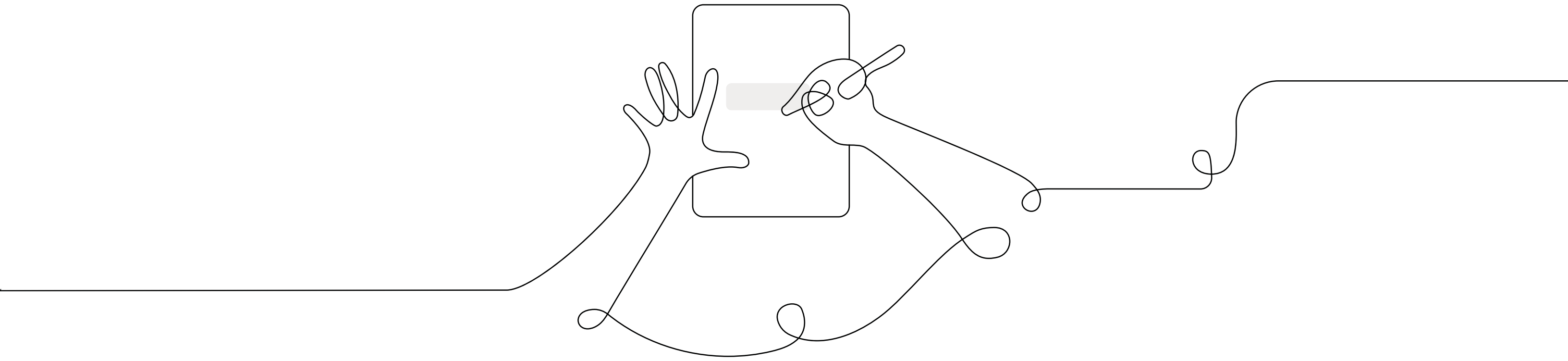
AmplifyScience

Participant Notebook

Grade 6: Traits and Reproduction
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 do Darwin's bark spider offspring have different silk flexibility traits even though they have the same parents?

Scientists and engineers are investigating possible ways spider silk can be used for medical purposes, such as for artificial tendons. Students act as student geneticists to investigate what causes variation in spider silk traits. Specifically, they explain why parent spiders have offspring with widely varied silk flexibility traits. They uncover the roles of proteins and genes and the way that genes are inherited.

Chapter 1: Why do traits for silk flexibility vary within this family of Darwin's bark spiders?

Students figure out: The spiders in this family must have different proteins for silk flexibility in their cells. Variation in traits can be caused by variation in protein molecules within individuals' cells. Protein molecules' structures affect their function and the way they connect to other molecules. Spider silk is made of proteins, and connections between these molecules affect the silk flexibility.

How they figure it out: Students explore traits and proteins in the Sim and test the effect of changing protein molecules. They read short articles about different kinds of spiders and how their silk traits are related to the protein molecules that make up the silk. They build physical models of connected protein molecules to make silk with different levels of flexibility.

Chapter 2: Why do Darwin's bark spiders make different proteins for silk flexibility?

Students figure out: Genes are instructions for proteins; each gene version provides an instruction to make a specific protein molecule. An organism has two copies of a gene for each feature; these can be the same version (homozygous) or different (heterozygous). The spiders in the family have different gene versions for silk flexibility; some are homozygous and some are heterozygous.

How they figure it out: Students read about the genes and proteins involved in hemophilia. They use the Sim to investigate genes and their outcomes by making changes to genes and observing the effect on proteins and traits. They engage in a physical model that highlights genes as instructions and introduces mutations. They create visual models showing their explanations for how the spider offspring have different traits.

Chapter 3: Why do the Darwin's bark spider offspring have different gene combinations even though they have the same parents?

Students figure out: In sexual reproduction, each parent randomly passes on one of its two copies of each gene to its offspring. Each offspring receives two copies of each gene, one from each parent. Each offspring can inherit a different combination of gene versions, so siblings can have different traits from each other and from their parents. This random recombination of genes accounts for the variation in silk flexibility among the spider offspring. Each gene version present in the offspring is also present in the parents, meaning no mutations took place.

How they figure it out: They read about identical and fraternal twins to learn how genes are passed on in sexual reproduction. They investigate how genes are passed on when spiders in the Sim reproduce, and test the effects of random mutations during reproduction. They model their understanding of how genes were passed on in the Darwin's bark spider family.

Chapter 4: Students apply what they learn to a new question—Why is Jackie an elite distance runner when no one else in her family has that trait?

Jackie is an elite distance runner while other members of her family are sprinters or not serious runners. Students consider whether this variation is related to the ACTN3 gene that appears to affect running ability. They construct arguments about whether Jackie's unique trait is due to differences in experience, a mutation in Jackie's genes, or just the combination of genes passed on by her parents. They consider evidence about the family's ACTN3 proteins, levels of ACTN3 proteins in Olympic sprinters and long-distance runners, and family members' experience and training. 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 *Traits and Reproduction* 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 why traits vary. 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 *Traits and Reproduction* unit, middle school students are likely to understand that organisms in the same species can have varying body characteristics, such as different feather or fur colors, and that this variation can occur even between parents and offspring and among siblings within the same family. However, they will most likely be largely unfamiliar with the mechanism of genetic inheritance. Many students are likely to have a simplified conception that equates genes with traits. Students may also recognize genes mostly in connection with DNA testing. However, students are unlikely to understand what a gene is, where genes are located in the body, or any specifics about how genes influence traits. Without these concepts, they may not be convinced by scientific explanations of variation and inheritance. Understanding this material is especially difficult due to the molecular scale of the phenomena. For this reason, it becomes even more important to leverage interactive visualizations to allow students to develop their understanding. This experience and prior knowledge can be built on and refined, which the *Traits and Reproduction* Progress Build and unit structure are designed to do.

Progress Build Level 1: The traits of an organism are determined by the structure of protein molecules and the interactions of those protein molecules in cells.

The traits that an organism has depend on the proteins in its cells and how those proteins function. The function of a protein molecule depends on its structure and how it interacts with other protein molecules. Differences in the structure of protein molecules affect how they connect to other protein molecules, which can result in different traits.

Progress Build Level 2: Genes are instructions for producing proteins.

The traits that an organism has depend on the proteins in its cells and how those proteins function. The function of a protein molecule depends on its structure and how it interacts with other protein molecules. Differences in the structure of protein molecules affect how they connect to other protein molecules, which can result in different traits. **Genes are instructions for proteins, and each gene version provides a unique instruction to make a specific protein molecule in an organism's cells. An organism has two copies of a gene for each feature. The two copies of a gene for each feature can be the same version (homozygous) and provide instructions for only one type of protein or different versions (heterozygous) and provide instructions for two types of protein.**

Progress Build Level 3: Through sexual reproduction, an organism inherits a random combination of gene versions from its parents.

The traits that an organism has depend on the proteins in its cells and how those proteins function. The function of a protein molecule depends on its structure and how it interacts with other protein molecules. Differences in the structure of protein molecules affect how they connect to other protein molecules, which can result in different traits. Genes are instructions for proteins, and each gene version provides a unique instruction to make a specific protein molecule in an organism's cells. An organism has two copies of a gene for each feature. The two copies of a gene for each feature can be the same version (homozygous) and provide instructions for only one type of protein or different versions (heterozygous) and provide instructions for two types of protein. **Organisms inherit their genes through sexual reproduction. Each parent randomly passes on only one of its two copies of each gene to its offspring. The offspring, therefore, receives two copies of each gene. Offspring from the same parents can inherit a different combination of gene versions from one another. For this reason, siblings can have different traits from each other and from their parents.**

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?	

Traits and Reproduction @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 *Traits and Reproduction* Lessons

@Home Lesson	Adapted from Amplify Science *Traits and Reproduction*
@Home Lesson 1	Lesson 1.2
@Home Lesson 2	Lessons 1.3
@Home Lesson 3	Lessons 1.4 and 1.5
@Home Lesson 4	Lesson 2.1
@Home Lesson 5	Lesson 2.2
@Home Lesson 6	Lesson 2.3
@Home Lesson 7	Lesson 2.3 and 2.4
@Home Lesson 8	Lesson 3.1
@Home Lesson 9	Lesson 3.2
@Home Lesson 10	Lesson 3.3
@Home Lesson 11	Lessons 3.6
@Home Lesson 12	Lessons 4.1
@Home Lesson 13	Lesson 4.2 and 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 *Traits and Reproduction* materials

@Home Lesson	Student Sheet/Packet page title	Investigation Notebook page, copymaster, or print material
1	Observing Spiders from the Sim	New
1	Traits and Reproduction Glossary	Pg. 138
2	Surprising Spider Silk	Lesson 1.3 copymaster
2	Building and Comparing Silk Strands	Modified, based on Pgs. 14–15
3	Observing Proteins in the Sim Part 1	Modified, based on Pg. 18
3	Observing Proteins in the Sim Part 2	New
3	Explaining Variation in Silk Flexibility	New
3	Chapter 1 Science Wall	New, based on Classroom Wall materials
4	Hemophilia, Proteins, and Genes	Lesson 2.1 copymaster
5	Modeling the Role of Genes	New
6	Investigating Gene Copies in the Sim	New
7	Reflecting on the Investigation Question	New
7	Modeling Variation in Spider Offspring	New
7	Chapter 2 Science Wall	New, based on Classroom Wall materials
8	Why Are Identical Twins Rare?	Lesson 3.1 copymaster
9	Gathering Evidence from the Sim	New

10	Making Predictions About Inheritance	Modified, based on Pg. 78
10	Test Predictions About Inheritance	Modified, based on Pg. 79
10	Annotating a Model of Venom Inheritance	Modified, based on Pg. 80
11	Writing About Variation in the Spider Offspring	New
11	Chapter 3 Science Wall	New, based on Classroom Wall materials
12	Observing Mutations in the Sim	Modified, based on Pg. 121
12	Science Seminar Evidence Cards	Lesson 4.1 copymaster
12	Science Seminar Claim Cards	Lesson 4.1 copymaster
12	Sorting Evidence	Pg. 120
13	Argumentation Sentence Starters	Print materials
13	Writing a Scientific Argument About Jackie's Trait for Running Ability	Pg. 133
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 ____________			
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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		    ❏ @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) 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.</td>
<td colspan="2">Some Types of Written Work in Amplify Science</td>
</tr>
<tr>
<td colspan="2">● 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</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>

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

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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	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.)

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