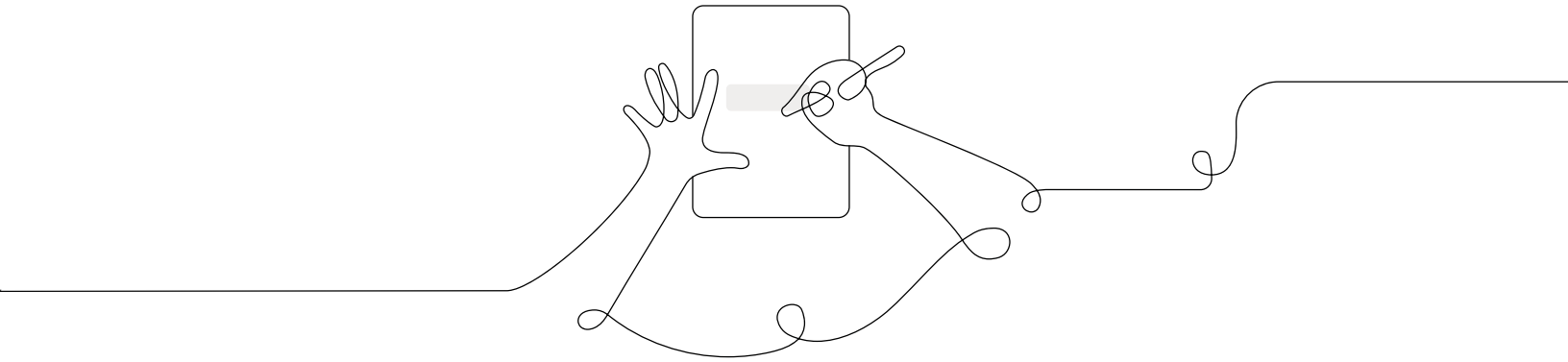
AmplifyScience

Participant Notebook

Unit Internalization and Guided Planning

Grade 8, Force and Motion



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

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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.

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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.

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Guided Unit Internalization

Part 1: Unit-level internalization

Unit title: Force and Motion

What is the phenomenon students are investigating in your unit?

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?

Unit Question:

How do forces affect motion?

Student role:

Student physicists

By the end of the unit, 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.

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

A force causes a change in an object's velocity. An object's mass determines its velocity change for a given force. When two objects collide, both experience the same strength force, but in opposite directions.

Amplify.

Guided Unit Internalization Planner

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?

Multi-day planning, including planning for differentiation and evidence of student work

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:
	
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	❏ Review
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	  ❏ @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	Submitting 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)	• 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	**Minutes for science:** _____ **Instructional format:** ☐ Asynchronous ☐ Synchronous

Lesson or part of lesson:
 	
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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.)		

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.	

Adapting the Amplify Science Approach for Remote Learning

In Amplify Science units, students figure out phenomena by using science and engineering practices. They gather evidence from multiple sources and make explanations and arguments through multiple modalities: doing, talking, reading, writing, and visualizing. They also make their learning visible by posting key concepts on the classroom wall. While we have retained this core approach in the @Home Lessons, enacting it at home will require adaptations.

The @Home Lessons provide general guidance for these adaptations, but you may need to set up expectations for specific routines or provide additional support to your students. Below are ideas for how different aspects of the Amplify Science approach might be adapted for your learners' particular contexts.

Student talk options

- Talk to a member of their household about their ideas.
- Call a friend or classmate and discuss their ideas.
- Talk in breakout groups in a video class meeting.
- Use asynchronous discussion options on technology platforms.

Student writing options

- Write in a designated science notebook.
- Photograph writing and submit digitally.
- Complete prompts in another format. (Teachers can convert prompts so they are completed in an on-line survey or an editable document so students can submit digitally.)
- Submit audio or video responses digitally, rather than submit a written response.
- Share a response orally with a family member or friend with no submission required.
- For students with technology access, complete written work in the students' Amplify accounts (links to corresponding student activities are provided in the @Home Slides).

Student reading options

- Read printed version of article, included with @Home Packets. (Note: although the articles are originally in color, they are provided in the @Home Packets in grayscale for ease of copying. Most articles translate well into grayscale but there will be some exceptions).

- Read printed or PDF version of article, included with @Home Student Sheets.
- Listen to the article being read aloud using the audio feature in the Amplify Science Library or read articles in digital format via the Amplify Science Library (links are provided in the @Home Slides).
- Read with a partner, classmate, or someone from their home.

Hands-on activity options

- Do the activity with simple materials students are likely to have at home. (For activities where this is feasible, instructions are provided.)
- Watch a video. (For some hands-on activities in the @Home Units, a video / images of the investigation are provided.)
- Do the activity using kit materials if available. For example,
    - If possible, send home materials to students who need them.
    - If you have access to your Amplify Science kit, and have opportunities to teach synchronously, demonstrate some hands-on activities with student input.

Classroom wall options

The classroom wall, which provides an important reference for students to track and reflect on their developing understanding of the unit's anchor phenomenon and content, has been reimagined as an @Home Science Wall. A complete list of Chapter Questions, key concepts, and vocabulary that have been introduced so far are provided in the last lesson of each chapter. To enhance students' experience of the @Home Science Wall, you could have students:

- Draw a picture or write their ideas on their @Home Science Wall pages.
- Highlight each question, key concept, or word that is introduced.
- Cut out each question, key concept, or word. These can be then posted on a wall, large sheet of paper, or refrigerator at home.

Additionally, if you are meeting with your class remotely, you could create a virtual @Home Science Wall.

Adaptations of other Amplify Science routines

- **Reading support.** In Amplify Science 6–8, support for student reading includes: teacher modeling; structured paired and whole group discussion of texts; multiple readings of text; an audio feature in the Amplify Library; as well as suggestions for additional

strategies for students who need more reading support. Some suggestions to offer similar supports with the @Home Lessons are:

  - Meet virtually as a class or in small groups and read the first part of the article with students, modeling how you would read the text.
  - Ask student pairs to meet after reading to discuss their annotations.
  - Have each student meet with someone in their home to read at least some of the text together and/or discuss their annotations after reading.

- **Talk routines.** In Amplify Science units students periodically talk in small groups using routines such as Word Relationships and Write and Share. You may consider including and adapting these routines by having students meet and talk to their peers in small groups or asking each student to conduct the routine with someone in their home.

- **Science Seminar.** Each core unit in Amplify Science 6–8 culminates with a Science Seminar, which is a whole-class, student-led argumentation routine. An adapted version of the Science Seminar has been included in the @Home Units. Some suggestions for implementing this are:
  - Hold your Science Seminar in class, if you are meeting in person some of the time.
  - Hold Seminars with your whole class, remotely. Students can participate all at the same time, or you might break the group up in thirds or in half and have the students who are not talking take notes using the Science Seminar Observations sheet.
  - Hold Seminars with pairs or small groups meeting on the phone, on video calls, or in virtual breakout rooms.
  - Have students talk to someone in their household about the Science Seminar evidence and claims.

@Home Units assessment considerations

Each Chapter Outline contains considerations for assessment and feedback in the Amplify Science units, and in some cases, the pre-unit and end-of-unit assessments. Generally, we recommend the following:

- You may need to adapt the format in which you collect student work. See the “Student writing options” above.

- When providing feedback to students, you may wish to focus on how students are attending to the Investigation and/or the Chapter Questions, if they are using evidence they have gathered to support their responses to questions, and if they are using appropriate unit vocabulary in their responses.

@Home Units guidance for synchronous and in-person learning

Each @Home Lesson contains suggestions for using these asynchronous resources in conjunction with virtual or in-person class sessions. If you are able to choose particular lessons to conduct together with students, we recommend:

- Holding discussions to engage students in figuring out the unit phenomenon.
    - At the beginning of each chapter so students can share their initial ideas or evolving ideas about the unit phenomenon.
    - At the end of the chapter so students can talk as they make sense of evidence, and/or synthesize various sources of information, and make an explanation or argument about the phenomenon.
- If you have access to kit materials, you can conduct hands-on demonstrations when hands-on materials are unavailable to students. Solicit student input as you demonstrate.
- If students do not have access to technology at home, when in-person, you can provide time for them to make observations and discuss ideas related to the simulations and digital tools.

Notes