Name _____ Date _____ Class _____

Surfs Up, Part Two

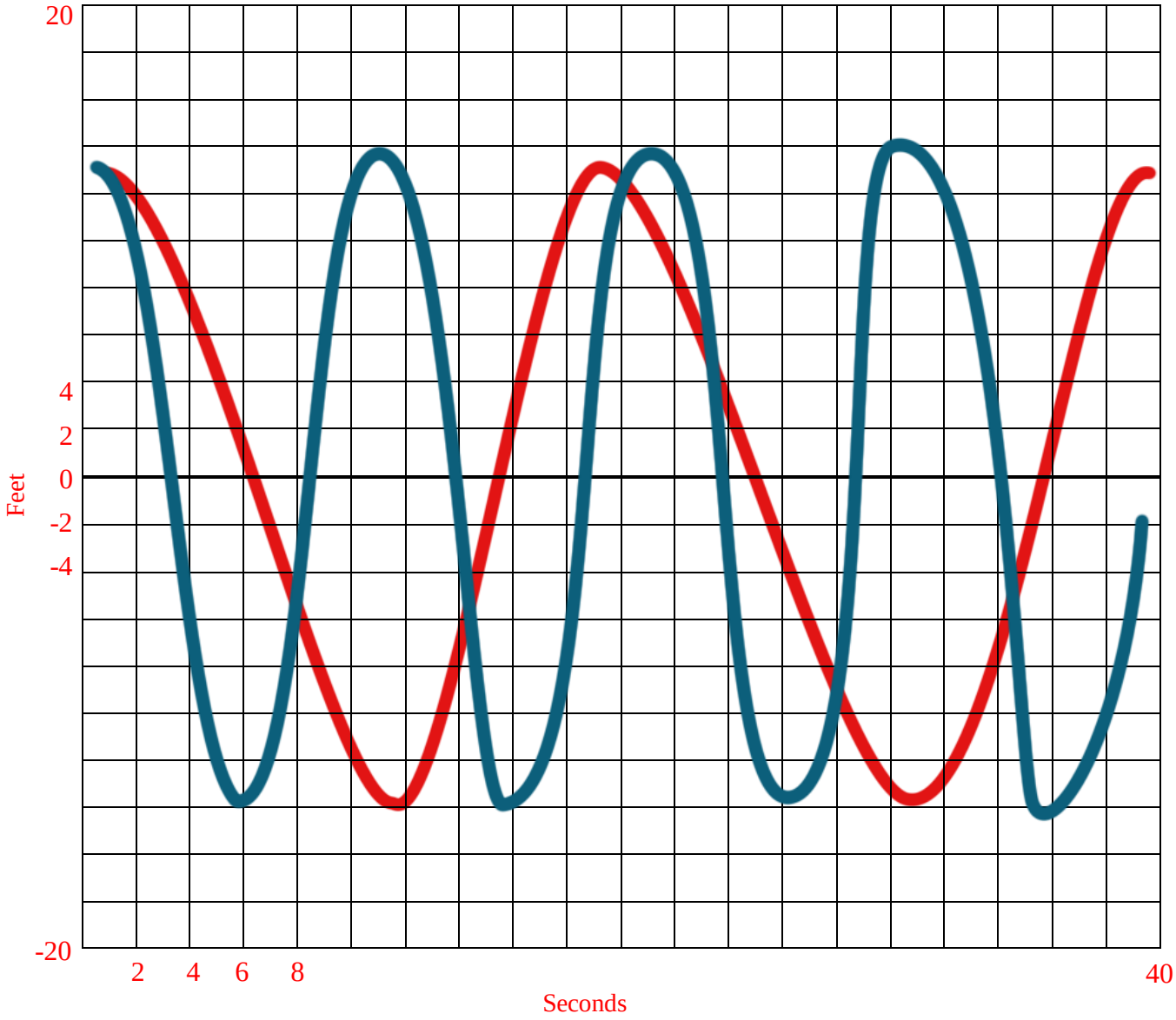
How can we use what we know about wave characteristics to pick the best surf break?

Challenge: You and your friends are trying to decide what break to surf. One break has a wave height of 8 feet and a period of 8 seconds. A second break has a wave height of 4 feet and a period of 4 seconds. Which break do you choose and why?

This was the surf report of Maverick's on February 11th, 2016.

1. Let's graph the wave.
   - First label the x- and y-axes.
   - Plot wave amplitude. (The wave amplitude is half of the height. Use 28 ft. as height.)
   - Plot wave period/frequency.

Have students graph this height. Half of 28 feet is 14 feet (the amplitude)



2. On the graph on the previous page, use a different color to draw a wave with the same amplitude but twice the frequency (so half the time) of the Maverick's wave.

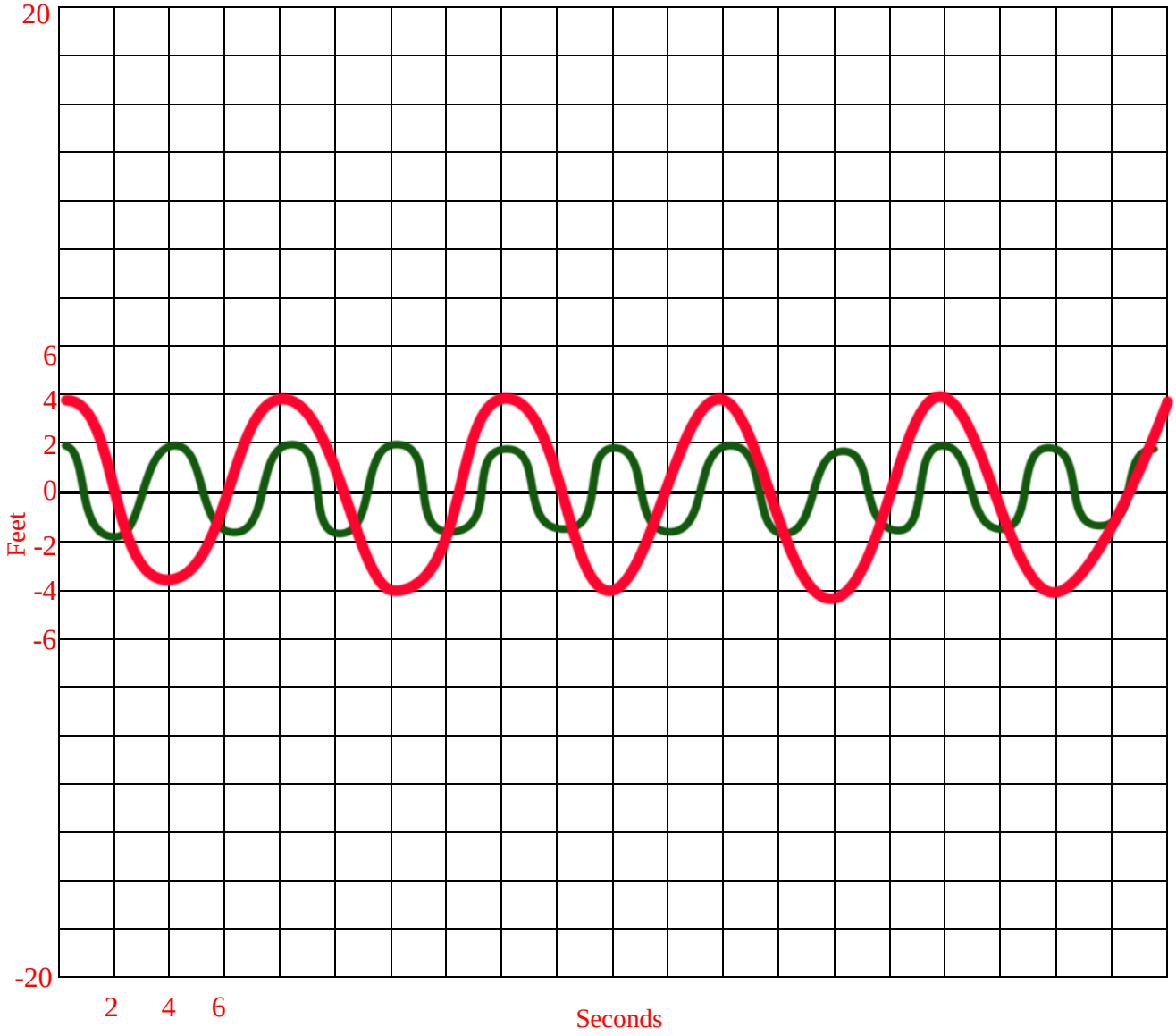
   Amplitude: 14 What are the units? feet
   Frequency: 9.5 What are the units? seconds

3. Which wave carries more energy? Why do you think that?

   The second wave, because more waves pass by a set point (and are more frequent) than the first.

4. Graph the two waves described in the surfing challenge below:

   One break has a wave height of 8 feet and a period of 8 seconds. Amplitude: 4 feet
   A second break has a wave height of 4 feet and a period of 4 seconds. Amplitude: 2 feet
   (Remember to add labels for the x- and y-axes.)



5. The energy transported by a wave is directly proportional to the square of the amplitude of the wave. That means that if the amplitude of a wave is doubled, the energy transported by the wave is quadrupled.

Amplitude	Energy
1 unit	2 units
2 units	8 units
3 units	18 units
4 units	32 units
5 units	50 units

Sometimes it's expressed like this: $E \propto A^2$

Looking at the surf break challenge in the previous question, answer:

- How many more units of energy does the higher amplitude wave carry than the lower amplitude wave? Use the above equation to figure it out.

  $E \propto A^2$ Higher amplitude, $E \propto 4^2$ $E \propto 16$

  $E \propto A^2$ Lower amplitude, $E \propto 2^2$ $E \propto 4$

  The higher amplitude wave carries 12 more units of energy.

- Go back to question 3. How does the energy carried by both waves on the first graph compare?

  The higher frequency wave carries more energy over time since the frequency is doubled (waves pass a point in half the time).

6. Which wave in the below scenario would you choose to surf and why? What other information about the waves would be helpful?

   One break has a wave height of 8 feet and a period of 8 seconds.

   OR

   A second break has a wave height of 4 feet and a period of 4 seconds.

   Answers will vary. Objectively the taller wave with lower frequency (first wave) may be easier to ride because there is space between waves to paddle in. But as long as students provide evidence and reasoning for their thinking, all answers are OK.