

THE FUTURES CHANNEL
MARS HELICOPTER: INGENUITY - LESSON

Subject:
Math

Grade Level: 11th Grade, 12th Grade
(**CCSS: HSA-REI.4, F-IF.1, F-IF.7a, F-IF.7b, F-IF.7c**)

Topics: Mathematics, Algebra 2, parabolas

Concepts:
- Quadratic equations and graphing quadratic equations

Knowledge and Skills Needed for the Project:
- Knowledge of quadratic equations and parabolas
- Knowledge of the roots of a quadratic equation
- Knowledge of the vertex (maximum, minimum) of a parabola

Materials:
Paper and pencil

Watch The Futures Channel video - "Mars Helicopter: Ingenuity"

Lesson:

Procedure: This project should be done by students individually.

NOTE: The following lesson can be done during class as a teacher-led class lesson for an example of how parabolas and parabolic paths are used in real life, or the following lesson can be passed out as homework if the students are already proficient at working with parabolas and graphing them.

STUDENT HANDOUT

INTRODUCTION:

You are part of the NASA team tasked with controlling the Mars Helicopter: Ingenuity. From your station in the control room, the helicopter can be moves from location to location around the surface of Mars, feeding valuable information back to Earth. Today, Ingenuity has sent an image of a large range of Mars mountains right in front of it. You will need to safely fly Ingenuity over the mountain range to the other side. Luckily, satellite imagery tells you how high and wide this range is. From the data the satellite has given you, the range's highest point is 6,184 ft. The width of the mountains to flat land on the other side is 3 miles. Your team has been crunching the numbers and believes they have an equation which will safely carry Ingenuity across the mountain range.

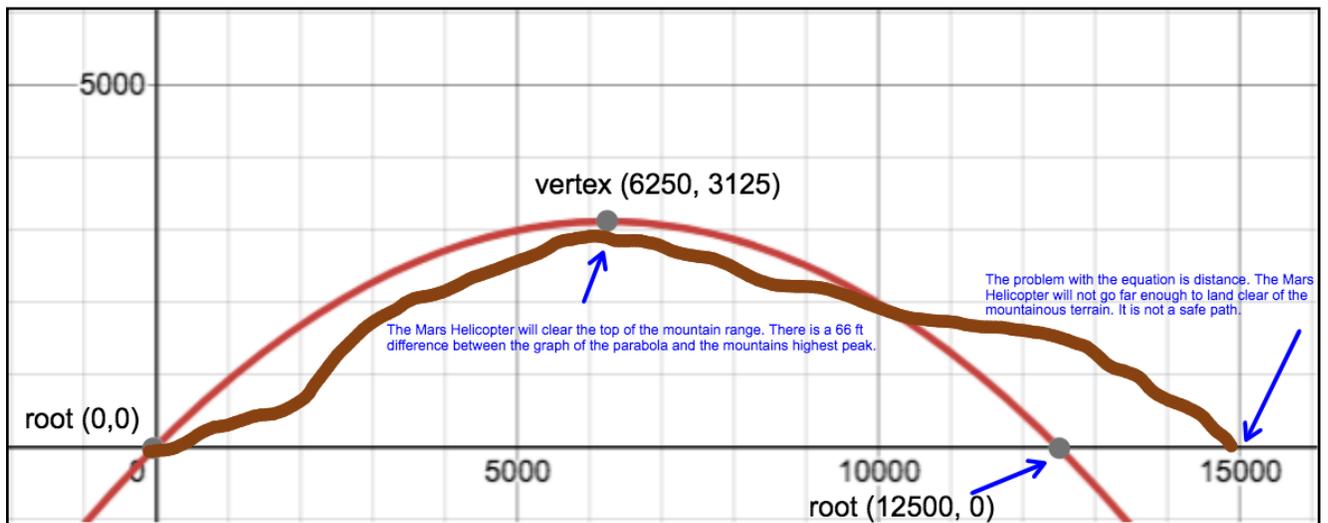
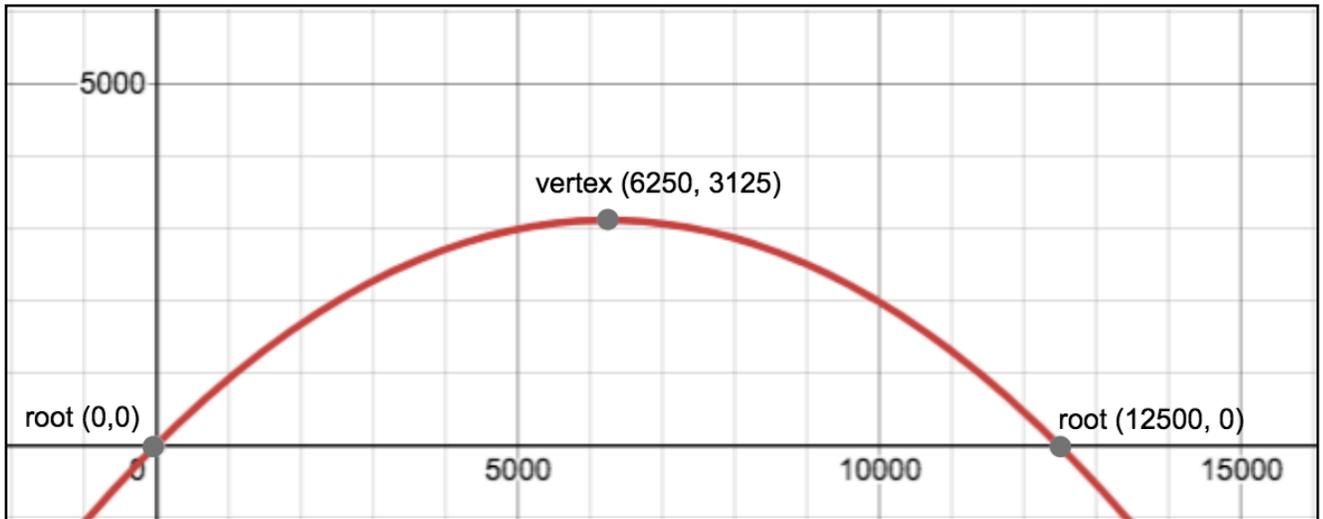
They have presented you with the equation: $f(x) = - 0.00008x^2 + x$.

ANSWER THE FOLLOWING QUESTIONS:

1. Will the above equation provide a safe path for Ingenuity to land on flat ground? Yes or No? If no, tell whether it is a problem of height or a problem of distance.
2. Graph the quadratic equation $f(x) = - 0.00008x^2 + x$ to support you claims. Show why the team's equation works or does not work.

ANSWERS

Path of the given equation:



Path of the given equation as compared to data given about the mountain range.

1. Will the above equation provide a safe path for Ingenuity to land on flat ground? Yes or No? If no, tell whether it is a problem of height or a problem of distance.

No, it is problem if distance. The vertex of the parabola is (6250, 3125). The highest peak of the mountains is 6,184. Ingenuity will clear the height.

However, the first root of the equation is (0,0) which is the starting point of Ingenuity's flight path. The second root is (12,500, 0) which is where it will land, 12,500 ft away from its starting point. The mountains are 3 miles wide (15,840) feet. Ingenuity needs to travel farther than the second root of the equation above, or it will not land on safe terrain on the other side of the range.

2. Graph the quadratic equation $f(x) = -0.00008x^2 + x$ to support you claims. Show why it works or does not work.

Student graphs should show an overlay of the given equation's parabola as compare to the dimensions of the mountain range. It should indicate visually that the equation is not workable. See pictures above. The parabola the equation forms is not wide enough for Ingenuity to land safely out of mountainous terrain. There is too high a possibility of crashing Ingenuity if you try to land it in the mountains. Another, more workable equation must be found.