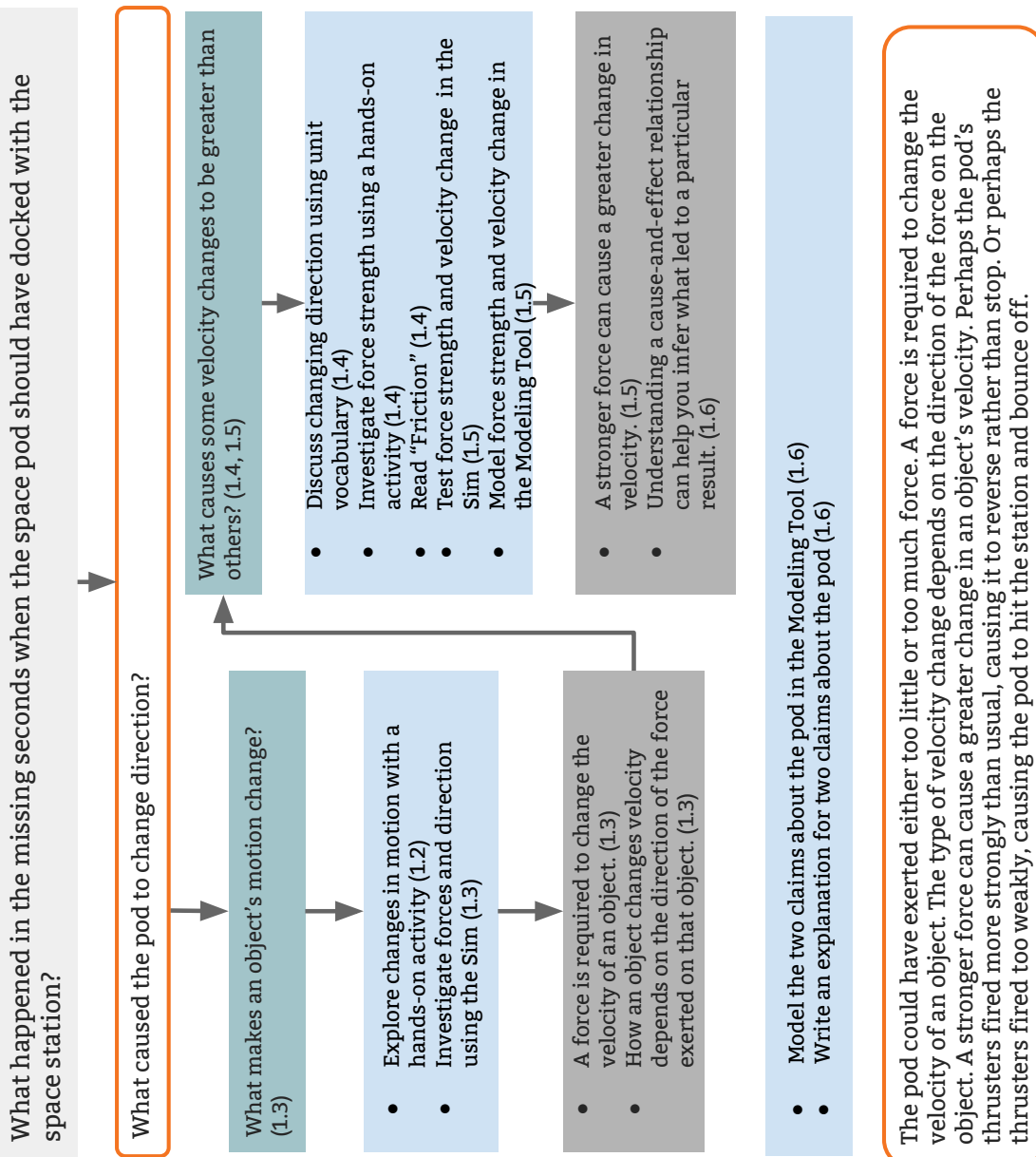
How they figure it out: They read an article about the forces produced in collisions and how these affect objects of different masses. They investigate collisions using balls and with the Sim. They discuss a common misconception about forces in collisions using key vocabulary. They use the Reasoning Tool to write about equal and opposite forces in a collision, and they model the effect of the collision between the pod and the space station on each object.

Chapter 4: Students apply what they learn to a new question—Why did Vehicle 2 fall off the cliff in Claire's test of the collision scene, but Vehicle 2 did not fall off the cliff in the film *Iceworld Revenge*?

Filmmakers want to use props to create a scene where one vehicle crashes into another on an icy surface, but can't achieve the desired effect. Students advise them on whether the problem has to do with the mass of the vehicles or the friction of the surface. They engage in oral argumentation in a student-led discourse routine called a Science Seminar and then write final arguments.

Force and Motion Coherence Flowchart

Force and Motion: Docking Failure in Space



Problem Students Work to Solve

Chapter 1 Question

Investigation Questions

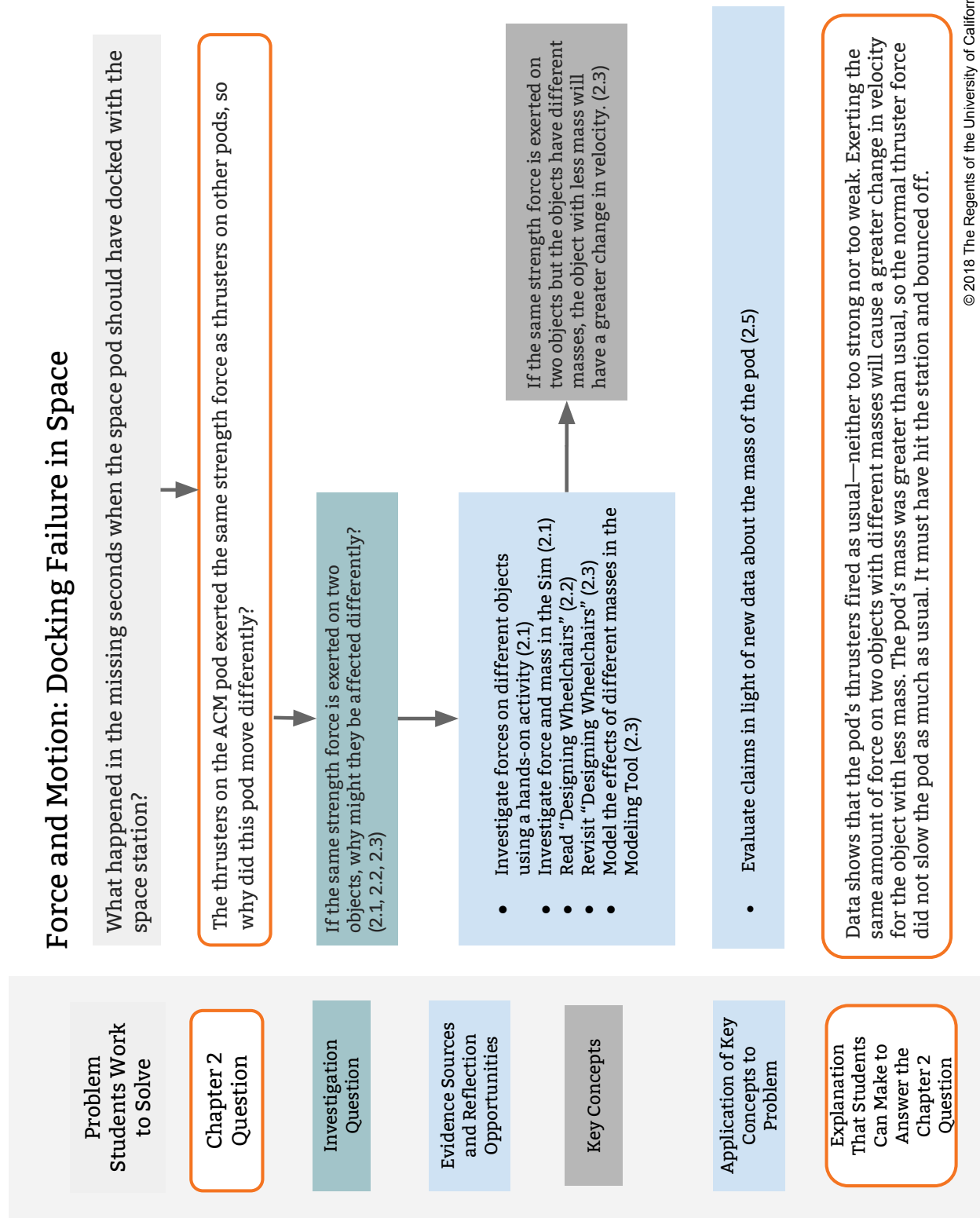
Evidence Sources and Reflection Opportunities

Key Concepts

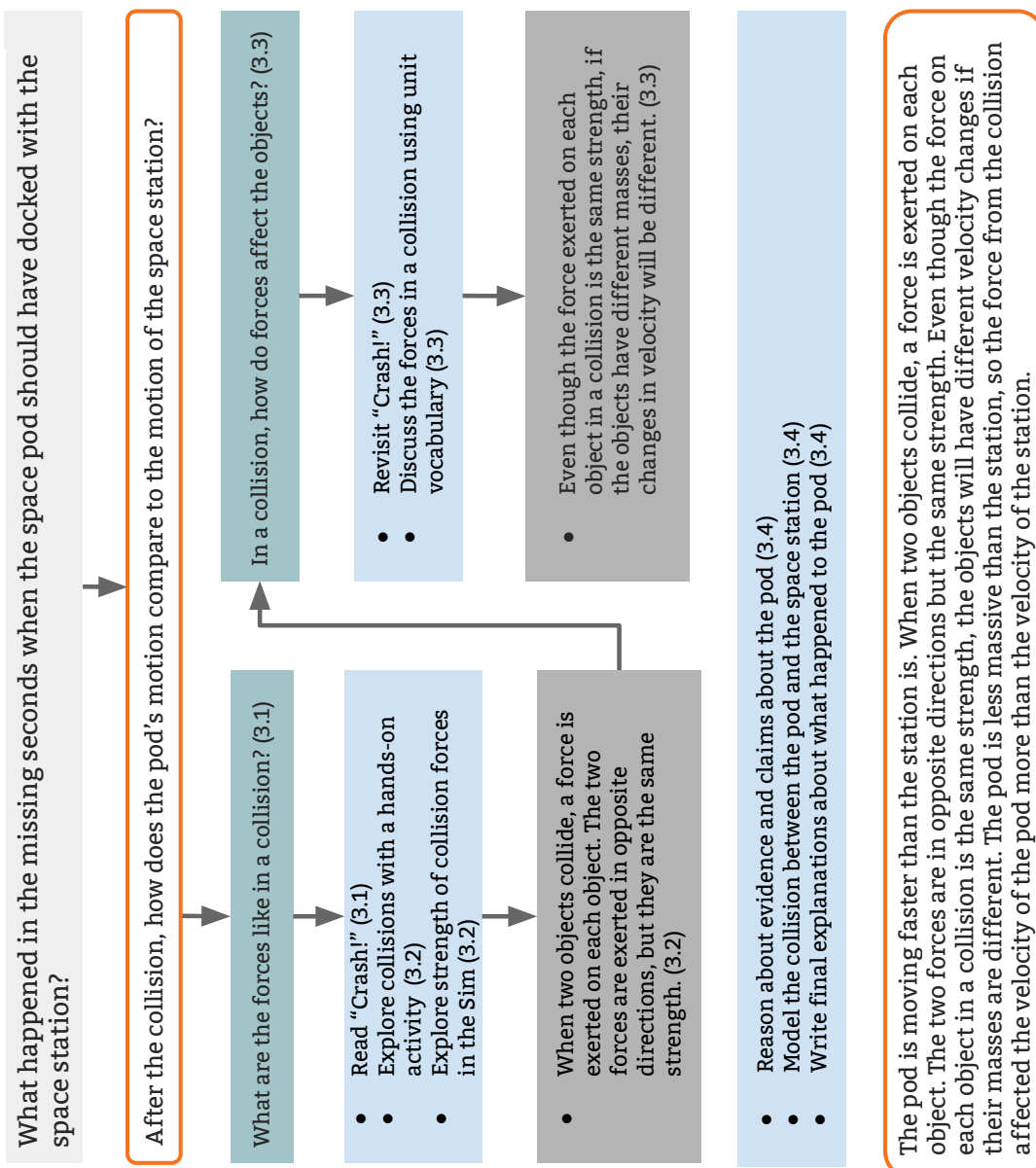
Application of Key Concepts to Problem

Explanation That Students Can Make to Answer the Chapter 1 Question

Force and Motion: Docking Failure in Space



Force and Motion: Docking Failure in Space



Force and Motion: Docking Failure in Space

Why did Vehicle 2 fall off the cliff in Claire's test of the collision scene, but Vehicle 1 did not fall off the cliff in the film *Iceworld Revenge*?

- Analyze and sort evidence based on claims (4.1)
- Participate in the Science Seminar (4.2)
- Reason about evidence and claims (4.3)
- Write an argument to support one claim (4.3)

One possible explanation students can make:
The masses of the vehicles in *Iceworld Revenge* were different from each other, while in Claire's test, the vehicles were the same mass. In *Iceworld Revenge*, Vehicle 1 rolled backward off the screen and Vehicle 2 moved slowly after the crash. This indicates the vehicles experienced different changes in velocity from the collision. In a collision, both objects experience the same strength force, but in opposite directions. Vehicle 1 must have had less mass than Vehicle 2, since objects with less mass have a greater change in velocity from the same strength force.

Problem
Students Work
to Solve and
the Chapter 4
Question

Application of key
concepts to new
problem

Explanation
That Students
Can Make to
Answer the
Chapter 4
Question



Force and Motion: Docking Failure in Space

Investigation Notebook

Name: _____ Date: _____

Gathering Evidence About Velocity Changes

Part 1: Gathering Evidence About Changes in Velocity

1. Use the *Force and Motion* Simulation to discover what you need to do to change an object's velocity.
2. Your teacher will demonstrate the first change, and then each member of your group will explore one of the four remaining changes.

Object's velocity change	How you made this change
1. start moving	
2. speed up	
3. slow down	
4. stop moving	
5. move in opposite direction	

Part 2: Gathering More Evidence About Velocity

1. Use the *Force and Motion* Simulation to determine how to exert a force to cause an object's velocity to change in each of the five ways.
2. Predict the direction a force must be exerted. Use one of these options:
 - **same** direction as object's motion
 - **opposite** direction as object's motion
 - **any** direction
3. With your partner, test your predictions and record the results in the third column.
4. Discuss the Investigation Question with your partner: *What makes an object's motion change?*

Object's velocity change	Direction of force (predicted)	Direction of force (actual)
1. start moving		
2. speed up		
3. slow down		
4. stop moving		
5. move in opposite direction		

Name: _____ Date: _____

Investigating Strong and Weak Forces

Use the launcher to exert different strength forces on the jar lids. Observe how the velocity changes in response to different strength forces. Review the steps below.

What will you change (the independent variable) in each test? _____

What will you observe (the dependent variable) as a result of that change? _____

What will be kept the same (control) in each test? _____

1. Lay a meter stick on the floor or table.
2. Place two jar lids on the floor or table, one on each side of the meter stick at the end, or at 0 cm.
3. Exert a different force on each jar lid, but release the launchers at the same time.
 - Have one partner press the launcher to the **2** mark (force 2).
 - Have the other partner press the launcher to the **3** mark (force 3).
4. Observe which jar lid is the first to reach the opposite end of the meter stick.
5. Record your observations in the data table.
6. Repeat this process twice so you have data for three trials, and then answer the questions.

Trial number	Which jar lid reached the end of the meter stick first? (force 2 or 3)
Trial 1	
Trial 2	
Trial 3	

Wait to answer these questions until you have completed all three trials.

1. Which mark exerted the stronger force? (check one)
 mark 2 (force 2) mark 3 (force 3) both exerted the same strength force
2. Which force caused the jar lid to travel faster and reach the end of the meter stick first? (check one)
 the weaker force the stronger force both forces had the same effect
3. Circle the bold phrase that completes the sentence to match your observations:
When you exert a stronger force on an object, you will see (**a greater** | **a smaller** | **the same**)
change in velocity as compared to exerting a weaker force on the same object.

Name: _____

Date: _____

Warm-Up

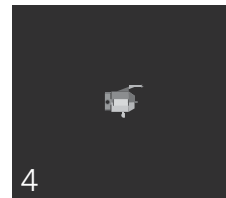
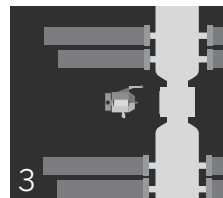
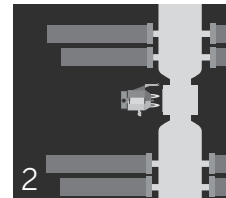
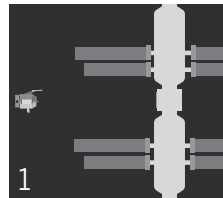
ACM pods normally fire the thrusters with a force that stops the pod and allows it to dock at the space station. For this pod, something else happened.

Think about the thruster force in successful missions, and then compare that to the thruster force that would cause the situation in each of the claims.

Normally, when the thrusters fire, the pod will stop, but this mission was different.

Claim 1: The thrusters caused the pod to move in the opposite direction.

Claim 2: The thrusters only slowed the pod, it didn't stop; the pod hit the space station, which made it bounce and move in the opposite direction.



Circle the bold phrase that completes each claim.

Claim 1: If this pod went in the opposite direction because of the thrusters, the thrusters would have exerted (**a force stronger than** | **a force weaker than** | **an equal force to**) the thrusters in other missions.

Claim 2: If this pod crashed into the space station because of the thrusters, the thrusters would have exerted (**a force stronger than** | **a force weaker than** | **an equal force to**) the thrusters in other missions.

Name: _____ Date: _____

Modeling Thruster Forces (continued)

Modeling Claim 1

1. Open the *Force and Motion* Modeling Tool activity: Claim 1, Chapter 1.
2. When your model is complete, press HAND IN. If you worked with a partner, write their name here:

Goal: Model the force that would cause the pod to move in the opposite direction.

Do:

- Use the first row as a reference; use the second row to show what happened to this pod.
- Drag one force arrow into the During Force panel so it shows the direction and strength of the thruster force.
- Drag velocity lines into the After Force panel so it shows the pod's final velocity.

Modeling Claim 2

1. Open the *Force and Motion* Modeling Tool activity: Claim 2, Chapter 1.
2. When your model is complete, press HAND IN. If you worked with a partner, write their name here:

Goal: Model the force that would only slow the pod (not stop it) and cause it to hit the space station.

Do:

- Use the first row as a reference; use the second row to show what happened to this pod.
- Drag one force arrow into the During Force panel so it shows the direction and strength of the thruster force.
- Drag velocity lines into the After Force panel so it shows the pod's final velocity.

Name: _____ Date: _____

Reading “Designing Wheelchairs”

1. Read and annotate the article “Designing Wheelchairs.”
2. Choose and mark annotations to discuss with your partner. Once you have discussed these annotations, mark them as discussed.
3. Now, choose and mark a question or connection, either one you already discussed or a different one you still want to discuss with the class.
4. Answer the reflection question below.

Rate how successful you were at using Active Reading skills by responding to the following statement:

As I read, I paid attention to my own understanding and recorded my thoughts and questions.

- Never
- Almost never
- Sometimes
- Frequently/often
- All the time

Active Reading Guidelines

1. Think carefully about what you read. Pay attention to your own understanding.
2. As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.
3. Examine all visual representations carefully. Consider how they go together with the text.
4. After you read, discuss what you have read with others to help you better understand the text.

Name: _____ Date: _____

Revisiting “Designing Wheelchairs”



How would you design a wheelchair for basketball? The players need the wheelchair to be stable, or at least not tip over when there's contact between players. Players also need to be able to stop and start quickly and move fast so they can gain control of the basketball.

1. Reread paragraphs 3, 4, and 5 of “Designing Wheelchairs for All Shapes and Sizes.” Highlight or annotate evidence in the text that helps you understand how massive a wheelchair for basketball needs to be.
2. Discuss your ideas with a partner after you finish reading.
3. Answer the questions and record your design ideas, including ideas from the text that support your design choice.
4. Be prepared to share your ideas with the class.

Questions

Which wheelchair would be more difficult to stop? (check one)

- more massive wheelchair
 less massive wheelchair

If the same strength force were exerted on both wheelchairs, which chair would go faster? (check one)

- more massive wheelchair
 less massive wheelchair

How would you design a wheelchair for wheelchair-using basketball players? Would you make it more or less massive? Explain how the text supports your choice.



People use wheelchairs for lots of different activities, and wheelchairs come in many styles.

Designing Wheelchairs for All Shapes and Sizes

People who use wheelchairs come in all different shapes and sizes—children and adults, tall and short, big and small—and so do the wheelchairs they use. Some wheelchairs have motors, and others are operated by hand. People who use wheelchairs do all kinds of different things. Wheelchair users may go to school or work in an office. They may sing in a rock band, take their dogs to the park, compete in races, or lead a parade through city streets.



Dr. Rory Cooper designs wheelchairs and other technologies for people with disabilities. Here, he demonstrates a robotic arm that attaches to a wheelchair and helps its user grasp items from far away.

Wheelchairs are designed for the people who use them and for the different activities they want to do. Dr. Rory Cooper knows all about designing wheelchairs: he's an engineer who works to improve wheelchair safety, comfort, and usefulness. He and his team design wheelchairs for many different purposes, from world-class racing and other sports to everyday mobility.

Dr. Cooper served in the United States Army. During his service, he was injured and began using a wheelchair. After he left the military, he went to college and studied engineering. Today, Dr. Cooper runs the Human Engineering Research Labs (HERL) at the University of Pittsburgh, Pennsylvania. There, he works with other scientists on technologies that help people with disabilities. Dr. Cooper is also an athlete: he won a bronze medal in wheelchair racing at the 1988 Paralympics. The Paralympics are a series of athletic events for people with disabilities. They take place just after the Olympics and in the same location as the Olympics.

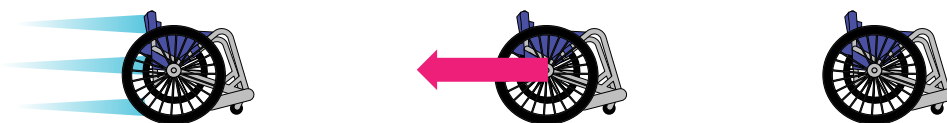
Dr. Cooper designs each wheelchair to fit the

person who will be using it and the activities it will be needed for. One way he and his team can change the design of a wheelchair is by changing the mass of the chair. Mass is the amount of matter that makes up an object—on Earth, objects with more mass are heavier than objects with less mass. By changing the mass of a wheelchair, Dr. Cooper can make it change velocity more easily or less easily. That makes each chair useful for certain activities. For example, some wheelchairs are built especially for playing different sports.

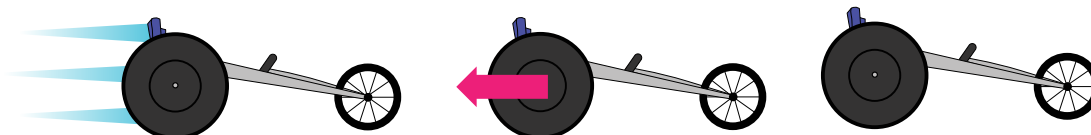
Wheelchairs used for wheelchair racing are built for speed. That means they need to be light. Lighter chairs change velocity more easily than heavier ones, so it's easier for a racer to go from sitting still to racing speed in a light chair. It also takes less force from the racer to stop a light chair than it takes to stop a heavy chair. Dr. Cooper's racing wheelchairs are made of materials that are light and strong, so the racer can start the race and speed up as quickly as possible using the least possible force.

Not all athletes in wheelchairs want to change velocity easily. Another popular sport that

Rugby wheelchair design



Racing wheelchair design



The strength of force needed to stop a quickly moving wheelchair will vary depending on how massive the wheelchair is. Rugby wheelchairs take more force to stop than those used in racing because they are more massive.

uses wheelchairs is wheelchair rugby, a fast, full-contact sport played on a court similar to a basketball court. Wheelchair rugby players need stability—they crash into each other often, and it’s important that they don’t tip over in a collision. For this reason, rugby wheelchairs are heavier than racing wheelchairs. Their weight means players need to use more force to get them moving when they’re stopped and to make them stop moving once they get going, but it also means they aren’t affected as much by the forces involved in collisions, so they are less likely to fall over during a crash. Rugby players in heavy, stable wheelchairs are more likely to stay upright and play successfully for their teams.

Designing wheelchairs with less mass for racing and wheelchairs with more mass for sports like rugby is just one example of how wheelchairs can be designed for different users and activities. When engineers design wheelchairs, the most important consideration is the person who is using the chair. A smaller person needs a different wheelchair than a larger person. Some wheelchair users turn the wheels of their chair by hand, while others use chairs with electric motors. Some wheelchair users are able to operate their chairs simply by moving their eyes. Wheelchair users choose chairs that work for their needs, fit their budget, and suit their own personal styles.

Wheelchairs come in many types—and thanks to Dr. Cooper’s work at HERL, wheelchair users have more options than ever before.



Wheelchairs built for racing need to be light. The less mass the chairs have, the farther they can go on a single push.



The heavy wheelchairs used for wheelchair rugby are very stable. Even when they run into each other, they are hard to tip over.



Some people use special wheelchairs to play tennis. These wheelchairs are light, strong, and easy to adjust quickly for different types of matches.

Connecting key concepts to chapter explanations

Force and Motion

Directions:

1. For each chapter, read the key concepts, then the explanation.
2. With a partner, discuss how the key concepts connect to the explanation.
3. Make annotations about the connections.

Ch	Key concepts	Explanation
1	<p>A force is required to change the velocity of an object. (1.3)</p> <p>How an object changes velocity depends on the direction of the force exerted on that object. (1.3)</p> <p>A stronger force can cause a greater change in velocity. (1.5)</p> <p>Understanding a cause-and-effect relationship can help you infer what led to a particular result. (1.6)</p>	<p>The pod could have exerted either too little or too much force. A force is required to change the velocity of an object. The type of velocity change depends on the direction of the force on the object. A stronger force can cause a greater change in an object's velocity. Perhaps the pod's thrusters fired more strongly than usual, causing it to reverse rather than stop. Or perhaps the thrusters fired too weakly, causing the pod to hit the station and bounce off.</p>
2	<p>If the same strength force is exerted on two objects but the objects have different masses, the object with less mass will have a greater change in velocity. (2.3)</p>	<p>Data shows that the pod's thrusters fired as usual—neither too strong nor too weak. Exerting the same amount of force on two objects with different masses will cause a greater change in velocity for the object with less mass. The pod's mass was greater than usual, so the normal thruster force did not slow the pod as much as usual. It must have hit the station and bounced off.</p>
3	<p>When two objects collide, a force is exerted on each object. The two forces are exerted in opposite directions, but they are the same strength. (3.2)</p> <p>Even though the force exerted on each object in a collision is the same strength, if the objects have different masses, their changes in velocity will be different. (3.3)</p>	<p>The pod is moving faster than the station is. When two objects collide, a force is exerted on each object. The two forces are in opposite directions but the same strength. Even though the force on each object in a collision is the same strength, the objects will have different velocity changes if their masses are different. The pod is less massive than the station, so the force from the collision affected the velocity of the pod more than the velocity of the station.</p>

Reflecting on the progression of ideas

Directions:

Part 1: Reflecting on the progression

1. Using the key concepts and explanations, reflect on how ideas build throughout the unit.
2. With your group, discuss the following questions:
 - Which ideas are revisited over multiple chapters?
 - What new ideas are added in each chapter?
3. Make notes about the progression of ideas in the space below.

Part 2: Creating a visual

1. With your group, use the provided materials to create a visual to represent your ideas. You can use words or pictures, or a mix of both. The following questions may help you plan your visual:
 - How can you represent the new information that is added throughout the progression?
 - How can you represent foundational ideas that are revisited throughout the unit?



Progress Build

Each Amplify Science Middle School unit is structured around a unit-specific learning progression, which we call the Progress Build. The unit's Progress Build describes the way students' explanatory understanding of the unit's focal phenomena is likely to develop and deepen over the course of a unit. It is an important tool in understanding the structure of a unit and in supporting students' learning: it organizes the sequence of instruction (generally, each level of the Progress Build corresponds to a chapter), defines the focus of assessments, and grounds the inferences about student learning progress that guide suggested instructional adjustments and differentiation. By aligning instruction and assessment to the Progress Build (and therefore to each other), evidence about how student understanding is developing may be used during the course of the unit to support students and modify instruction in an informed way.

The *Force and Motion* Progress Build consists of three levels of science understanding. To support a growth model for student learning progress, each level encompasses all of the ideas of prior levels and represents an explanatory account of unit phenomena, with the sophistication of that account increasing as the levels increase. At each level, students add new ideas and integrate them into a progressively deeper understanding of how forces can affect the motion of objects. Since the Progress Build reflects an increasingly complex yet integrated explanation, we represent it by including the new ideas for each level in bold.

Prior knowledge (preconceptions): At the start of the *Force and Motion* unit, middle school students will likely have a range of ideas and intuitions about motion change. Many students will have an intuitive notion that forces are required to change an object's motion, but may not yet be able to describe formal or general rules for how forces cause changes in motion. Students may believe that objects in motion possess or are given a force and that this force runs out when the object comes to a stop. This is commonly expressed by students conflating force and velocity and saying that a faster object "has more force." Because of everyday experiences with sliding objects coming to a stop, students will not immediately believe that an object in motion will remain in motion. This alternate conception implies an intuitive sense of friction, but most students do not think of a surface as exerting a force against an object in motion. Also, during collisions between two objects, many students may believe that only the larger, heavier, or faster object delivers a force. The *Force and Motion* Progress Build and unit structure are designed to build on and extend this experience and prior knowledge.

Progress Build Level 1: A force causes a change in an object's velocity.

When an object experiences a force, its velocity will change, depending on the strength and direction of the force. A stronger force causes a greater change in an object's velocity.

Progress Build Level 2: An object's mass determines its velocity change for a given force.

When an object experiences a force, its velocity will change, depending on the strength and direction of the force. A stronger force causes a greater change in an object's velocity. **However, if two objects of different mass experience the same force for the same amount of time, the less massive object will have a greater change in velocity.**



Progress Build Level 3: When two objects collide, both experience the same strength force, but in opposite directions.

When an object experiences a force, its velocity will change, depending on the strength and direction of the force. A stronger force causes a greater change in an object's velocity. However, if two objects of different mass experience the same force for the same amount of time, the less massive object will have a greater change in velocity. **If two objects collide, each object exerts a force on the other that is equal in size, but in the opposite direction. If those two objects have different masses, the less massive object will have a greater change in velocity.**

Force and Motion: Docking Failure in Space (Middle School)

Rubrics for Assessing Students' Final Written Arguments

Argumentation is an important practice in science; scientists use arguments to convince an audience that the explanation being proposed is the best one supported by evidence. To assess students' written arguments—as an opportunity for demonstrating their understanding of science concepts and for demonstrating the *practice* of constructing arguments—we have provided three rubrics. The first rubric may be used summatively to assess students' understanding of science concepts from the unit. The second rubric may be used summatively to assess students' application of the crosscutting concept of Cause and Effect as applied to a specific phenomenon. The third rubric is designed to formatively assess the practice of constructing arguments, which includes the associated practices of constructing explanations and obtaining, evaluating, and communicating information; students' facility with this practice takes time to develop, and students will have opportunities to practice argumentation in each unit. Rubric 3 provides possible student responses that illustrate how a student's written work may demonstrate different levels of understanding. A full response for each claim is provided in the Possible Responses tab in the instructional guide for the activity in which students write their scientific arguments.

Prompt for final written argument: *Why did Vehicle 2 fall off the cliff in Claire's test of the collision scene, but Vehicle 2 did not fall off the cliff in the film Iceworld Revenge?*

- **Claim 1:** The vehicles in *Iceworld Revenge* had different masses; in Claire's test, the vehicles had the same mass.
- **Claim 2:** The friction of the surface that was used in *Iceworld Revenge* was different from the friction of the surface in Claire's test.

Rubric 1: Assessing Students' Understanding of Science Concepts

Rubric 1 may be used to assess students' written arguments from Lesson 4.3 for how well the writing demonstrates mastery of core science concepts from the unit. The science concepts described in the rubric build in complexity with each row.

Rubric 1: Assessing Students' Understanding of Science Concepts

Score	Description: Claim 1	Description: Claim 2
0	Response is off-target or does not yet demonstrate understanding of key concepts identified in the Progress Build.	Response is off-target or does not yet demonstrate understanding of key concepts identified in the Progress Build.
1	Response correctly describes that: both objects in a collision experience a force.	Response correctly describes that: a force is required to change an object's velocity.
2	Response correctly describes that: both objects in a collision experience a force. AND the force on both objects is the same strength, in opposite directions.	Response correctly describes that: a force is required to change an object's velocity. AND the stronger a force is, the larger the change to an object's velocity.
3	Response correctly describes that: both objects in a collision experience a force. AND the force on both objects is the same strength, in opposite directions. AND the two objects can exhibit different changes in velocity, because an object's mass affects its velocity change due to a force.	Response correctly describes that: a force is required to change an object's velocity. AND the stronger a force is, the larger the change to an object's velocity. AND a force in the opposite direction of an object's motion (like friction) causes an object to slow down.

Rubric 2: Assessing Students' Understanding of the Crosscutting Concept of Cause and Effect

Rubric 2 considers how well students are able to apply the crosscutting concept of Cause and Effect to a specific phenomenon.

Rubric 2: Assessing Students' Understanding of the Crosscutting Concept of Cause and Effect	
Score	Description
0	Response is off-target or does not yet demonstrate understanding that particular causes will lead to particular effects.
1	Response correctly describes a cause OR an effect, but does not describe a particular cause leading to a particular effect. For example, states that the masses of the vehicles Claire used must have been different from those of the <i>Iceworld Revenge</i> vehicles, but does not describe what the effect of these differences in mass would be; or, describes the different ways that Claire's vehicles moved compared to those in <i>Iceworld Revenge</i> , but does not identify a cause for this difference.
2	Response correctly describes a cause-and-effect relationship in which a particular cause leads to a particular effect. For example, states that the surface in <i>Iceworld Revenge</i> must have had more friction than the surface in Claire's test, and describes that this greater friction must have caused the vehicles in <i>Iceworld Revenge</i> to slow down more than Claire's vehicles.

Rubric 3: Assessing Students' Performance of the Practice of Constructing Scientific Arguments

Rubric 3 may be used to assess students' written arguments from Lesson 4.3. The purpose of this rubric is to guide support for students as they develop the scientific practice of argumentation and come to appreciate that science, as a field, advances through argumentation. The rubric is grounded in the principle that ideas in science are based on evidence and that students are doing science when they are making explanations and arguments—just as scientists use evidence to justify why a particular explanation is the best one available. The rubric is designed to guide formative feedback that:

- supports students in understanding science as a collaborative process of knowledge building, using evidence derived from the natural world.
- helps students feel capable as they build on the skills they already have for evaluating possible answers in relation to available evidence.
- develops students who can skillfully construct and critique arguments in science and bring those skills to other areas.

In this unit, a strong written argument meets the following criteria:

- **takes a stance** by stating a claim that directly addresses the question
- **explanatory** by identifying a cause for the phenomenon in question *and* explaining the mechanism by which it is a cause
- **justified by the reasoned use of evidence** that is likely to convince a scientific audience
- **employs high-quality information** as evidence to support the claim
- **clear and well-organized** by following conventions and being structured in a way that clearly communicates to the intended audience why the proposed claim is the one most likely to be true
- **going further: engages with alternative claims** by acknowledging and challenging competing ideas

Rubric 3 describes how these criteria may be applied to students' written arguments in this unit and suggests feedback to help students advance the practice of argumentation.

Rubric 3: Assessing Students' Performance of the Practice of Constructing Scientific Arguments		
Criteria	Score	Description and possible feedback
takes a stance Does the argument propose a claim that directly answers the question?	0	No claim is proposed, or proposed claim does not answer the question. (e.g., the claim is off-topic) Possible feedback: <i>What question are we trying to answer? What kinds of things might cause that to happen? How can you make sure that your proposed answer is clear to your audience?</i>
	1	Argument proposes a claim that answers the question. Note that students who select one of the provided claims would receive a score of 1 for this criterion.
explanatory Does the argument fully address the question by identifying a cause for the phenomenon and by explaining the mechanism or process by which it is a cause?	0	Argument does not offer an explanatory account to answer the question. A cause is not identified, and a mechanism is not described.
	1	Argument identifies a cause of the observed phenomenon without indicating the mechanism. Example (Claim 2): Vehicle 2 fell off the cliff in Claire's test, but not in <i>Iceworld Revenge</i> because the friction of the surface was higher in <i>Iceworld Revenge</i> . Possible feedback: <i>You wrote that the friction was higher, but why did that cause the difference in motion?</i>
	2	Argument proposes an explanation that identifies the cause but does not explain the mechanism in appropriate depth, or argument explains only part of the mechanism. Example (Claim 2): Vehicle 2 fell off the cliff in Claire's test, but not in <i>Iceworld Revenge</i> because the friction of the surface was higher in <i>Iceworld Revenge</i> . Higher friction causes objects to slow down and stop in a shorter distance than lower friction. Possible feedback: <i>You've told me that friction causes objects to slow down sooner, but how does friction do that?</i>

Rubric 3: Assessing Students' Performance of the Practice of Constructing Scientific Arguments		
Criteria	Score	Description and possible feedback
<p>explanatory</p> <p>Does the argument fully address the question by identifying a cause for the phenomenon and by explaining the mechanism or process by which it is a cause?</p>	3	<p>Argument proposes a complete and thorough explanation that identifies the causes and fully describes the mechanism.</p> <p>Example (Claim 2): Vehicle 2 fell off the cliff in Claire's test, but not in <i>Iceworld Revenge</i> because the friction of the surface was higher in <i>Iceworld Revenge</i>. Higher friction causes objects to slow down and stop in a shorter distance than lower friction. This is because friction is a force in the opposite direction of the motion of an object. A stronger force causes a greater change in an object's velocity, so Vehicle 2 stopped moving before it reached the cliff edge.</p>
<p>justified by the reasoned use of evidence</p> <p>Is evidence connected to the claim in a way that is likely to convince the audience that the proposed explanation is the best one?</p>	0	<p>Argument does not support the claim with any of the available information (data or science ideas).</p> <p>Possible feedback: <i>How could you convince your audience that the claim you made is the best one?</i></p>
	1	<p>Argument includes information to support the claim but does not explain <i>how</i> that information supports the claim.</p> <p>Example (specific data but not science ideas) (Claim 1): The masses of the vehicles in <i>Iceworld Revenge</i> were different from each other, while in Claire's test, the vehicles were the same mass. The motion of Vehicle 1 was much greater after the collision in <i>Iceworld Revenge</i> than in Claire's test (Evidence Card D).</p> <p>Possible feedback: <i>How do these specific data support your claim? Why does the information you provide matter? Why is the information you provided evidence for your claim? How does the data about Vehicle 1's motion support your claim?</i></p> <p>OR</p>

Rubric 3: Assessing Students' Performance of the Practice of Constructing Scientific Arguments		
Criteria	Score	Description and possible feedback
<p>justified by the reasoned use of evidence</p> <p>Is evidence connected to the claim in a way that is likely to convince the audience that the proposed explanation is the best one?</p>	1	<p>(continued)</p> <p>Example (science ideas but not specific data) (Claim 1): The vehicles in <i>Iceworld Revenge</i> had different masses, while in Claire's test, the vehicles were the same mass. More massive objects change velocity less from a force than less massive objects.</p> <p>Possible feedback: <i>How do you know that this is what happened in this specific case? How do you know that this is what happened in Iceworld Revenge?</i></p>
	2	<p>Argument includes information to support the claim and explains how some of the information supports the claim.</p> <p>Example (Claim 1): The masses of the vehicles in <i>Iceworld Revenge</i> were different from each other, while in Claire's test, the vehicles were the same mass. The motion of Vehicle 1 was much greater after the collision in <i>Iceworld Revenge</i> than in Claire's test (Evidence Card D). This shows that something about the mass of the vehicles must have been different in Claire's test, because an object's mass affects how much it changes velocity from a force. Also, Vehicle 2 moved less after the collision in <i>Iceworld Revenge</i> (Evidence Card B).</p> <p>Possible feedback: <i>You explained how the motion of Vehicle 1 indicates something about mass, but how does the motion of Vehicle 2 support the claim that the mass of the vehicles was different?</i></p>

Rubric 3: Assessing Students' Performance of the Practice of Constructing Scientific Arguments		
Criteria	Score	Description and possible feedback
<p>justified by the reasoned use of evidence</p> <p>Is evidence connected to the claim in a way that is likely to convince the audience that the proposed explanation is the best one?</p>	3	<p>Argument includes information to support the claim and explains how <i>all</i> the information supports the claim.</p> <p>Example (Claim 1): The masses of the vehicles in <i>Iceworld Revenge</i> were different from each other, while in Claire's test, the vehicles were the same mass. In <i>Iceworld Revenge</i>, Vehicle 1 rolled backward off the screen and Vehicle 2 moved slowly after the crash (Evidence Cards D and B). This evidence shows that the objects experienced different changes in velocity from the collision. In a collision, both objects experience the same strength force, but in opposite directions. This evidence matters because it shows that Vehicle 1 must have had less mass than Vehicle 2, because objects with less mass have a greater change in velocity from the same strength force. Additional evidence that supports this claim is that it is possible to make the miniature cars look the same even if they are made out of materials with very different masses (Evidence Card E).</p> <p>Possible feedback: <i>Are there other ways or reasons why this event could have happened? Does all the available information support your claim? Does any available information support other claims? How might you refute one of the other claims?</i></p>
<p>employs high-quality information as evidence</p> <p>This unit's criterion for quality of evidence involves using data from reliable sources.</p>	0	<p>Argument prioritizes information and evidence sources that are not from reliable sources presented in the <i>Force and Motion</i> unit.</p> <p>Example: I saw on TV that sometimes cars slow down because they have sticky wheels.</p>
	1	<p>Argument includes high-quality information that could be used as evidence to support the claim.</p> <p>Example: Plexiglass can look like ice but it has a higher friction.</p>

Rubric 3: Assessing Students' Performance of the Practice of Constructing Scientific Arguments		
Criteria	Score	Description and possible feedback
<p>clear and well-organized</p> <p>Does the argument follow conventions and is it structured in a way that clearly communicates to the intended audience why the proposed claim is the best and most likely to be true?</p>	0-3	<p>This criterion, scored on a scale of 0-3, is intended to be applied to the written argument as a whole to formatively assess how clearly students' writing communicates why the proposed claim is most likely to be true. The questions below are intended to guide scoring and formative feedback for students to support their development of academic writing and language as it relates to scientific argumentation.</p> <ul style="list-style-type: none"> • Does the argument begin with a clearly articulated claim? • Is the argument logically organized (e.g., by focusing on one causal factor at a time)? • Does the argument follow grade-appropriate conventions for academic writing? • Does the argument use transition words to organize ideas?
<p>going further: engages with alternative claims</p> <p>Does the argument adequately address counterclaims? (While refutation is not a practice that is explicitly supported in this unit, some students may engage with alternative claims. This rubric can help provide feedback for students who do so.)</p>	0	<p>Alternative claims are not acknowledged.</p> <p>Possible feedback: <i>Have you considered what other claims might have some support?</i></p>
	1	<p>Alternative claims are acknowledged, but evidence against those claims is not leveraged.</p> <p>Example: Another claim is that the mass of the vehicles was different in <i>Iceworld Revenge</i>, but this is not correct.</p> <p>Possible feedback: <i>You mentioned that another claim might not be as strong. Can you provide evidence for why that claim might not be as strong?</i></p>

Rubric 3: Assessing Students' Performance of the Practice of Constructing Scientific Arguments		
Criteria	Score	Description and possible feedback
<p>going further: engages with alternative claims</p> <p>Does the argument adequately address counterclaims? (While refutation is not a practice that is explicitly supported in this unit, some students may engage with alternative claims. This rubric can help provide feedback for students who do so.)</p>	2	<p>Alternative claims are acknowledged, and evidence against those claims is leveraged.</p> <p>Example: Another claim is that the mass of the vehicles was different in <i>Iceworld Revenge</i>, but this is not correct. Vehicle 2 stops before it falls off the cliff in <i>Iceworld Revenge</i> (Evidence Card B). This can only happen if the surface provides a lot of friction. A more massive car will still keep moving when there is very little surface friction, so a difference in mass could not explain what happened.</p> <p>Possible feedback: <i>You mentioned evidence that supports your claim. Is there any evidence that could support the other claim? If so, what is your reason for discarding it?</i></p>
	3	<p>Alternative claims are acknowledged AND evidence against those claims is leveraged AND evidence supporting those claims is critique</p> <p>Example: Another claim is that the mass of the vehicles was different in <i>Iceworld Revenge</i>, but this is not correct. Vehicle 2 stops before it falls off the cliff in <i>Iceworld Revenge</i> (Evidence Card B). This can only happen if the surface provides a lot of friction. A more massive car will still keep moving when there is very little surface friction, so a difference in mass could not explain what happened. Additionally, Evidence Card D describes how Vehicle 1 moved in the two crashes, but it is based on observations, not measurements. It's possible that Claire was not an accurate observer, so this evidence is not reliable to support Claim 2.</p>

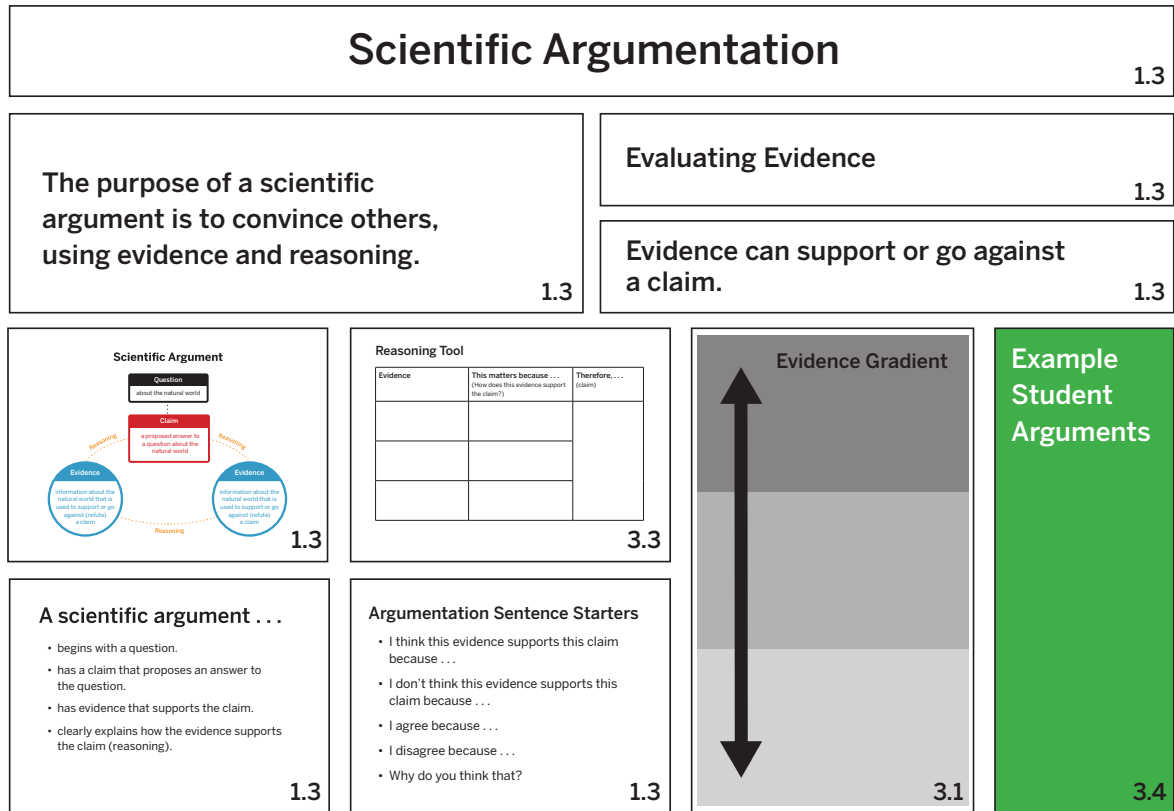
Science Seminar Observations

Write a check mark in the right-hand column every time you hear one of your peers say or do something listed in the left-hand column. If you hear an interesting idea, write it in the last row of the table.

OBSERVATIONS DURING THE SEMINAR	CHECK MARKS
I heard a student use evidence to support a claim.	
I heard a student respectfully disagree with someone else's thinking.	
I heard a student explain how her evidence is connected to her claim.	
I heard a student evaluate the quality of evidence.	
I heard an idea that makes me better understand one of the claims. That idea is: _____ _____	

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Completed Scientific Argumentation Wall Diagram



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Name: _____

Date: _____

Using the Reasoning Tool

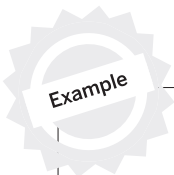
Use the Science Seminar Reasoning Tool sheet to explain how the evidence supports your claim. Follow the instructions below.

1. Record the claim that you think is best supported by the evidence (in the Therefore, column).
If you prefer, you can also write and record your own claim.
2. Tape the evidence cards that support your claim to the Reasoning Tool (in the Evidence column).
You do not need to use all the cards, but you can use more than one to support your claim.
3. Use the middle column (This matters because . . .) to record how the evidence in the left column connects to the claim in the right column.

Preparing to Write

Organizing Your Reasoning Tool

- Draw a circle around your strongest piece of evidence.
- Draw an X over a piece of evidence if you do not plan to use it in your argument.
- Draw an arrow to connect two pieces of evidence if you think that they go together.



	Evidence	This matters because . . . (How does this evidence support the claim?)	Therefore, . . . (claim)
	Example Evidence Card A	Your ideas about how the evidence supports the claim	Your claim
	Example Evidence Card B	Your ideas about how the evidence supports the claim	
	Example Evidence Card C	Your ideas about how the evidence supports the claim	

Writing a Scientific Argument

Write your scientific argument to Claire. As you write,

- review your Reasoning Tool. Include your strongest piece of evidence and make connections between pieces of evidence that go together; and
- use the Scientific Argument Sentence Starters to help write sentences that clearly explain your thinking.

Scientific Argument Sentence Starters

<p>Describing evidence:</p> <p>The evidence that supports my claim is . . .</p> <p>My first piece of evidence is . . .</p> <p>Another piece of evidence is . . .</p> <p>This evidence shows that . . .</p>	<p>Describing how the evidence supports the claim:</p> <p>If _____, then . . .</p> <p>This is important because . . .</p> <p>Since _____, . . .</p> <p>Based on the evidence, I conclude that . . .</p> <p>This claim is stronger because . . .</p>
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Write a scientific argument that addresses this question: *Why did Vehicle 2 fall off the cliff in Claire's test of the collision scene, but Vehicle 2 did not fall off the cliff in the film Iceworld Revenge?*

Claim 1: The vehicles in *Iceworld Revenge* had different masses; in Claire's test, the vehicles had the same mass.

Claim 2: The friction of the surface that was used in *Iceworld Revenge* was different from the friction of the surface in Claire's test.

State your claim. Use evidence to support your claim, and then explain how the evidence supports your claim.

Name: _____

Date: _____

Homework: Revising an Argument

1. Reread the scientific argument you wrote in class.
2. Complete your argument, if needed.
3. Look for ways that you could make your argument clearer or more convincing.
4. Consider reading your argument aloud or having another person read it.
5. Ask yourself these questions as you review your argument:
 - Does this argument clearly state a claim?
 - Did I describe the supporting evidence?
 - Did I thoroughly explain how the evidence supports the claim?
6. Rewrite any sections of your argument that could be clearer or more convincing.

Write a scientific argument that addresses this question: *Why did Vehicle 2 fall off the cliff in Claire's test of the collision scene, but Vehicle 2 did not fall off the cliff in the film Iceworld Revenge?*

- State your claim.
- Use evidence to support your claim.
- Explain how the evidence supports your claim.

Targeted small group work time

- i. Analyzing the End-of-Unit Assessment
- ii. Deepening understanding of content
- iii. Formative assessment and differentiation
- iv. Internalizing the upcoming unit

Analyzing the End-of-Unit Assessment

Force and Motion

Goal: Deepen understanding of how student responses in the End-of-Unit Assessment reflect the conceptual learning progression.

Reflect

In your teaching, how have you used summative assessments in the past?

In what format have you conducted an End-of-Unit Assessment or summative assessment (i.e. short answer, multiple choice, performance tasks)? What do students do to show what they've learned?

Analyzing the End-of-Unit Assessment cont.

Analyze the End-of-Unit Assessment

In Amplify Science, the End-of-Unit Assessment is a summative assessment that provides students an opportunity to demonstrate their understanding of a unit's content. It's designed to reveal students' understanding along the unit's Progress Build.

A unit's Progress Build defines a progression of student understanding. Let's analyze the Progress Build for Force and Motion in order to deepen our understanding of the End-of-Unit Assessment.

Level 1 A force causes a change in an object's velocity.	Level 2 An object's mass determines its velocity change for a given force.	Level 3 When two objects collide, both experience the same strength force, but in opposite directions.
Between Level 1 and Level 2, what new ideas were integrated into students' deep understanding of force and motion?		Between Level 2 and Level 3, what new ideas were integrated into students' deep understanding of force and motion?

Check your understanding!

Navigate to the Force and Motion unit landing page and select [Jump Down to Unit Guide](#). Click to open the Progress Build and read each level of the expanded Progress Build to better understand how student learning progresses throughout the unit. Add any new ideas to the diagram above.

Part 1: Assessment design

Navigate to Lesson 4.4 in the Force and Motion unit. To view the multiple choice items, either select Activity 1 in the Lesson Map or select Force and Motion End-of-Unit Assessment copymaster from Digital Resources. Spend the next 5 minutes reading through the multiple choice items. Record any patterns or observations in the space below:

Analyzing the End-of-Unit Assessment cont.

You might have noticed that the assessment items follow a pattern. Each assessment item is aligned to a particular level of the Progress Build:

- 4 items focusing on each level
- Answering at least 3 out of the 4 items correctly represents full, explanatory understanding of that level.

Return to the Force and Motion Progress Build on page 25 in your Participant Notebook. Then, reread multiple choice items 1-3 in the End-of-Unit Assessment and reflect on which Progress Build level is to be assessed for each question. Record in your responses in the table below:

Multiple choice item	Corresponding Progress Build level	Evidence
1		
2		
3		

Check your understanding!

Open the Force and Motion End-of-Unit Assessment Answer Key and Scoring Guide in the Digital Resources of Lesson 4.4. Refer to the Item-PB Mapping table on page 2 to check your responses above.

Supporting concepts

Next, turn to page 1 of the End-of-Unit Answer Key and Scoring Guide. What supporting concepts are assessed in this unit? Which items are aligned in these supporting concepts?

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Analyzing the End-of-Unit Assessment cont.

Part 2: Analyzing student responses

Navigate to Lesson 4.4, Activity 2 and read Written-Response Question 1. Below you will find four different student responses to the question. Using your analysis of the Progress Build, determine which Progress Build level (Level 0 to Level 3) each response reflects. You may want to annotate the student response or use the space provided to include the rationale for your choice.

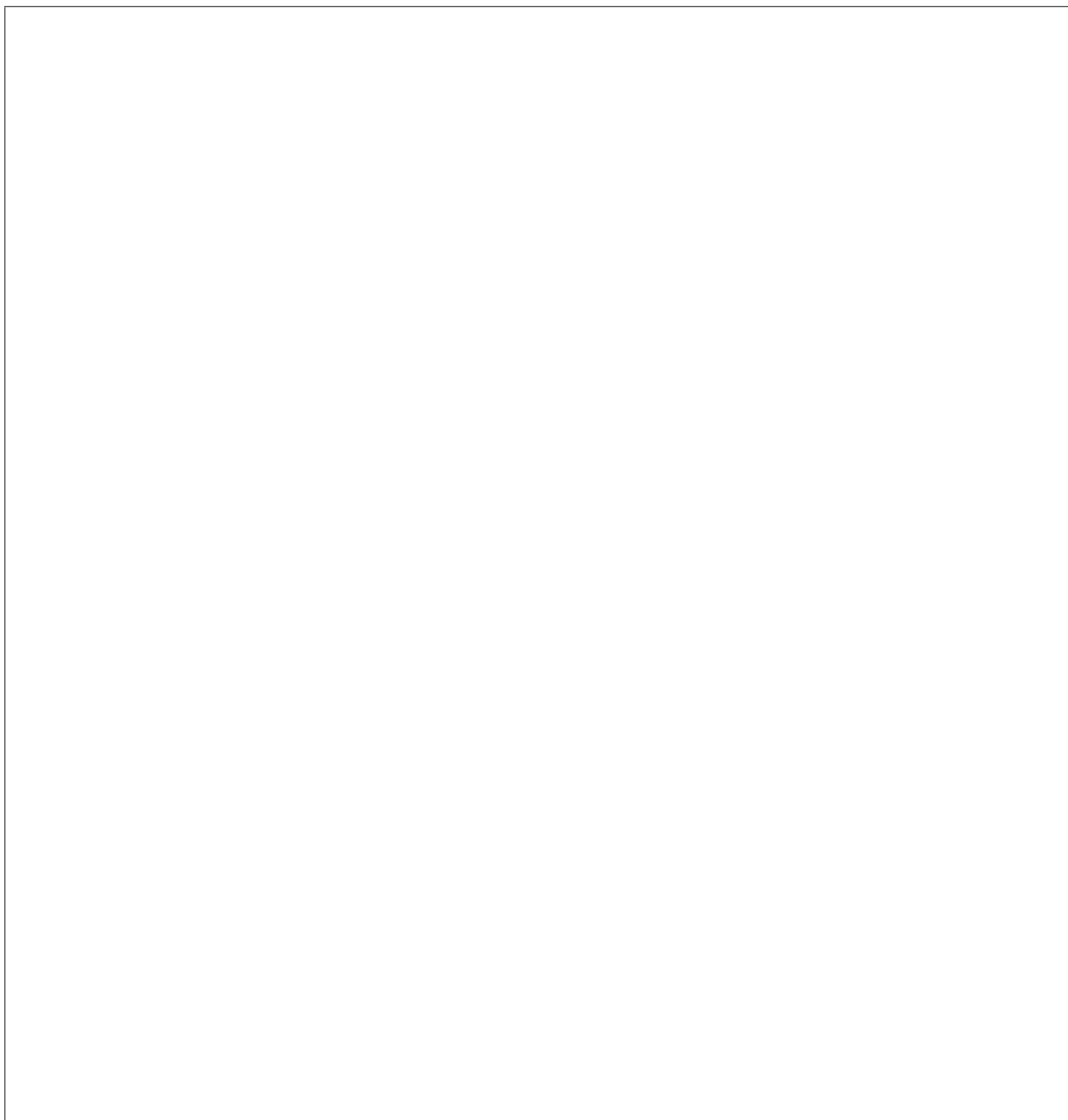
<p>Written-response question #1: A satellite was in two separate crashes. In both crashes, the satellite had the same mass. Engineers want to know about the speed and direction of the satellite after the crashes. Why would the crash affect the motion of the satellite, and which crash caused a greater change in motion for the satellite?</p>	
<p>Student A response Crashing into the asteroid would cause the satellite to stop and break.</p>	<p>Progress Build level: ____ Rationale:</p>
<p>Student B response Crashing into the asteroid would cause the satellite to slow down, stop, or reverse direction because it is a force in the opposite direction to the satellite's motion. Whichever crash was a stronger force would cause it to change speed more. The more massive asteroid in Crash 1 changed speed the same amount as the less massive asteroid in Crash 2, so the asteroid in Crash 1 exerted a stronger force because a stronger force is required to change the speed of a more massive object by the same amount as a less massive object. Maybe this means the satellite experienced a stronger force, too.</p>	<p>Progress Build level: ____ Rationale:</p>
<p>Student C response Crashing into the asteroid would cause the satellite to slow down, stop, or reverse direction, because it is a force in the opposite direction to the satellite's motion. Whichever crash was a stronger force would cause it to change motion more.</p>	<p>Progress Build level: ____ Rationale:</p>
<p>Student D response Crash 1 caused a greater change in speed for the satellite. In a collision, both objects experience the same strength force, but in opposite directions. It takes a stronger force to change the velocity of a more massive object. So, since the asteroid with more mass changed speed the same amount as the asteroid with less mass, the more massive asteroid must have experienced a stronger force in the collision than the asteroid with less mass. This means that the satellite must have experienced a stronger force when it collided with the more massive asteroid (Crash 1).</p>	<p>Progress Build level: ____ Rationale:</p>

Analyzing the End-of-Unit Assessment cont.

Check your understanding!

Open the Force and Motion End-of-Unit Assessment Answer Key and Scoring Guide in the Digital Resources of Lesson 4.4. Refer to Science Content Rubrics on page 7 to check your responses above.

What are the advantages of using a summative assessment to determine where a student's understanding falls on the Progress Build at the conclusion of a unit?



Deepening understanding of content

Goal: Deepen my own content knowledge.

Step 1: Read the Science Background Planning for the Unit doc (10 mins)

- Read today's deep dive unit's Science Background Planning for the Unit doc. The purpose of this active reading activity is for you to pay attention to concepts that you want more support with and, in turn, about which you feel hesitant in supporting students (i.e. your "challenge concepts").
- As you read, note these concepts in the "My challenge concepts" column in the table below.
- Also consider concepts that you feel particularly comfortable with. Your expertise in these areas may support your colleagues later in this activity. Note these concepts in the "My comfort concepts" portion of the table (at the bottom).

Step 2: Share your challenge areas (5 mins)

- Working in a group of 4, take turns sharing your challenge concepts. Note who is sharing similar concepts to yours. You will want to partner with them in a moment.

Step 3: Find your challenge concepts within the unit (25 mins)

- Use the Coherence Flowchart to identify where your personal challenge concepts arise during the unit. Look at the Investigation Questions and key concepts to consider which moments in the unit students grapple with ideas related to your challenge concepts. Record the lesson(s) when this happens (indicated on the Coherence Flowchart) in the "Location in Unit" column.
- Navigate to the identified lessons, and explore the activities during which students build these key concepts. Try to dive into a variety of modalities, including a Sim activity, active reading, and using a modeling tool, etc. Record the activity in the "Activity that helps construct this concept" column in the table below. In the last column of the table, note how this activity helps students figure out this concept (much like how we annotated the Coherence Flowchart earlier in the day).

Deepening understanding of content cont.

My challenge concepts	Location in unit (lesson-level)	Activity that helps construct this concept	How does this activity help construct this concept?
My comfort concepts			

Deepening understanding of content cont.

Reflect: Discuss these questions with a partner, and record your thoughts. (5 mins)

- What steps will I take to ensure that I am prepared enough to teach this concept effectively and accurately?

- What are my resources for deeper learning around these concepts?

- How will I know if I am teaching these concepts effectively?

OPTIONAL: Identifying student preconceptions

Goal: Get to know possible student preconceptions in your upcoming unit, and identify where your challenge concepts and theirs align.

Step 1: Re-read Science Background doc with preconception focus. (5 mins)

- Return to the Science Background document. The purpose here is to identify possible student preconceptions that may require extra support during teaching. Skim through the document, stopping where you come to a “Note: Preconceptions” paragraph. Read and record brief notes in the associated column in the table below.

Step 2: Identify associated key concepts.

- Using the Coherence Flowchart, identify and record the associated key concepts, including the location in which these preconceptions may arise.

Step 3: Consider how to best support your students.

- Navigate to these locations in the digital platform, and use the Differentiation tab in the Lesson Brief and the Teacher Support tabs within the activities to research ideas for extra support at these points. Record in the “Extra support ideas from Amplify Science” column below.
- Discuss other ideas with a partner about how to identify when these preconceptions arise, and how to support your students. Record in the “Your ideas” column in the table which follows.

Deepening understanding of content cont.

Possible student preconceptions	Associated concepts	Location(s) in unit	Extra support ideas from Amplify Science	Your ideas

Reflect:

- Review your two tables constructed during these activities. Where do your challenge concepts and possible student preconceptions overlap? How will you use this information during your implementation?

Formative assessment and differentiation

Force and Motion

Goal: Examine embedded formative assessment opportunities in order to plan for differentiated instruction.

Step 1: How do we assess learning?

In Amplify Science, students can demonstrate what they've learned through embedded formative assessments (e.g., On-the-Fly Assessments, Critical Juncture Assessments, Student Self-Assessments). These assessments represent the most opportune moments for a glimpse into students' developing conceptual understanding and their facility with the practices.

First, let's analyze an embedded assessment opportunity we experienced earlier in the day. During our Force and Motion deep dive sequence, we discussed how students write about the cause-and-effect relationship between the force exerted by the thrusters and the pod's change in velocity after using the Modeling Tool. Follow the steps below to navigate to the On-the-Fly Assessment in Lesson 1.6.

- Navigate to Force and Motion → Chapter 1 → Lesson 1.6 → Activity 3
- Select Embedded Formative Assessment
- Select On-the-Fly Assessment 2: Inferring Strength and Direction of Forces from Velocity Changes
- Read the Look for and Now what? sections and then complete the table below.

Force and Motion Lesson 1.6, Activity 3	
Which disciplinary core ideas, science and engineering practices, and/or crosscutting concepts are being assessed?	
What data can be collected from this assessment opportunity?	
How could you collect data?	
What will this formative assessment opportunity tell you about student understanding?	

Formative assessment and differentiation cont.

Step 2: Reflecting on differentiated instruction

Based on student responses to embedded formative assessments, you may need to differentiate instruction in the next activity or lesson. Differentiated instruction is a powerful classroom practice that recognizes that students bring a wide variety of skills, talents, and needs to their daily learning. When you differentiate instruction, it enables you to address varying degrees of proficiency and skill while also meeting identifiable differences in learning styles and interests. There are various ways to differentiate instruction—what you teach, how you teach, and/or how students demonstrate their learning.

How do you currently respond to students' needs, styles, or interests in your classroom?

Formative assessment and differentiation cont.

Step 3a: Determine strategies to differentiate instruction.

First, let's read about the variety of differentiation strategies which are embedded in the Amplify Science curriculum. Follow the steps below to access the Program Guide:

1. Navigate to the Science Program Guide using the Global Navigation Bar.
2. Select Access and Equity.
3. Choose Differentiation Strategies.
4. Explore the description and associated strategies for the student groups listed.
5. Use the space below to record strategies you could use to differentiate instruction for each group of students.

Student population	Strategies for support
English learners	
Students with disabilities	
Standard English learners	
Girls and young women	
Advanced learners and gifted learners	
Students living in poverty, foster children and youth, and migrant students	

Step 3b: Review Lesson Brief

Navigate to the 1.6 Lesson Brief and select the drop-down arrow to expand the Differentiation section. Read the Embedded Supports for Diverse Learners. Are there any additional strategies noted in this brief that you would like to capture in the table above?

Formative assessment and differentiation cont.

Step 4: Preparing to differentiate

Now it's time to draft a plan to implement differentiated instruction.

What is one strategy you just reviewed and/or recorded which you feel most comfortable implementing after the next embedded formative assessment opportunity?

How will you prepare your students for the implementation of this new strategy?

(Ex: Expected student behavior for group work, step-by-step directions)

How will you prepare your classroom for the implementation of this new strategy?

(Ex: Classroom arrangement, organizing materials)

Internalizing the upcoming unit

Goal: Gain familiarity with an upcoming unit, and start to plan how you will teach it!

Step 1: Begin by reading the general guidance in *Planning for the Unit: Getting Ready to Teach*.
(Navigate to the unit landing page, select Jump Down to Unit Guide, then select Getting Ready to Teach).

Step 2: Use the following questions and workspace to guide you as you get to know a new unit.

Question to ask yourself	Resources Note: resources in italics are names of documents
Getting to know the unit overall	
What is the problem students have to solve, and how is it introduced?	<ul style="list-style-type: none"> • <i>Planning for the Unit: Unit overview</i> • Grades 6-8: lesson 1.2
My notes:	
What are the learning goals (NGSS) for this unit? <ul style="list-style-type: none"> • DCIs • SEPs • CCCs 	<ul style="list-style-type: none"> • <i>Planning for the Unit: Standards at a Glance</i> • <i>Teacher Reference: Standards and Goals</i> • <i>Teacher Reference: 3-D Statements</i>
My notes:	
How does the unit unfold chapter by chapter?	<ul style="list-style-type: none"> • Chapter Overviews • <i>Planning for the Unit: Unit Overview</i> • <i>Planning for the Unit: Unit Map</i> • <i>Teacher Reference: Lesson Overview Compilation</i>
My notes:	
What is the Progress Build and how will students demonstrate their progress? (Core units only)	<ul style="list-style-type: none"> • <i>Planning for the Unit: Progress Build</i> • <i>Teacher Reference: Assessment System</i> • <i>Teacher Reference: Embedded Formative Assessments</i>
My notes:	

Internalizing the upcoming unit cont.

What is some of the underlying science background that will help you teach this unit?	<ul style="list-style-type: none"> • <i>Planning for the Unit: Science Background</i>
My notes:	
Gathering evidence to make explanations and arguments	
What are some of the types of activities students do to gather evidence?	<ul style="list-style-type: none"> • <i>Planning for the Unit: Unit Overview</i>
My notes:	
<p>Articles: What articles do students read? Students engage with some of the articles during two active reading sessions; generally the students read and annotate for the first read to get to know the unit. What is the focus for the second read of the same article?</p>	<ul style="list-style-type: none"> • <i>Teacher Reference: Articles in this Unit</i> • Lessons with the article title as the lesson title
My notes:	
What are the explanations or arguments students come to at the end of each chapter? What is the topic of the Science Seminar?	<ul style="list-style-type: none"> • <i>Planning for the Unit: Unit Map</i> • Download the Investigation Notebook • Look in end-of-chapter lessons
My notes:	
Digital apps	
<p>Sims: Every unit has a Sim (except Geology on Mars which uses <i>Google Mars</i>.) Get to know the Sim and how it's used throughout the unit.</p>	<ul style="list-style-type: none"> • Go to the Global Navigation menu to find the Sim with the same name as your unit. • <i>Teacher Reference: Apps in this Unit.</i>
My notes:	

Internalizing the upcoming unit cont.

<p>Modeling tool: All core units have a modeling tool. Is it paper or digital? When and how is it used?</p>	<ul style="list-style-type: none"> • For units with digital modeling tools, <i>Teacher Reference: Apps in this Unit</i> • Otherwise, first lesson where modeling tool is used
<p>My notes:</p>	
<p>Materials management for your unit</p>	
<p>What physical materials and print materials come in your kit? What is considered “teacher provided?”</p>	<ul style="list-style-type: none"> • <i>Planning for the Unit: Materials and Preparation</i>
<p>My notes:</p>	
<p>What days will you need more time to prep and set up?</p>	<ul style="list-style-type: none"> • <i>Planning for the Unit: Materials and Preparation (“Preparation at a Glance” section)</i>
<p>My notes:</p>	
<p>How often will students need the digital devices?</p>	<ul style="list-style-type: none"> • <i>Planning for the Unit: Materials and Preparation (“Preparation at a Glance” section)</i> • “Unplugged?” section in each lesson’s Lesson Brief
<p>My notes:</p>	

Amplify Science support

Program Guide

Gain additional insight into the program's structure, intent, philosophies, supports, and flexibility.

my.amplify.com/programguide


Amplify Help

Find lots of advice and answers from the Amplify team.

my.amplify.com/help

Customer care

Seek information specific to enrollment and rosters, technical support, materials and kits, and teaching support, weekdays 7AM-7PM EST.

 800-823-1969

 scihelp@amplify.com

 Amplify Chat

When contacting customer care, be sure to:

- Identify yourself as an Amplify Science user.
- Note the unit you are teaching.
- Note the type of device you are using (Chromebook, iPad, Windows laptop, etc.).
- Note the web browser you are using (Chrome or Safari).
- Include a screenshot of the problem, if possible.
- Cc: your district or site IT contact.

