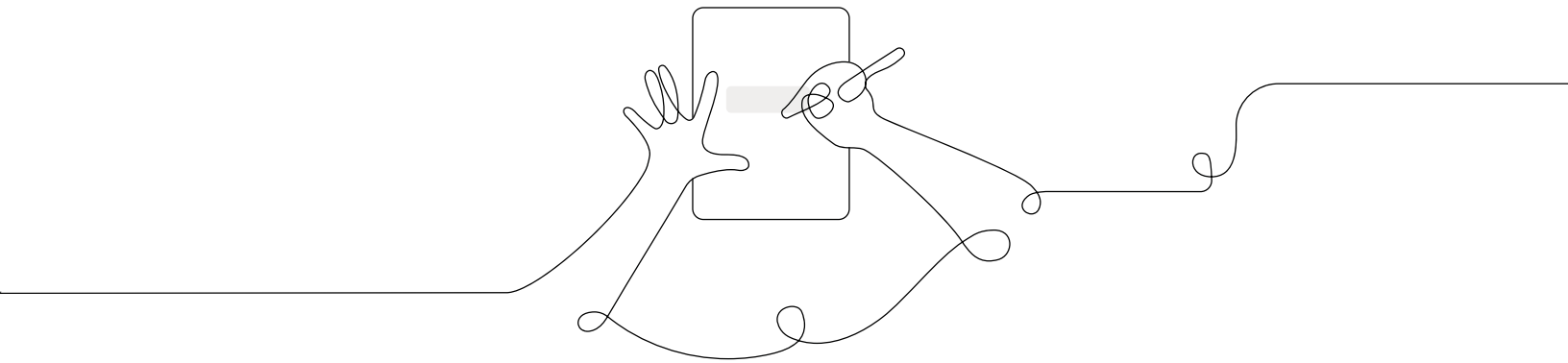


Participant Notebook

Unit Internalization and Guided Planning

Grade 8, Force and Motion Engineering Internship





Unit Map

How can we design delivery pods that are damaged as little as possible when dropped?

Students act as mechanical engineering interns to design delivery pods—pods of emergency supplies that will be dropped in areas experiencing a natural disaster. These delivery pods must meet three design criteria: 1) limiting the amount of damage to the cargo during the drop; 2) reusing the pod's shell as much as possible (for example, as emergency shelter); and 3) minimizing the cost of the pod as much as possible. Students focus on the practice of analyzing data to deepen their understanding of force and motion; students also learn about how structure and function are interrelated to determine the integrity and, therefore, the success of their pods.

Research Phase:

They review information from the *Force and Motion* unit, and learn new related content by reading detailed supporting articles in the project Dossier. They conduct physical “egg-drop” tests to learn more about important variables. Finally, they work with the digital Design Tool, SupplyDrop, to conduct iterative tests and better understand how each pod structure functions to affect the outcomes.

Design Phase:

They use the SupplyDrop Design Tool as a part of the Design Cycle. They build digital supply pods, test them, analyze the results, and then plan another iteration to test. Interns learn the value of iterative tests, how to balance trade-offs, and how to analyze the results in order to inform their next decisions. Students submit their optimal pod design to the project director for feedback, then refine these designs in order to create an optimal design that appropriately addresses all the project criteria.

Proposal Phase:

They gather evidence and write proposals, supporting their claim about an optimal solution. They focus on the types of evidence for the design decisions that helped them address each criterion. They submit an outline of the proposal to their project director for feedback. They use the feedback letter, proposal rubric, review of the Dossier, and peer discussion to improve their proposals so it is clear how and why each decision led to the proposed optimal design. They brainstorm other problems that relate to understanding impact forces, and then define the criteria for a solution to one of the problems.

Students apply science content:

To design successful pods, students apply their understanding of force, velocity, mass, and collisions from the *Force and Motion* unit. They also learn and apply new related ideas: how air resistance affects velocity and how the time over which a collision occurs affects the forces produced in the collision. Students also have the opportunity to relate the idea of gravity as an attractive force that acts at a distance to their designs.

Guided Engineering Internship Unit Internalization Planner

Part 1: Unit-level internalization

Unit title:		
What is the phenomenon students are investigating in your unit?		
Unit Question:		Student role:
What do students figure out in each phase of the Engineering Internship?		
Research Phase:	Design Phase:	Proposal Phase:
What science ideas do students apply from the core unit to solve the engineering problem?		

Part 2: Lesson-level internalization

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

Day 1: _____			
Minutes for science: _____		Minutes for science: _____	
Instructional format: <ul style="list-style-type: none"><input type="checkbox"/> Asynchronous<input type="checkbox"/> Synchronous		Instructional format: <ul style="list-style-type: none"><input type="checkbox"/> Asynchronous<input type="checkbox"/> Synchronous	
Lesson or part of lesson:		Lesson or part of lesson:	
Mode of instruction: <ul style="list-style-type: none"><input type="checkbox"/> Preview<input type="checkbox"/> Review<input type="checkbox"/> Teach live<input type="checkbox"/> Students work independently		Mode of instruction: <ul style="list-style-type: none"><input type="checkbox"/> Preview<input type="checkbox"/> Review<input type="checkbox"/> Teach live<input type="checkbox"/> Students work independently	
Students will...	Teacher will...	Students will...	Teacher will...

<p>Look at the Students will columns from Part C. 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.</p> <p>If there isn't a work product listed above, do you want to add one? Make notes below.</p>	<p>Some Types of Written Work in Amplify Science</p> <ul style="list-style-type: none"> • 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 	
<p>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.</p>	<p>Completing Written Work</p> <ul style="list-style-type: none"> • 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) 	<p>Submitting Written Work</p> <ul style="list-style-type: none"> • 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
<p>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.)</p>		

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

Day 1: _____			
Minutes for science: _____		Minutes for science: _____	
Instructional format: <ul style="list-style-type: none"><input type="checkbox"/> Asynchronous<input type="checkbox"/> Synchronous		Instructional format: <ul style="list-style-type: none"><input type="checkbox"/> Asynchronous<input type="checkbox"/> Synchronous	
Lesson or part of lesson:		Lesson or part of lesson:	
Mode of instruction: <ul style="list-style-type: none"><input type="checkbox"/> Preview<input type="checkbox"/> Review<input type="checkbox"/> Teach live<input type="checkbox"/> Students work independently		Mode of instruction: <ul style="list-style-type: none"><input type="checkbox"/> Preview<input type="checkbox"/> Review<input type="checkbox"/> Teach live<input type="checkbox"/> Students work independently	
Students will...	Teacher will...	Students will...	Teacher will...

<p>Look at the Students will columns from Part C. 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.</p> <p>If there isn't a work product listed above, do you want to add one? Make notes below.</p>	<p>Some Types of Written Work in Amplify Science</p> <ul style="list-style-type: none"> • 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 	
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<p>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.)</p>		

Guided Engineering Internship Unit Internalization Planner

Part 1: Unit-level internalization

Unit title: Force and Motion Engineering Internship

What is the phenomenon students are investigating in your unit?

Design a delivery pods filled with emergency supplies that will be dropped in areas experiencing a natural disaster.

Unit Question:

How can we design delivery pods that are damaged as little as possible when dropped?

Student role:

Mechanical engineers

What do students figure out in each phase of the Engineering Internship?

Research Phase:

Conduct "egg-drop" tests to learn about variables.
Conduct iterative tests to better understand how each pod structure functions affect the outcome.

Design Phase:

Value of iterative tests, how to balance trade-offs, and how to make sense of the results in order to inform their next design

Proposal Phase:

Gather and use multiple pieces of evidence to improve their proposals so it is clear how and why each decision led to the proposed optimal design

What science ideas do students apply from the core unit to solve the engineering problem?

Students apply their understanding of force, velocity, mass, and collisions from the Force and Motion unit.

Remote and hybrid instruction note catcher

	Ideas for synchronous instruction	Ideas for asynchronous instruction
Research phase		
Design phase		
Proposal phase		

Name: _____ Date: _____

Day 2: Designing an Egg Drop Model

Hi interns,

Welcome back! I hope you found what you read in the Dossier useful, because today you will continue research on how to protect falling objects. Mechanical engineers often start by reading, and then they make physical models to test out ideas. This is what you will do today.

You'll be experimenting with how to best protect something small and fragile. Make careful decisions about the design based on what you learned from the readings in the Dossier. I expect you to take detailed notes on your design and test results—what you learn today will help make sure you design a top-notch supply pod for International Disaster Aid.

Deliverables

- Part 1: Egg Drop Design sheet
- After Hours: Reread and revise annotations in Chapter 2: "Collisions and Impact Forces"

Stay focused,

Nisha

Nisha Kar, Project Director

Futura | Mechanical Engineering Division

Daily Message Notes

Name: _____ Date: _____

Egg Drop Design

1. **Plan:** Choose the materials for your Egg Drop Model. Sketch and label your initial design in the space below.
2. **Build:** Make your design.
 - Before you test, record the mass of your Egg Drop Model in the Plan and Build section below. Be sure your egg is inside!
3. **Test:** Bring your Egg Drop Model to the test site. After you test, record the results.
4. **Analyze:** Reflect on your design in the Design Analysis (on page 7).

PART 1: DESIGNING AN EGG DROP MODEL

Plan and Build: Draw your design. Record your Egg Drop Model's mass.

Mass of the Egg Drop Model (grams): _____

Describe your design:

Test Results: Record your results in the space below. Sketch or describe what happened to the pod and to the egg when it collided with the ground.

Name: _____ Date: _____

Egg Drop Design (continued)

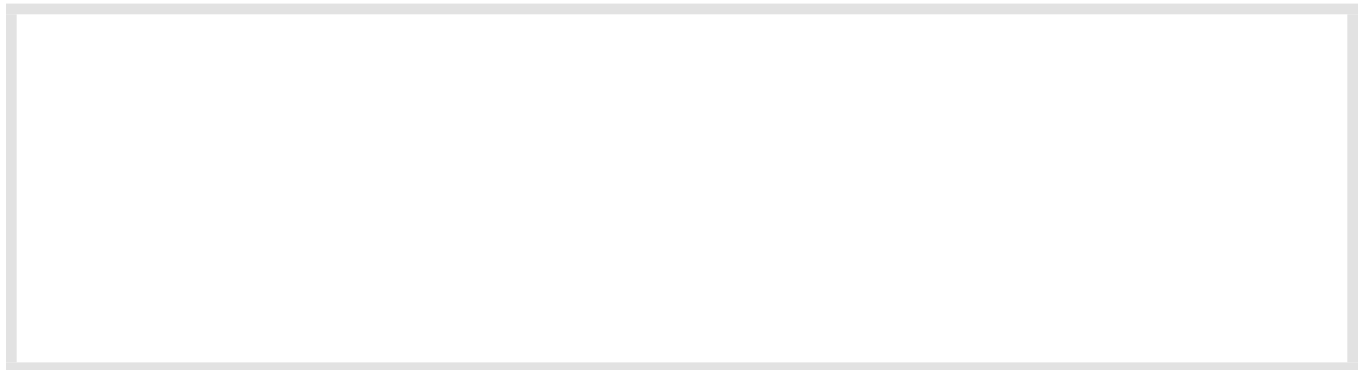
PART 2: ANALYZE YOUR EGG DROP MODEL

Design Successes: Which parts of your design worked? Why do you think they worked?

Design Failures: Which parts of your design did not work? Why do you think they did not work?

PLAN YOUR NEXT ITERATIVE TEST

Draw and describe your revised design.



What would you change?

Why would you make these changes? Describe the science concepts that support your decisions.

Name: _____ Date: _____

Day 3: Revising Your Pods

Hi interns,

In this workday, you will be wrapping up the Research phase of your internship. You will read and annotate Chapter 3: “Velocity, Mass, and Impact Forces” in the Dossier to learn more about how impact forces can affect your design. You’ll also have some time to plan how you would revise your Egg Drop Model design. After hours, you should reread and revise your annotations for Chapter 3 as you think about how this information on velocity, mass, and impact forces can help with your designs.

Take time to reflect on what you have learned in your work so far. Is there a way you can reduce the force of impact that you hadn’t thought of before? This is important preparation before you begin working on your supply pod designs for International Disaster Aid!

Deliverables

- Read and annotate Chapter 3: “Velocity, Mass, and Impact Forces”
- Completed Egg Drop Design sheet
- After Hours: Reread and revise annotations in Chapter 3: “Velocity, Mass, and Impact Forces”

Regards,

Nisha

Nisha Kar, Project Director
Futura | Mechanical Engineering Division

Daily Message Notes

Chapter 3:

Velocity, Mass, and Impact Forces

Changing the time over which a collision happens isn't the only way engineers can design for impact forces. Both the velocity and the mass of an object affect the impact forces involved in a collision.

Changing the Velocity of the Pod on Impact

The faster objects are moving when they collide, the more force they experience during the collision. If you can slow an object down, it collides with less force. How can you slow a falling object? Imagine taking two identical pieces of paper, crumpling one into a ball, and then dropping both pieces from the same height. The crumpled piece of paper would have a greater velocity than the flat piece (and would hit the ground much sooner). Both pieces of paper have the same mass, so why does one move faster than the other? The flat piece is more spread out and more of its surface interacts with the air as it falls—it slows down due to air resistance, a type of friction caused by air molecules.

Just as friction slows objects down as they move across surfaces, air resistance slows objects down as they fall through the air. The more of the surface of the object interacts with air molecules as it falls, the more air resistance it experiences. Engineers can slow falling objects and reduce impact forces on objects by increasing the amount of the objects' surfaces that experience air resistance. However, this doesn't work in space. In places where there are no air molecules (like in space), there is no air resistance.



A flat sheet of paper falls much more slowly than a crumpled paper ball because, even though they have the same mass, the flat paper has more surface exposed to the air and more air resistance.

Changing the Mass of the Supply Pod

Objects with more mass collide with more force. Imagine that a soccer ball rolls off a table and falls on your foot. Next, imagine a bowling ball rolls off that same table and falls on your other foot. You will feel that there is more impact force with the bowling ball—ouch! Many people think that the bowling ball must be moving faster than the soccer ball because it hits your foot harder. However, since the objects are about the same size and shape, they experience a similar amount of air resistance as they fall. They fall at the same velocity. (In fact, this is true for any two objects, no matter what their mass, if air resistance is not a big factor. When dropped from the same height, they will land at the same time.) Changing an object's mass does not change the speed at which it falls; it only affects the impact force.

Designing for Impact Forces

Our pod designs are a bit like that soccer ball and bowling ball—in each test, the shell is the same size, but the contents have a different mass. The contents of the shell and the materials used to build it determine its mass, but do not change its velocity on impact. In order to change velocity, the pod would need something that increases the surface that interacts with the air, like a parachute or flaps.

Engineers can decrease the impact forces by decreasing the mass of the pod, decreasing the velocity of the pod, and increasing the time over which the collision occurs.



Open parachutes have large surfaces that interact with air molecules. This helps reduce the velocity of falling objects (or humans) and makes the impact force smaller.

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.

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
<p>Online discussions: It's worthwhile to establish norms and routines for online discussions in science to ensure equity of voice, turn-taking, etc.</p> <p>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.</p> <p>Interactive read-alouds: Screen share a digital book or article, and pause to ask questions and invite discussion as you would in the classroom.</p> <p>Shared Writing: This is a great opportunity for a collaborative document that all your students can contribute to.</p> <p>Co-constructed class charts: You can create digital charts, or create physical charts in your home with student input.</p>	

[illegible]