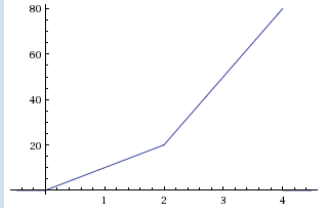
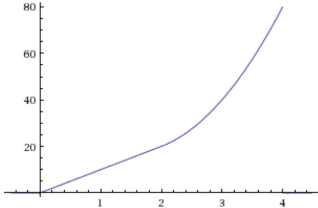
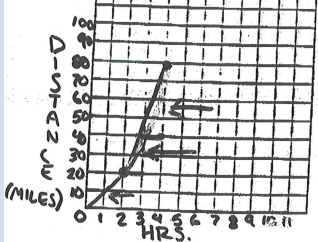

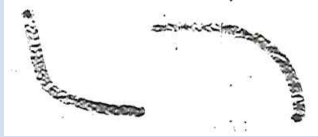


Graphing a Story: Straight versus Curved – Video Analysis Guide

Segment Focus	Approximate time in video	Line #s in transcript	Visual Cues	Narrative Summary	Salient quotes
Solution with linear segments	0:00 – 0:52	1-9		Jennifer presents her graph of the story, which includes two straight lines.	Jennifer: In 2 hours it traveled 20 miles [draws a straight line segment on overhead]. Jennifer: In 4 hours it'd be 80 miles from shore. Which is right there [draws a second, steeper straight line segment on overhead].
Solution with a curved segment	0:52 – 2:40	11 - 42		John explains that he thinks the graph should be curved. John draws his curved line below Jennifer's straight line.	John: "It said it goes faster and faster, so wouldn't it be curved on the, from 20 miles to 80 miles?" John: "It goes more miles per hour so that distance would go up more at the end and less at the front."
Discussion of straight versus curved line	2:40 – 4:18	43 – 65		The students discuss what a straight line versus a curved line represent. Most students see a straight line representing the same speed.	Robert: "On a graph a straight line means it's going the exact same speed." Ashley: "The straight line maybe goes up faster. It doesn't take as much time." Gary: "You curve it to have more distance in less time."
Talking about speed	4:18 – 6:20	66 – 94		John explains why he thinks the second part of the graph is curved. Gary summarizes Jennifer and John's thinking about the second part of the graph.	John: The first hour is going on the same speed, 30 miles an hour on the one that goes straight...[the curved arc] starts out, it goes about 25, the other side goes 35. Gary: it um, like jumped once and then didn't go like faster after that and...after two hours, it kept on accelerating all the way up to ah, 'til four hours later
Discussion of different curves	6:20 – 6:34	95 - 102		Jennifer asks if the curved graph would mean that it was slowing down. John shows two curves, one for slowing down and one for speeding up.	Jennifer: if it's going 10 miles per hour for two hours and it curves out at the 2 hour mark, then wouldn't it slow down? John: Oh, no, it curves the other way.

Graphing a Story: Straight versus Curved

Video Analysis Guide

1. Student Disagreement

Central Issues

What is the central disagreement that students are having about the graph?

Jennifer, Ashley and possibly Jared think that the portion of the graph representing the ship speeding up should be a straight line. John, Gary, Aman, and Nelson think that the second part should be represented by a curve.

Relevant Quotes

Lines 3-6

Jennifer: And then, ‘Then it keeps picking up speed, going faster and faster until 2 hours later, the ship is 80 miles from shore.’ So that means in 4 hours it’d be 80 miles from shore. Which is right there [draws a second, steeper straight line segment on overhead].

Lines 11-12

John: It said it goes faster and faster, so wouldn't it be curved on the, from 20 miles to 80 miles?

2. Unpacking Student Ideas about the Straight Line

Central Issues

What is Jennifer’s idea about the second part of the graph?

Jennifer thinks that the second part of the graph should be a straight line. She also expresses that she thinks the boat speeds up once at 2 hours.

How do the other students think about straight lines?

Robert thinks a straight line means the ship is moving at a constant speed.

Ashley thinks that the straight line is a more direct path to 80 miles away from the shore. She may be interpreting the graph physically because the straight line is shorter than the curve.

Relevant Quotes

Lines 3-6

Jennifer: And then, ‘Then it keeps picking up speed, going faster and faster until 2 hours later, the ship is 80 miles from shore.’ So that means in 4 hours it’d be 80 miles from shore. Which is right there [draws a second, steeper straight line segment on overhead].

Lines 60-64

- Jennifer: Ah, well, it might not, a straight line might not be the same distance because it accelerates from the, after the two hours, the first two hours. It speeds up then.
- Mr. Louis: Oh, OK, so you're interpreting the faster and faster as just one change in speed. Like from the two hours to after the two hours.
- Jennifer: Yeah.

Line 46

- Robert: On this graph a straight line means it's going the exact same speed.

Lines 48-51

- Ashley: ...the straight line maybe goes up faster. It doesn't take as much time.
- Mr. Louis: Because there's less distance on the line?
- Ashley: Um, hm.

What do you think Ashley means when she says “the straight line maybe goes up faster. It doesn't take as much time” on lines 48-49? Why might this idea lead Ashley to think the graph should be straight?

Additional Issues:

When Robert says “on this graph a straight line means it's going the exact same speed” do you think he means only this graph or on graphs in general?

3. Unpacking Student Ideas about the Curved Line

Central Issues

What reasons do students give for claiming that the second part of the graph should be a curve?

John says that it goes faster and faster and that it is accelerating. When pressed, he explains it goes more distance at the end of the time, and less distance at the beginning.

Gary says the line must be curved in order to go more distance in less time.

Relevant Quotes

Lines 11-12

- John: It said it goes faster and faster, so wouldn't it be curved on the, from 20 miles to 80 miles?

Line 16-17

- John: Oh, as it goes faster the, it goes more miles per hour and so that distance would go up more at the end and less at the front.

Line 39

- John: Because it said it accelerated.

Line 54-56

Gary: I think that it should be curved 'cuz it may be straight and may be going faster, but it continues at the same speed all the way up and it said that they got faster as they went, so, you curve it to have more distance in less time.

Lines 98-99

Jennifer: If it's going 10 miles per hour for two hours and it curves out at the two hour mark, wouldn't it slow down?

What does Gary mean when he says “you curve it to have more distance in less time” in line 56? Does Gary think that the curve represents a ship that goes more distance than a ship represented by the straight line?

Additional Issues:

Are Gary and John reasoning about the curve in the same way?

What is Jennifer’s idea about the upward curve in the graph?

Jennifer thinks that the upward curve represents the ship slowing down. She may think that all upward curves represent slowing down, but she may also be talking about how the curved part of the graph on the board represents the ship slowing down at 2 hours.

How are Jennifer and John interpreting what happens to the movement of the ship differently?

Jennifer seems to think that the ship accelerates once to a new, higher speed at 2 hours, but John thinks the ship constantly accelerates after two hours.

4. Unpacking Student Ideas about the Speed on the Graph

Central Issues

Gary and John talk about the speed of the ship at different times. What are their ideas about the speed of the ship?

John talks about the speed of the ship by calculating the speed of the ship in the second straight line. He also gives values for the speed of the ship at the beginning and end of the curve.

Gary talks about Jennifer’s graph as having a jump in speed, and then having a steady speed. When talking about the curved graph, Gary talks about the ship accelerating the entire time after two hours, but he doesn’t reference specific speeds of the ship at different times.

Relevant Quotes

Lines 68-73

John: On this one [the line segment] it shows, from hour 2 to, from hour 2 to hour 3 it goes up three, ten, so it's going up 30 miles per hour, so each one of these is going up 30 miles per hour. So it's going 30 miles an hour on this. But on mine, the first hour is going on the same speed, 30 miles an hour on the one that goes straight. But on mine, it [the curved arc] starts out, it goes about 25, the other side goes 35.

Lines 79-85

Gary: I think he was saying was that it accelerated, like between the first segment, um, this is like the straight line, the first segment it accelerated like fast between two hours and the rest of it, but it jumped to like 30 miles per hour and then I think it went just like steady at 30 and I think that Jennifer was trying to say that it um, like jumped once and then didn't go like faster after that and what he's trying to say is, um, after two hours, it kept on accelerating all the way up to ah, 'til four hours later they were still accelerating.

How does John determine the speed of the ship at different times?

John uses the graph to determine the speed of the ship. John seems to be using the difference in time and the difference in distance between two points on the straight line at 2 and 4 hours. He finds the difference between them to be 60 miles and the time between them to be 2 hours, so the speed is 30 mph. For the speed of the curved line, it is unclear how he determines the values. He may just give values that are slightly under and slightly over what he found for the straight line.

What does Gary mean by “it jumped to like 30 miles per hour”?

Additional Issues:

Does John think that the speed of the ship at any point on a straight line is the same?

Do John and Gary talk about the change in speed of the ship in the same way?

John explains the change in the speed of the ship in terms of discrete points in time at the beginning and the end when the ship had different speeds. Gary talks about a continuous acceleration of the ship.

Extension:

John claims that the ship was going 30 miles an hour for the first two hours, and then the ship goes about 25 miles per hour at the beginning and 35 at the end of the curved line. Does it make sense for the speed of the ship to change from 30 miles per hour to 25 miles per hour in this situation? What would the speed of the ship be when it starts accelerating? What would the speed of the ship be when it is 80 miles from shore if it accelerated at a constant rate?