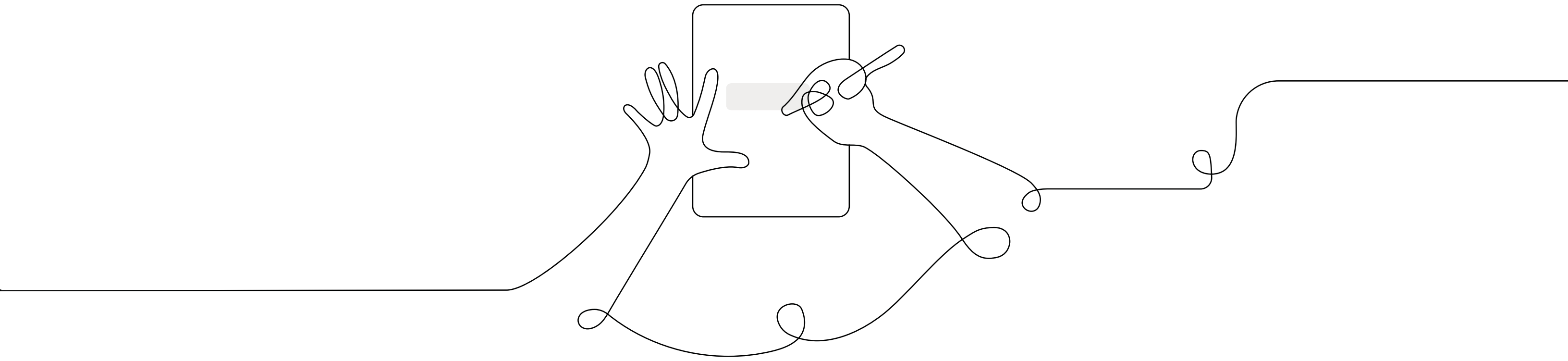
AmplifyScience

Participant Notebook

Grade 8: Magnetic Fields
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 NGSS Standards (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) standards 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
Articles 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 6-8)
Flextensions in This Unit	Summarizes information about the Hands-On Flextension lesson(s) in the unit

Printable resources

Coherence Flowcharts	Visual representation of the storyline of the unit
Copymaster Compilation	Compilation of all copymasters for the teacher to print and copy throughout the unit
Flextension Compilation	Compilation of all copymasters for Hands-on Flextension lessons throughout the unit
Investigation Notebook	Digital version of the Investigation Notebook, for copying and projecting
Multi-Language Glossary	Unit vocabulary words in 10 languages
NGSS Information for Parents and Guardians	Information for parents about the NGSS and the shifts for teaching and learning
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 Chapter Questions and Key Concepts provided in the kit

Unit Map

Why did the tests of a magnetic spacecraft launcher not go as planned?

As student physicists consulting for the fictional Universal Space Agency, students work to understand the function of a magnetic spacecraft launcher (a simplified version of real technology currently under development). In particular, they seek to explain why a particular test launched the spacecraft much faster than expected. To do this, they investigate how magnets move some objects at a distance, the source of the energy for that movement, and what causes differences in energy and forces involved.

Chapter 1: How can the launcher make the model spacecraft move without touching it?

Students figure out: The launcher made the spacecraft move by exerting a magnetic force on it. Magnetic forces can attract or repel objects at a distance. In a system of magnets, there is a repelling force between like poles and an attracting force between opposite poles. A magnet creates a magnetic field that can be modeled with field lines that connect opposite poles. The pattern of magnetic field lines is different for attracting or repelling forces.

How they figure it out: They explore attracting and repelling forces with magnets and with the Simulation. They are introduced to the importance of controlling variables in experiments, and select stronger data based on this criterion and analyze it. They read about the Earth's magnetic field and how it affects compasses. They analyze field line data from the spacecraft launches.

Chapter 2: Where did the energy to launch the model spacecraft come from?

Students figure out: The energy to launch the spacecraft came from moving the spacecraft against the magnetic force. The energy used to move a magnet against a magnetic force is stored as potential energy in the magnetic field. Magnetic forces can convert potential energy stored in the magnetic field to kinetic energy. An electromagnet is created with electric current. Creating a model of a magnetic system and defining its parts help scientists test and explain the relationship between force and energy.

How they figure it out: They read about potential energy and kinetic energy in extreme sports and investigate how potential energy in elastic, gravitational, and magnetic systems can be converted to kinetic energy. With real magnets and in the Sim, they test which movements of magnets increase potential energy. They analyze energy evidence from launches and model their understanding.

Chapter 3: Why was there so much more potential energy stored in the launcher system on Wednesday than on Tuesday?

Students figure out: Moving an object against a stronger magnetic force transfers more energy to the magnetic field. Magnetic forces are stronger closer to magnets. The Wednesday launch stored more potential energy, and launched the spacecraft at a faster speed because the stronger magnetic field closer to the magnet resulted in a greater increase in potential energy.

How they figure it out: They plan and conduct experiments with real magnets and in the Sim to test differences in the strength of magnetic forces. They test both different strengths of magnets and different distances from magnets. They analyze new data about the three launches, create final visual models, and write their final explanation of the launches.

Chapter 4: Students apply what they learn to a new question—Which design will launch the roller coaster car the fastest?

They evaluate competing designs about how to build a model electromagnetic roller coaster. They consider several variables: number of wire coils in the electromagnet, distance between launcher and car, arrangement of magnetic poles, and guide rail material. They engage in oral argumentation in a student-led discourse routine called a Science Seminar and then write final arguments.

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 *Magnetic Fields* 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 magnetic force can cause objects to move in different ways. 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 *Magnetic Fields* unit, middle school students will likely have some everyday experience with magnets. Many students may think of magnets as primarily capable of attraction, neglecting the possibility of repulsion. Students may be familiar with the concepts of potential energy and kinetic energy from their experience in the *Harnessing Human Energy* launch unit. However, many students will not have considered potential energy as something a system of magnets can have, or how the position of magnets can affect potential energy. Most will not have considered how magnetic force is related to potential energy and kinetic energy. This experience and prior knowledge can be built on and refined, which the *Magnetic Fields* Progress Build and unit structure are designed to do.

Progress Build Level 1: Magnetic fields exert force from a distance that can repel like poles or attract opposite poles.

Magnetic force can act at a distance to make objects move. In a system of magnets, there is a repelling force between like poles and an attracting force between opposite poles.

Progress Build Level 2: Potential energy is stored in a system when a magnet is moved against magnetic force.

Magnetic force can act at a distance to make objects move. In a system of magnets, there is a repelling force between like poles and an attracting force between opposite poles. **The energy used to move a magnet against a magnetic force is stored as potential energy in the magnetic field. This magnetic force can convert potential energy stored in the magnetic field to kinetic energy.**

Progress Build Level 3: Moving a magnet against a stronger magnetic force transfers more energy to the magnetic field. Magnetic force is stronger closer to a magnet.

Magnetic force can act at a distance to make objects move. In a system of magnets, there is a repelling force between like poles and an attracting force between opposite poles. The energy used to move a magnet against a magnetic force is stored as potential energy in the magnetic field. **Magnetic force is stronger closer to a magnet, so it takes more energy to move against magnetic force closer to a magnet.** This magnetic force can convert potential energy stored in the magnetic field to kinetic energy.

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?

Magnetic Fields @Home Lesson Index

The Amplify Science@Home Units are versions of Amplify Science units adapted for use in a remote learning or hybrid learning situation. To help you plan instruction, below we have listed the @Home Lessons alongside the Amplify Science unit's Lesson(s) from which they come.

Index: @Home Unit Lessons and corresponding *Magnetic Fields* Lessons

@Home Lesson	Adapted from Amplify Science *Magnetic Fields*
@Home Lesson 1	Lesson 1.2 and 1.3
@Home Lesson 2	Lessons 1.4
@Home Lesson 3	Lessons 1.5
@Home Lesson 4	Lesson 1.6
@Home Lesson 5	Lesson 2.1
@Home Lesson 6	Lesson 2.2
@Home Lesson 7	Lesson 2.3
@Home Lesson 8	Lesson 2.4
@Home Lesson 9	Lesson 3.1 and 3.2
@Home Lesson 10	Lesson 3.3
@Home Lesson 11	Lessons 3.5 and 4.1
@Home Lesson 12	Lessons 4.2
@Home Lesson 13	Lesson 4.3
@Home Lesson 14	Lesson 4.4

The student sheets and packets used in @Home units are original or modified versions of the unit's Amplify Science Investigation notebook pages or copymasters. When necessary, new pages were also created. In the following table we have outlined the @Home Student Sheet and Packet page titles and their origins.

Index: @Home Student Sheets/Packets and corresponding *Magnetic Fields* materials

@Home Lesson	Student Sheet/Packet page title	Investigation Notebook page, copymaster, or print material
1	Gathering Evidence About Magnets	New
2	Earth's Geomagnetism	Article
3	Rereading "Earth's Geomagnetism"	Pg. 22
3	Exploring Field Lines	Modified, based on Pgs. 23–24
4	Launcher Alignment	Pg. 30
4	Chapter 1 Science Wall	New, based on Classroom Wall materials
5	The Potential for Speed	Article
6	Sharing Ideas About Potential Energy	Pg. 41
6	Exploring Energy in Systems	Modified, based on Pgs. 42–43
7	Simulating Energy Changes	New
7	Write and Share 1: Spring and Pom Pom	Modified, based on Pgs. 50–51
7	Write and Share 2: Magnet and Iron Rod	Modified, based on Pgs. 50–51
8	Simulating Spacecraft Launch Energy	New
8	Chapter 2 Science Wall	New, based on Classroom Wall materials
8	Magnetic Fields Modeling Tool	Lesson 2.4 copymaster
9	Exploring Force and Potential Energy	New

9	Simulating Magnetic Force	New
10	Evidence Cards from the USA Scientists	Print Materials
10	Research Questions and Claims	New
10	Analyzing the Spacecraft Launches	Pgs. 83–85
10	Modeling the Spacecraft Launches	Pg. 86
10	Modeling Tool: Spacecraft Launches	Pg. 87
10	Chapter 1 Science Wall	New, based on Classroom Wall materials
10	Chapter 2 Science Wall	New, based on Classroom Wall materials
10	Chapter 3 Science Wall	New, based on Classroom Wall materials
10	Explaining the Spacecraft Launches	Pgs. 88–89
11	How an Electromagnet Works	Pg. 94
11	Roller Coaster Design Claims	Lesson 4.1 Copymaster
11	Annotating Competing Designs	Pg. 114
12	Science Seminar Evidence Cards	Lesson 4.1 Copymaster
12	Analyzing Roller Coaster Evidence	New
12	Evaluating Roller Coaster Designs	Pg. 122
13	Argumentation Sentence Starters	Print Materials
13	Writing a Scientific Argument	Lesson 4.3 Copymaster
14	Written Response Question #1	Lesson 4.4 Copymaster
14	Written-Response Question #2	Lesson 4.4 Copymaster

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

Day ____________

Day 1		Day 2	
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:
    ❏ Printed @Home Slides
    ❏ Digital @Home Slides
    ❏ @Home Videos
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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) above 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 ● (6-8) Homework tasks ● (K-5) 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.)		

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

<table>
<tr><td colspan="4">Day ____________</td></tr>
<tr><td colspan="2">Minutes for science: ____________

Instructional format:
❏ Asynchronous
❏ Synchronous</td><td colspan="2">Minutes for science: _____________

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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.	

Notes