



pets in the
classroom

Shell Showdown

Adapted from	A House for Hermit Crab Lesson Plan MYSTERY: WHAT IS THAT IN THE HERMIT CRAB HABITAT?	
Pet: Hermit crab	Class: 3-5	
Brief Overview: In this lesson, students learn about the function of a hermit crab's shell in terms of protection, camouflage, movement, and temperature regulation. They then design and test a "better shell".		Lesson Breakdown Lesson 1: Shell-ebrate Hermit Crabs! Lesson 2: Building Better Homes Lesson 3: Shell-ter from the Storm
Essential Question Can we design and build a better shell than nature for our classroom hermit crab?		
Subjects <ul style="list-style-type: none"><input checked="" type="checkbox"/> Science<input checked="" type="checkbox"/> ELA<input checked="" type="checkbox"/> Math<input checked="" type="checkbox"/> STEM<input type="checkbox"/> Art<input type="checkbox"/> Other	Stem Connections Science: adaption Technology: 3D modeling software (optional) Engineering: design, build and test a new shell Math: measurement,	

Performance Expectations/ Standards

NGSS

5-PS1-3. Make observations and measurements to identify materials based on their properties

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

CCSS

Math 5.G.2 Represent real world and mathematical problems by graphing

English SL.5.1. Engage effectively in a range of collaborative discussions

English L.5.1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking

I CAN statements

- observe and describe the unique features of hermit crab shells.
- discuss and explain the reasons why hermit crabs need to shed their shells.
- identify and explain the important features of a good hermit crab shell.
- brainstorm and generate creative ideas for designing a better hermit crab shell.
- compare and contrast different design solutions for effectiveness.
- sketch and label my hermit crab shell design, clearly showing key features and materials.
- plan and organize the construction process for my shell.
- safely and responsibly use a variety of materials and tools to build my hermit crab shell model.
- collaborate and communicate effectively with my team members during the construction process.
- conduct fair and controlled investigations to gather accurate data.
- record and organize my data in a clear and concise table.
- analyze and interpret the data to identify strengths and weaknesses of my design.
- revise and improve my hermit crab shell design based on the data and feedback I received.
- explain and justify the changes I made to my design.
- present my final hermit crab shell design to the class, explaining my choices and findings.

Materials

- [Introduction to Hermit Crab Shells Presentation](#)
- [Shell Showdown Student Worksheet](#)
- A variety of safe, recycled materials (cardboard, plastic bottles, straws, fabric scraps) for construction.
- Scale
- Small bowl of water
- Stop watch/ timer
- Spoon
- Clothespin
- Soft toys
- Sand, pebbles, seaweed (colored laminated pictures can also be used)
- 3D modeling software (optional)

Teacher Background

Hermit crabs lack their own hard carapace, relying instead on a second-hand sanctuary: the seashell. But these aren't just pretty beach finds; they're life-sustaining shields, portable apartments, and even fashion statements in the ever-shifting underwater world.

Unlike their hard-shelled brethren, hermit crabs have soft, vulnerable abdomens. Enter the seashell, a pre-owned palace plucked from the ocean floor. These shells, primarily composed of calcium carbonate, a mineral secreted by mollusks like snails and clams, act as life-saving fortresses. They shield the crab's squishy interior from hungry fish, curious gulls, and the perils of a rocky coastline. It's a portable security blanket, ensuring our crustacean friend avoids becoming a tasty snack.

But beyond a mere shield, the shell is a multi-functional marvel. It's a cozy condo, offering space for rest, dining, and even sunbathing. Some shells even come with built-in camouflage, sporting patterns and textures that blend seamlessly with the seabed, transforming the crab into a stealthy ninja of the reef.

As hermit crabs grow, their homes become cramped. They undergo a process called molting. The crab secretes a new, larger exoskeleton beneath its old one. Then, it contorts its body and escapes its old shell. With its shiny new exoskeleton exposed, the crab embarks on a house-hunting spree, often engaging in epic shell battles with competitors before claiming the perfect upgrade.

Hermit crabs are nature's ultimate recyclers, giving used shells a new lease on life. This reduces the need for new shell production, saving marine animals valuable energy and resources. Sadly, with pollution and habitat loss plaguing our oceans, finding a suitable shell has become a growing challenge for hermit crabs. This highlights the importance of protecting marine ecosystems and the creatures that call them home.

Lesson 1: Shell-ebrate Hermit Crabs!

Time	Materials	Activity
10 mins		Ask students: Imagine walking down the street without your clothes! For most of us, it's an unthinkable scenario. But for hermit crabs, it's a natural part of life. These curious crustaceans don't have their own built-in armor, relying instead on a portable palace: the seashell. But these aren't just beach souvenirs; they're vital for survival, serving as a multi-purpose marvel of nature's engineering.
10 mins	Introduction to Hermit Crab Shells Presentation	Show students pictures and videos of hermit crabs and their elaborate shells. Discuss their unique adaptation and the reasons for shedding. The slide presentation reviews the function of hermit crab shells.
25 mins	3D modeling software (optional) Shell Showdown Student Worksheet	Present the design challenge: "Build a better shell for a hermit crab!" Allow students to identify crab size: have them measure and weigh actual hermit crab shells or use models to determine the necessary size and dimensions of the shell. Guide students to consider material limitations and prioritize key features. Guide students through a brainstorm session on characteristics of good hermit crab shells: size, weight, protection, camouflage, buoyancy etc. Make sure they label the important features and materials. Encourage creativity and diverse solutions. <i>Optional: Students may use a 3D modeling software to design their shell.</i>

Lesson 2: : Building Better Homes

Time	Materials	Activity
45 mins	Shell Showdown Student Worksheet Provide a variety of safe, recycled materials (cardboard, plastic bottles, straws, fabric scraps) for construction.	Construction Time! Students use their chosen materials and tools to build their model shells. Encourage collaboration and problem-solving during the construction process. <i>If using 3D software modeling, analyze design features and test performance digitally</i>

Lesson 3: Shell-ter from the Storm

Time	Materials	Activity
		<p>Before class,prepare the testing stations:</p> <p>Underwater Stability:</p> <p>Station 1: Sink or Swim: Fill a clear container with water and gently place the shell models inside. Observe their buoyancy: Do they float, sink, or stay partially submerged? Time how long it takes for any sinking models to stabilize or reach the bottom. Analyze how weight distribution and material choices affect buoyancy.</p> <p>Station 2: Whirlpool Woes: Create a mini whirlpool in the water using a spoon. Observe how the shells handle the movement. Do they stay upright, tilt, or tip over? Discuss how stability affects the crab's ability to feed and maneuver underwater.</p> <p>Predator Protection:</p> <p>Station 3: Crabby Critters: Use soft toys or stuffed animals as mock predators. Gently "attack" the models from different angles, observing how the shells protect the crab's vulnerable body. Analyze how shape, thickness, and openings influence defense against different types of</p>

Lesson 3: Shell-ter from the Storm

		<p>threats.</p> <p>Station 4: Pincer Pinch! Use a clothespin to simulate a predator's pincer pinch. Test how much force the shells can withstand before cracking or breaking. This station focuses on material strength and structural integrity.</p> <p>Other Tests; Station 5: Camouflage Challenge: Test how well the shells blend into different environments (sand, pebbles, seaweed) (colored laminated pictures can also be used) Discuss the importance of camouflage for predator avoidance and food acquisition.</p> <p>Durability Test: Subject the shells to simulated wear and tear by gently scratching, dropping, or bending them. Analyze how different materials withstand stress and potential damage in the wild.</p>
5 mins	scale	Before testing, have the students record the weight of their shell.
30 mins	Shell Showdown Student Worksheet	Allow students to conduct their tests. If time permits allow the students to make and test alterations to their designs.
10 mins	Shell Showdown Student Worksheet	Have the students present their final hermit crab shell design to the class, explaining choices and findings.

Differentiation

For students who need additional support:

- Provide pre-made templates or simpler materials for younger students.
- For students with learning challenges: Break down the design process into smaller steps. Offer visual aids like pictures or diagrams of different shell features. Consider pre-cut materials or model shells for easier construction.

For students who need additional challenges:

- Art & Design: Design and illustrate a new species of hermit crab with a unique shell adaptation. Explain the function and benefits of this adaptation.

- **Creative Writing:** Write a short story from the perspective of a hermit crab searching for the perfect shell. Describe the challenges and triumphs of your crab protagonist.
- **Scaling Laws:** Research how the size and weight of a hermit crab affect its shell requirements. Apply scaling laws to design shells for different sized crabs, ensuring proper proportions and functionality.

Assessment					
Criteria	5 Points: Masterful Hermit Haven	4 Points: Shell-ebrating Success	3 Points: Crab-tastic Creation	2 Points: Needs Refinement	1 Point: Back to the Drawing Board
Design					
Creativity & Originality	Design showcases highly unique features demonstrably addressing functions beyond basic protection. (e.g., bioluminescent markings, detachable claws)	Design shows good originality and addresses multiple functions beyond protection.	Design has some unique features and addresses at least one function beyond protection.	Design lacks originality and primarily focuses on basic protection.	Design lacks creativity and functionality.
Testing Observations					
Accuracy & Detail	Observations are flawless, recording precise details about behavior in each testing station.	Observations are accurate and detailed, capturing key aspects of behavior in each station.	Observations are mostly accurate but may lack some detail or clarity.	Observations are inaccurate or incomplete, missing key details or behavior in some stations.	Observations are unclear or missing for one or more testing stations.
Completeness	Observations thoroughly address all	Observations cover all aspects of the	Observations address most aspects of the	Observations are incomplete, missing	Observations are significantly incomplete,

	aspects of the with specific examples.	testing with clear descriptions of behavior.	testing but may be missing details or examples for some stations.	information from one or more aspects of the testing.	lacking information from multiple aspects of the testing.
Analysis Questions					
Insightful Answers	Explanations are exceptionally insightful, demonstrating deep critical thinking and clearly connecting observed results to design features and effectiveness.	Answers showcase good critical thinking and effectively explain how observations relate to design features and effectiveness.	Answers show some understanding of results and attempt to connect them to design features, but may lack depth or clarity.	Answers are superficial or inaccurate, failing to adequately explain observations or connect them to design.	Answers are missing or irrelevant, demonstrating no understanding of the testing results or design features.
Identification of Strengths & Weaknesses	Analysis accurately identifies both strengths and weaknesses of the design based on testing results, providing specific suggestions for improvement.	Analysis identifies key strengths and weaknesses of the design with constructive suggestions for improvement.	Analysis identifies some strengths or weaknesses of the design but lacks depth or specific suggestions for improvement.	Analysis fails to identify strengths or weaknesses and offers limited or no suggestions for improvement.	Analysis is absent or unhelpful, providing no insights into design strengths or weaknesses.

Extension

- Research real-world examples of biomimicry inspired by hermit crabs. How have scientists and engineers been inspired by these adaptable creatures? Present findings to the class.
- Investigate the cultural significance of hermit crabs in different societies. How have myths, legends, or art been influenced by these creatures? Create your own artwork or story inspired by hermit crabs.
- Hold a debate on the ethics of collecting seashells. Encourage students to research the impact of shell collecting on hermit crab populations. This can foster critical thinking and social responsibility