

Design a Helicopter for Mars

Student worksheet

Name: _____

Date: _____

Directions: Complete the sections below in preparation for your design challenge.

1. The following statements are false. Correct the statement(s) assigned to your group and explain why the statement is incorrect.

a. Gravity pushes Earth away from the Sun.

b. Gravity pulls harder on objects that are farther away.

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- c. On Earth, the gravitational pull of the Sun does not act on us.
- d. Fact: Earth is 10 times more massive than Mars, and its diameter is smaller than that of Earth. Statement: Because of these differences, the mass of a helicopter on the surface of Mars is less than the mass of the same helicopter on the surface of Earth.
- e. Fact: Helicopter blades use air to create lift (the force that pushes upward on the helicopter blades). Statement: Mars has a thinner atmosphere than Earth, so it is easier to create lift on Mars compared to Earth.

2. In your own words, write a definition of gravity:

Directions: Complete the sections below to work through the engineering design process.

The Problem:

Helicopters built to fly on Earth do not fly on Mars. Your goal is to find design solutions for a helicopter that can fly on Mars.

Do background research.

3. What are the two main vertical forces that act on a helicopter? Think of what pulls the helicopter down and what keeps it in the air. Draw a helicopter (or paper helicopter) and indicate these forces with arrows.

4. Briefly write down how these forces are different on Mars compared to on Earth?

5. From that knowledge, what should be your goal for the weight and the lift when engineering a helicopter that needs to fly on Mars?

Make a prototype.

6. Use the template to make a paper helicopter. This paper helicopter is your initial design.

Brainstorm

7. In your group, brainstorm ideas to improve the design of the paper helicopter so it is better-suited to fly on Mars.

Evaluate, choose solutions, and test.

8. How will you measure improvement in your design? If you decide to use quantitative data (e.g., a time or number of frames in a video), take a measurement for your initial design and write down the result.

9. Decide which design solution(s) you want to test. Make a prototype, and then test it. Record your findings in the Prototype 1 line of Table 1.

Make design changes based on the results.

10. Draw conclusions from your tests and use the data to redesign your prototype. Record at least 2 iterations in Table 1. Label your prototypes and keep them, as you might want to use them to communicate your findings later.

Table 1: Test results		
Description or drawing of the main design features	Improvement? Yes/No If available: Quantitative data	What did we learn from this design iteration?
Prototype 1		
Iteration		
Iteration		

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Communicate results.

11. Look back at the data you collected. What design advice would you give to the NASA design team tasked with designing a helicopter for Mars (what to do, as well as what not to do)? Provide at least two suggestions.
12. Choose the best-performing design and describe its main features?
13. Prepare to present your advice and best-performing model in a clear, concise, and convincing way. Use the data you collected to support your claims.