

ScienceNews

Activity Guide for Students: Form Fits Function in Extreme Environments

Directions:

Part 1: Find a form

Choose an item from around the classroom or your home. Answer the following questions to analyze how the object's structure supports its function.

1. Describe the primary function, or the intended activity or purpose, of the object you selected.
2. Describe any secondary functions or requirements.
3. Describe the object's shape, or the geometric figures you see within it. Describe the structure of the object, or how the individual parts of shapes are arranged and connected. Are there patterns, or repeated shapes or designs, that you notice that may have been intentional in the object's design?
4. How do the overall shape and structure support the function? Could different shapes and patterns be used to support the same function?
5. What materials is the object made of and how do those materials affect the object's ability to perform its function?
6. Are there any improvements or alterations you would make to the structure that could better support the function?

After answering the questions, produce a "schematic" of the object that shows the specific aspects of the structure that help support the function. This can be a printed image or drawn by hand and should be done on a separate piece of paper.

Part 2: Lessons from urchins

Read the article "[Sea urchin skeletons' splendid patterns may strengthen their structure](#)" and answer the following questions. A version of the article, "The geometry of sea urchin skeletons," appears in the September 10, 2022 issue of *Science News*.

1. This article discusses the Voronoi pattern. What is the pattern and how does it affect the structure of the sea urchin skeleton?
2. Why is this pattern important to the function of the skeleton?
3. Can you think of other examples of patterns in nature that have a functional benefit?
4. How does understanding the structure of the sea urchin skeleton inform your understanding of the design of the object you selected in Part 1?
5. How could studying the structure of urchin skeletons or other natural objects inform researchers looking for solutions to real-world problems?

Extension: In sea or space

Reread the last two paragraphs of the article "[Sea urchin skeletons' splendid patterns may strengthen their structure](#)." A version of the article appears in the September 10, 2022 print issue of *Science News* with the headline "The geometry of sea urchin skeletons." The article mentions that the lightweight, strong Voronoi pattern could lead to other structural developments "in materials science, aerospace, architecture and construction." Answer the following questions after reading the last two paragraphs.

1. How does the Voronoi pattern benefit the organisms in which it is found?
2. What other structures in nature show the Voronoi pattern?

Follow your teacher's instructions to apply the first few steps of the design process to a real-world situation. Use the graphic organizer below as a guide.

SITUATION (What problem are you trying to solve?):		
ASK	Constraints (What are the limitations of the situation?)	
	Needs (What's necessary for a successful design?)	
RESEARCH	Problems (Why and how have other approaches failed?)	
	Successes (Why and how have other approaches succeeded?)	
IMAGINE	Proposals (What design would you suggest to solve the problem?)	



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