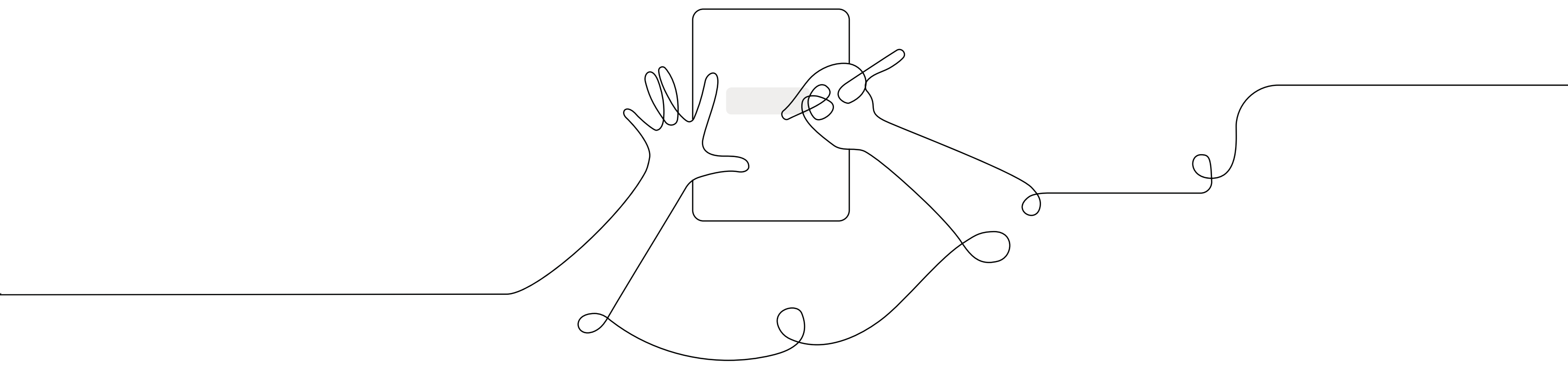
AmplifyScience

Participant Notebook

Grade: 6 Thermal Energy
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

Which heating system will best heat Riverdale School?

In their role as student thermal scientists, students work with the principal of a fictional school, Riverdale School, in order to help the school choose a new heating system. They compare a system that heats a small amount of water with one that uses a larger amount of cooler groundwater. Students discover that observed temperature changes can be explained by the movement of molecules, which facilitates the transfer of kinetic energy from one place to another. As they analyze the two heating system options, students learn to distinguish between temperature and energy, and to explain how energy will transfer from a warmer object to a colder object until the temperature of the two objects reaches equilibrium.

Chapter 1: What is happening when the air in the school gets warmer?

Students figure out: If the heating systems make the school's air warmer, it is because they increase the average speed of the molecules of the school's air. Things are made of molecules (or other types of atom groups). When a thing gets hotter, its molecules are moving faster. When a thing gets colder, its molecules are moving slower. Temperature is a measure of the average speed of the molecules of a thing.

How they figure it out: They investigate the movement of food coloring in warm and cool water. They investigate molecular movement and temperature in the Sim. They read about the idea of absolute zero. They create visual models showing the difference between a substance when it is warmer and cooler.

Chapter 2: What causes the air molecules inside the school to speed up?

Students figure out: The air molecules inside the school will speed up if energy is transferred to them. When a thing gets hotter, its molecules are moving faster and have more kinetic energy. When a thing gets colder, its molecules are moving slower and have less kinetic energy. When two things are in contact, their molecules collide, and kinetic energy transfers from the faster-moving molecules to the slower-moving molecules. Energy isn't created or destroyed. Therefore, as energy transfers, it increases in one part of the system as it decreases in another part of the system. The molecules of a system will transfer energy until the system reaches a stable state known as equilibrium, in which all of the molecules are moving at about the same speed. Both heating systems should work to heat the school's air because both have water that starts at a higher temperature than the starting temperature of the school's air, so energy will transfer to the air.

How they figure it out: They observe a video of an investigation in which a container of warm water heats the air around it, and they explore one thing warming another in the Sim. They read "How Air Conditioning Makes Cities Hotter" and examine molecule collisions during energy transfer in the Sim. They also model energy transfer using tokens in a physical model. They create sentences using key vocabulary and make visual models explaining energy transfer. They play a thermal energy card game to review key ideas.

Chapter 3: Which heating system will warm the air in the school more?

Students figure out: The groundwater system will heat the school more because it uses so much more water than the other system, even though its water is not as warm as in the other system. For things at the same temperature, the thing with more molecules has more total kinetic energy (thermal energy) than the thing with fewer molecules. When a thing gains or loses energy, the energy gained or lost is divided among all the molecules of the thing.

How they figure it out: They investigate energy transfer with different volumes of water. They read about size of objects (numbers of molecules) and energy transfer in the article "Thermal Energy Is NOT Temperature." Students test energy transfer using objects of different sizes in the Sim. They make a final model explaining energy transfer and write an explanation of which heating system is better for the school and why.

Chapter 4: Students apply what they learn to a new question—Why wasn't the water pasteurized?

Kits for pasteurizing water were distributed to help victims of a natural disaster heat water and make it safe to drink, but some people still got sick. Was this because of a problem with the kits or because some people did not follow the instructions? Students analyze evidence about temperature, mass, and energy transfer in order to make their arguments. 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

Why do things change temperature?

Chapter 1: Understanding Temperature

Chapter Question

What is happening when the air in the school gets warmer?

Investigation Questions

- How is something different when it is warmer or cooler? (1.2, 1.3, 1.4)

Key Concepts

- Things are made of molecules (or other types of atom groups). (1.3) ?
- When a thing gets hotter, its molecules are moving faster. (1.3) ?
- When a thing gets colder, its molecules are moving slower. (1.3) ?
- Temperature is a measure of the average speed of the molecules of a thing. (1.4)

Chapter 2: Temperature and Energy

Chapter Question

What causes the air molecules inside the school to speed up?

Investigation Questions

- Why do molecules change speed? (2.1, 2.2., 2.3)
- Why does the transfer of energy between two things stop? (2.4, 2.5)

Key Concepts

- Revised: When a thing gets hotter, its molecules are moving faster and have more kinetic energy. (2.1)
- Revised: When a thing gets colder, its molecules are moving slower and have less kinetic energy. (2.1)
- Revised: Temperature is a measure of the average kinetic energy of the molecules of a thing. (2.1)

- When two things are in contact, their molecules collide, and kinetic energy transfers from the faster-moving molecules to the slower-moving molecules. (2.3)
- Energy isn't created or destroyed. Therefore, as energy transfers, it increases in one part of the system as it decreases in another part of the system. (2.3)
- The molecules of a system will transfer energy until the system reaches a stable state known as equilibrium, in which all of the molecules are moving at about the same speed. (2.5)

Chapter 3: Changes in Temperature

Chapter Question

Which heating system will warm the air in the school more?

Investigation Questions

- What determines how much total kinetic energy something has? (3.1, 3.2) ?
- What determines how much something will change temperature? (3.2, 3.3)

Key Concepts

- For things at the same temperature, the thing with more molecules has more total kinetic energy (thermal energy) than the thing with fewer molecules. (3.2) ?
- At equilibrium, the average kinetic energy (temperature) of the molecules in the system is the total kinetic energy (thermal energy) evenly divided by the number of molecules in the system. (3.2) ?
- When a thing gains or loses energy, the energy gained or lost is divided among all the molecules of the thing. (3.2) ?
- Revised: Energy isn't created or destroyed. Therefore, as energy transfers, it increases in one part of the system as it decreases in another part of the system. The total energy of a system doesn't change. (3.3)

Chapter 4: Water Pasteurization

Chapter Question

Why wasn't the water pasteurized?

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 *Thermal Energy* 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 objects in contact can heat up and cool down. 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 *Thermal Energy* unit, middle school students will have ideas about hot and cold that draw heavily from sensory experiences. Based on experiences such as opening a freezer door or feeling a cold wind, students may believe that cold is a substance that can be transferred to warmer objects. Most students at this age will not distinguish between temperature and thermal energy. However, when faced with two objects in contact at different temperatures, most will have a productive notion that some change will occur due to the temperature difference.

Most students will have been exposed to the idea that objects are made of molecules (which themselves are composed of atoms). However, students are likely to have some alternate conceptions or partial conceptions about molecules; for example, they may think that the characteristics of each molecule mirror the characteristics of the object. If your students have had the *Harnessing Human Energy* unit, or another unit about energy, they may be familiar with kinetic energy as the energy of motion, but they may not have considered kinetic energy at the molecular scale. Thus, the idea of a motionless object being composed of molecules with kinetic energy might initially be confusing. The *Thermal Energy* Progress Build is structured to utilize all of these experiences and insights that students possess in order to refine and build upon students' understanding.

Progress Build Level 1: The temperature of an object is related to the kinetic energy of its molecules, which increases as the speed of the molecules increases.

Molecules move and change speed. Temperature is a measure of kinetic energy, which is the energy of the movement of the molecules. Hotter things are made up of faster-moving molecules, which have more kinetic energy. Colder things are made up of slower-moving molecules, which have less kinetic energy. Changes in temperature are the result of molecules changing kinetic energy.

Progress Build Level 2: Warmer objects transfer energy to cooler objects when they are in contact.

Molecules move and change speed. Temperature is a measure of kinetic energy, which is the energy of the movement of the molecules. Hotter things are made up of faster-moving molecules, which have more kinetic energy. Colder things are made up of slower-moving molecules, which have less kinetic energy. Changes in temperature are the result of molecules changing kinetic energy. **When things are in contact, the faster-moving molecules of the hotter thing transfer kinetic energy to the slower-moving molecules of the colder thing. The transfer of kinetic energy causes faster-moving molecules to slow down and slower-moving molecules to speed up until all of the molecules are moving at about the same speed.**

Progress Build Level 3: The size of the objects in contact affects the amount of energy transfer between them and the amount of temperature change.

Molecules move and change speed. Temperature is a measure of kinetic energy, which is the energy of the movement of the molecules. Hotter things are made up of faster-moving molecules, which have more kinetic energy. Colder things are made up of slower-moving molecules, which have less kinetic energy. Changes in temperature are the result of molecules changing kinetic energy. When things are in contact, the faster-moving molecules of the hotter thing transfer kinetic energy to the slower-moving molecules of the colder thing. The transfer of kinetic energy causes faster-moving molecules to slow down and slower-moving molecules to speed up until all of the molecules are moving at about the same speed. **Larger things are made of more molecules than smaller things (in circumstances where other factors, such as material and phase, are equal). Changes in temperature are affected by the number of molecules of a system (e.g., an object, or two objects in contact) because kinetic energy is distributed among all of the molecules of a system. At any given molecular speed, an object made of more molecules has more total kinetic energy than a similar object made of fewer molecules; therefore, larger objects have more total kinetic energy than smaller objects at the same temperature. In order to change the average speed of more molecules, more total kinetic energy must transfer into or out of a system. So, for any given transfer of kinetic energy, larger things experience less change in temperature than smaller things.**

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

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
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  - ❏ @Home Slides and @Home Student Sheets
  - ❏ @Home Videos

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	**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…**

<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.

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<tr><td colspan="2">• Daily written reflections
• Homework tasks
• Investigation notebook pages
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<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
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• 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:

@Home Unit lesson #:		
Date(s) to administer:		
Investigation question:		
@ Home Unit lesson (asynchronous)		
Key activities from @ Home lesson:	Dates to administer:	Other notes:
Corresponding synchronous ideas		
In-person or remote? ❏ In-person ❏ Remote	Synchronous activity: Dates(s) to administer:	Other notes:

<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