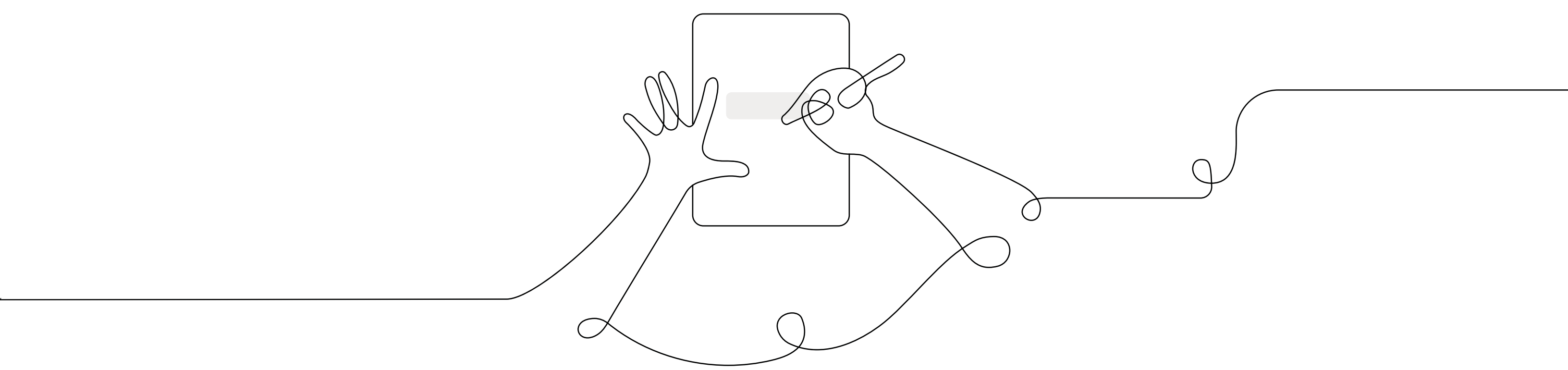
AmplifyScience

Participant Notebook

Grade 8: Force and Motion
Guided Unit Internalization with @Home Resources



Unit Guide resources

Once a unit is selected, select **JUMP DOWN TO UNIT GUIDE** in order to access all unit-level resources in an Amplify Science unit.

Planning for the unit

Unit Overview	Describes what's in each unit, the rationale, and how students learn across chapters
Unit Map	Provides an overview of what students figure out in each chapter, and how they figure it out
Progress Build	Explains the learning progression of ideas students figure out in the unit
Getting Ready to Teach	Provides tips for effectively preparing to teach and teaching the unit in your classroom
Materials and Preparation	Lists materials included in the unit's kit, items to be provided by the teacher, and briefly outlines preparation requirements for each lesson
Science Background	Adult-level primer on the science content students figure out in the unit
Standards at a Glance	Lists Next Generation Science Standards (NGSS) (Performance Expectations, Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts), Common Core State Standards for English Language Arts, and Common Core State Standards for Mathematics

Teacher references

Lesson Overview Compilation	Lesson Overview of each lesson in the unit, including lesson summary, activity purposes, and timing
Standards and Goals	Lists NGSS (Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts) and CCSS (English Language Arts and Mathematics) in the unit, explains how the standards are reached
3-D Statements	Describes 3-D learning across the unit, chapters, and in individual lessons
Assessment System	Describes components of the Amplify Science Assessment System, identifies each 3-D assessment opportunity in the unit
Embedded Formative Assessments	Includes full text of formative assessments in the unit
Books in This Unit	Summarizes each unit text and explains how the text supports instruction
Apps in This Unit	Outlines functionality of digital tools and how students use them (in grades 2-5)

Printable resources

Copymaster Compilation	Compilation of all copymasters for the teacher to print and copy throughout the unit
Investigation Notebook	Digital version of the Investigation Notebook, for copying and projecting
Multi-Language Glossary	Glossary of unit vocabulary in multiple languages
Print Materials (8.5" x 11")	Digital compilation of printed cards (i.e. vocabulary cards, student card sets) provided in the kit
Print Materials (11" x 17")	Digital compilation of printed Unit Question, Chapter Questions, and Key Concepts provided in the kit

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.

Chapters at a Glance

Unit Question

How do forces affect motion?

Chapter 1: Force and Velocity

Chapter Question

What caused the pod to change direction?

Investigation Questions

- What makes an object's motion change? (1.3, 1.4)
- What causes some velocity changes to be greater than others? (1.4, 1.5)

Key Concepts

- A force is required to change the velocity of an object. (1.3)
- How an object changes velocity depends on the direction of the force exerted on that object. (1.3)
- A stronger force can cause a greater change in velocity. (1.5)
- Understanding a cause-and-effect relationship can help you infer what led to a particular result. (1.6)

Chapter 2: Mass and Velocity

Chapter Question

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

Investigation Questions

- If the same strength force is exerted on two objects, why might they be affected differently? (2.1, 2.2, 2.3)

Key Concepts

- 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)

Lesson Overviews

Lesson 1.1: Pre-Unit Assessment

Lesson Summary

Students complete a Pre-Unit Assessment consisting of 14 multiple-choice questions and 2 written-response questions in which students analyze and interpret data and construct explanations. The Pre-Unit Assessment is diagnostic and designed to reveal students' understanding of the unit's core content—including unit-specific science concepts and crosscutting concepts—prior to instruction by indicating, for formative purposes, where students initially fall along the levels of the Progress Build. The Pre-Unit Assessment also measures students' understanding of important supporting content not explicitly included in the Progress Build. As such, the Pre-Unit Assessment offers a baseline from which to measure growth of understanding over the course of the unit.

Lesson at a Glance

1: Multiple Choice (25 min.)

These multiple-choice questions provide an auto-scored measure of students' placements on the Progress Build.

2: Written-Response Question #1 (10 min.)

This written-response question provides additional information about students' placements on the Progress Build, including both unit-specific science concepts and crosscutting concepts. This item can be scored by referring to the provided rubric in the *Force and Motion* Pre-Unit Assessment Answer Key and Scoring Guide (in Digital Resources).

3: Written-Response Question #2 (10 min.)

This written-response question provides additional information about students' placements on the Progress Build, including both unit-specific science concepts and crosscutting concepts. This item can be scored by referring to the provided rubric in the *Force and Motion* Pre-Unit Assessment Answer Key and Scoring Guide (in Digital Resources).

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.**

Guided Unit Internalization Planner

Part 1: Unit-level internalization

Unit title:

What is the phenomenon students are investigating in your unit?

Unit Question:	**Student role:**

By the end of the unit, students figure out ...

What science ideas do students need to figure out in order to explain the phenomenon?

Part 2: Chapter-level internalization

Chapter Question:	
What key concepts do students construct in this chapter?	**How do students apply the key concepts to answer the Chapter Question? To solve the phenomenon?**

Part 3: Lesson-level Internalization

Day ____________

Minutes for science: ____________ **Instructional format:** ☐ Asynchronous ☐ Synchronous	**Minutes for science: _____________** **Instructional format:** ☐ Asynchronous ☐ Synchronous

Lesson or part of lesson:
 	
Mode of instruction:
❏ Preview
❏ Review
❏ Teach full lesson live
❏ Teach using synchronous suggestions
❏ Students work independently using:
    ❏ @Home Packet
    ❏ @Home Slides and @Home Student Sheets
    ❏ @Home Videos
	Lesson or part of lesson:
	
	Mode of instruction:
	❏ Preview
	❏ Review
	❏ Teach full lesson live
	❏ Teach using synchronous suggestions
	❏ Students work independently using:
	    ❏ @Home Packet
	    ❏ @Home Slides and @Home Student Sheets
	    ❏ @Home Videos

Students will…	**Teacher will…**	**Students will…**	**Teacher will…**

Look at the *Students will* columns. What are students working in the lesson(s) that you could collect, review, or provide feedback on? See Some Types of Written Work in Amplify Science to the right for guidance. If there isn't a work product listed above, do you want to add one? Make notes below.	**Some Types of Written Work in Amplify Science** ● Daily written reflections ● Homework tasks ● Investigation notebook pages ● Written explanations (typically at the end of Chapter) ● Diagrams ● Recording pages for Sim uses, investigations, etc	
How will students submit this work product to you? See the Completing and Submitting Written Work tables to the right for guidance on how students can complete and submit work.	**Completing Written Work** ● Plain paper and pencil (videos include prompts for setup) ● (6-8) Student platform ● Investigation Notebook ● Record video or audio file describing work/answering prompt ● Teacher-created digital format (Google Classroom, etc)	**Submitting Written Work** ● Take a picture with a smartphone and email or text to teacher ● Through teacher-created digital format ● During in-school time (hybrid model) or lunch/materials pick-up times ● (6-8) Hand-in button on student platform
How will you differentiate this lesson for diverse learners? (Navigate to the lesson level on the standard Amplify Science platform and click on differentiation in the left menu.)		

Day ____________

Minutes for science: ____________

Instructional format:

- [ ] Asynchronous
- [ ] Synchronous

Lesson or part of lesson:

Mode of instruction:

- ❏ Preview
- ❏ Review
- ❏ Teach full lesson live
- ❏ Teach using synchronous suggestions
- ❏ Students work independently using:
  - ❏ @Home Packet
  - ❏ @Home Slides and @Home Student Sheets
  - ❏ @Home Videos

Students will...	Teacher will...

Minutes for science: _____________

Instructional format:

- [ ] Asynchronous
- [ ] Synchronous

Lesson or part of lesson:

Mode of instruction:

- ❏ Preview
- ❏ Review
- ❏ Teach full lesson live
- ❏ Teach using synchronous suggestions
- ❏ Students work independently using:
  - ❏ @Home Packet
  - ❏ @Home Slides and @Home Student Sheets
  - ❏ @Home Videos

Students will...	Teacher will...

<table>
<tr><td rowspan="2">Look at the Students will columns. What are students working in the lesson(s) that you could collect, review, or provide feedback on?
See Some Types of Written Work in Amplify Science to the right for guidance.

If there isn't a work product listed above, do you want to add one? Make notes below.</td><td colspan="2">Some Types of Written Work in Amplify Science</td></tr>
<tr><td colspan="2">● Daily written reflections
● Homework tasks
● Investigation notebook pages
● Written explanations (typically at the end of Chapter)
● Diagrams
● Recording pages for Sim uses, investigations, etc</td></tr>
<tr><td rowspan="2">How will students submit this work product to you?
See the Completing and Submitting Written Work tables to the right for guidance on how students can complete and submit work.</td><td>Completing Written Work</td><td>Submitting Written Work</td></tr>
<tr><td>● Plain paper and pencil (videos include prompts for setup)
● (6-8) Student platform
● Investigation Notebook
● Record video or audio file describing work/answering prompt
● Teacher-created digital format (Google Classroom, etc)</td><td>● Take a picture with a smartphone and email or text to teacher
● Through teacher-created digital format
● During in-school time (hybrid model) or lunch/materials pick-up times
● (6-8) Hand-in button on student platform</td></tr>
<tr><td colspan="3">How will you differentiate this lesson for diverse learners? (Navigate to the lesson level on the standard Amplify Science platform and click on differentiation in the left menu.)</td></tr>
</table>

Planning Tool: Guided Unit Internalization

Unit:

Chapter __ Question:

Cohort/Group/Pod:

<table>
<tr><td colspan="3">@Home Unit lesson #:</td></tr>
<tr><td colspan="3">Date(s) to administer:</td></tr>
<tr><td colspan="3">Investigation question:</td></tr>
<tr><th colspan="3">@ Home Unit lesson (asynchronous)</th></tr>
<tr><td>Key activities from @ Home lesson:</td><td>Dates to administer:</td><td>Other notes:</td></tr>
<tr><th colspan="3">Corresponding synchronous ideas</th></tr>
<tr><td>In-person or remote?
❏ In-person
❏ Remote</td><td>Synchronous activity:

Dates(s) to administer:</td><td>Other notes:</td></tr>
</table>

<table>
<tr><th colspan="3">@Home Videos</th></tr>
<tr><td>Use for synchronous or asynchronous?

❏ Synchronous
❏ Asynchronous
❏ Neither

If using, note lesson & activity/activities:</td><td>View for best practices?

❏ Yes
❏ No

If yes, notes some best practices:</td><td>Other notes:</td></tr>
<tr><th colspan="3">Corresponding original lesson(s)</th></tr>
<tr><td>Differentiation strategies:</td><td>Additional synchronous activity notes:</td><td>Use any original slides?
❏ Yes
❏ No

Other notes:</td></tr>
<tr><th colspan="3">Differentiation plan</th></tr>
<tr><td>Synchronous, remote ideas:</td><td>Synchronous, in-person ideas:</td><td>Asynchronous ideas:</td></tr>
</table>

3rd party apps to use		
Using Jamboard ? ❏ Yes ❏ No Notes: Using Pear Deck? ❏ Yes ❏ No Notes:	Google Classroom: Which @Home Resources to upload? ❏ @Home Unit pdf ❏ @Home Unit slides ❏ @Home Video url ❏ Other Notes:	Other apps & notes:

Suggestions for synchronous time

The following are some ideas for making the most of synchronous time with your students. As a general rule, the best way to use your synchronous time is to provide students opportunities to talk to one another, or to observe or visualize things they could not do independently.

Online synchronous time	Notes
Online discussions: It's worthwhile to establish norms and routines for online discussions in science to ensure equity of voice, turn-taking, etc. **Digital tool demonstrations:** You can share your screen and demonstrate, or invite your students to share their screen and think-aloud as they use a Simulation or other digital tool. **Interactive read-alouds**: Screen share a digital book or article, and pause to ask questions and invite discussion as you would in the classroom. **Shared Writing:** This is a great opportunity for a collaborative document that all your students can contribute to. **Co-constructed class charts:** You can create digital charts, or create physical charts in your home with student input.	

@Home Resources Scavenger Hunt

Directions: Use this scavenger hunt to practice navigating the Program Hub and decide which @Home Resources best supports your current instructional needs.

Part 1: @Home Units Task	**Notes**
Navigate to the @Home Unit resources. ● Select Remote learning: Amplify Science @Home ● Select Grade-level resources → Grade-level → Unit	
How long is each @Home lesson? Hint: Teacher Overview	
Which types of activities are recommended for synchronous and in-person learning? Hint: Teacher Overview	
How many @Home lessons are in Chapter 1 of your unit? Hint: Teacher Overview	
In which lesson is your unit's phenomenon introduced? Hint: Teacher Overview	
How does the @Home Packet for Lesson 1 differ from the @Home Slides for that same lesson? Hint: Student Materials	
When would you use @Home Student Sheets? Hint: Teacher Overview	
How does the @Home Family Overview support caregivers? Hint: Family Overview	

Part 2: @Home Videos Task	**Notes**
Navigate to the @Home Unit resources. ● Select Remote learning: Amplify Science @Home ● Select Grade-level resources → Grade-level → Unit ● Scroll down to the @Home Video Playlist ● Select the lesson in which the problem or phenomenon is introduced	
Describe the phenomenon (or observable event, something that students can see or experience) in your unit.	

Notes