What is slope?

Andersen Junior High School

February 25, 2015

1. Ask the question “What is slope?”

* Think, pair, share
* Volunteers respond
  + Expect “rise over run”, “”
  + Push students to explain what slope is rather than how to compute it.
  + Push students to articulate what they mean by, for example, “over” or why they use the formula.

2. Do the activity – which staircase is “steeper” and why?

3. Do the activity – who is traveling “faster” and why?

4. Do the activity – linear contexts (from context/no context)

**Which staircase is steeper?**

Below are pictures and descriptions of two staircases. Your task is to determine which staircase is steeper. Prepare a mathematical argument to defend your choice. Be prepared to share your work including an explanation of what “steeper” means.

 A section of the Staircase to Heaven has the following profile details:

2.5 feet

Push students to articulate what they mean by “steep”. For every 1.75 feet of horizontal movement, person climbs 2.5 feet vertically. We could proportionally break it down by cutting the 1.75 horizontal feet into 1 foot segments (1.75 of these segments). Each is 1/1.75 of the total. To preserve the proportionality, need to find 1/1.75 of 2.5. So, about 1.43 vertical feet for every 1 horizontal foot. Note…we could also say 1/2.5 of 1.75 = 0.7 and say 0.7 horizontal feet for every 1 vertical foot. In this case, the smaller the ratio, the steeper the stairs.

1.75 feet

Haiku Stairs (Stairway to Heaven) in Honolulu



A section of the Crooked Street stairs has the following profile details:

0.25 feet

1.5 feet

Push students to articulate what they mean by “steep”. For every 1.5 feet of horizontal movement, person climbs 0.25 feet vertically. We could proportionally break it down by cutting the 1.5 horizontal feet into 1 foot segments (1.5 of these segments). Each is 1/1.5 of the total. To preserve the proportionality, need to find 1/1.5 of 0.25. So, about 0.17 vertical feet for every 1 horizontal foot. Note…we could also say 1/0.25 of 1.5 = 6 and say 6 horizontal feet for every 1 vertical foot. In this case, the smaller the ratio, the steeper the stairs.



**Who is traveling faster?**

Consider the two situations and determine who is traveling faster. Prepare a mathematical argument to defend your choice. Be prepared to share your work including an explanation of what “faster” means.

Situation 1: During migration, ducks and geese can travel 25 miles in one-half hour (www.npwrc.usgs.gov)

Push students to articulate what they mean by “fast”. For every half hour, geese travel 25 miles. We could proportionally say that in a full hour, the geese will travel 50 miles…so average 50 MPH. The more distance traveled in a given unit of time (1 hour in this case), the faster the animal must be traveling. Note that we like to find the unit rate so that comparisons can be made.



Situation 2: During migration, humpback whales can travel 0.75 miles in one-quarter hour.

Push students to articulate what they mean by “fast”. For every quarter hour, whales travel 0.75 miles. We could proportionally say that in a full hour, the whales will travel 4\*0.75=3 miles…so average 3 MPH. The more distance traveled in a given unit of time (1 hour in this case), the faster the animal must be traveling. The less distance in the same given unit of time, the slower the travel. Note that we like to find the unit rate so that comparisons can be made.

Celsius/Fahrenheit Conversion

|  |  |
| --- | --- |
| ***Celsius Temp.*** | ***Fahrenheit Temp.*** |
| 0 | 32 |
| 5 | 41 |
| 10 | 50 |
| 15 | 59 |
| 20 | 68 |
| 25 | 77 |

For each context, work to push students to connect the idea of proportionality, “steepness” on a graph, slope as rate of change. Do not allow students to get away with simply remembering a formula like y=mx+b. For example, we see that for every increase of 5 degrees C, the temperature in F increases by 9 degrees. If we “cut” the 5 degrees C into 5 parts (1/5 of 5 degrees C), then we need to “cut” the 9 degrees F into 5 equal parts as well to preserve the proportionality (1/5 of 9 degrees or 9/5).

a. Show that these data can be modeled using a linear function.

b. Write an equation that models these data.

c. Express the equation in b. in function notation by using *F*(*C*).

d. Find the value of *F*(35) and explain what it would mean.

e. Solve 98.6 = *F*(*C*) and explain what it means.

f. What is your slope and what does it mean?

Visitors to the Grand Canyon

|  |  |
| --- | --- |
| ***Number of Years Since 1960*** | ***Number of Visitors (millions)*** |
| 0 | 1.2 |
| 10 | 2.3 |
| 20 | 2.6 |
| 30 | 3.8 |
| 40 | 4.8 |

a. Show that these data can be modeled using a linear function.

Here we see that for every increase of 10 years, the number of visitors increases by, on average, 0.9 million visitors. If we “cut” the 10 years into 10 parts (1/10 of 10 years), then we need to “cut” the 0.9 million visitors into 10 equal parts as well to preserve the proportionality (1/10 of 0.9 million visitors).

b. Write an equation that models these data.

c. Express the equation in b. in function notation by using *V*(*t*).

d. Find the value of *V*(45) and explain what it would mean.

e. Solve 6.0 = *V*(*t*) and explain what it means.

f. What is your slope and what does it mean?

Target Pulse Rate for Exercising

|  |  |
| --- | --- |
| ***Age*** | ***Target Pulse Rate (beats per minute)*** |
| 20 | 150 |
| 30 | 142 |
| 40 | 135 |
| 50 | 127 |
| 60 | 120 |
| 70 | 113 |

a. Show that these data can be modeled using a linear function.

Here we see that for every increase of 10 years of age, the target pulse rate decreases by, on average, 7.4 beats per minute. If we “cut” the 10 years into 10 parts (1/10 of 10 years), then we need to “cut” 7.4 beats per minute into 10 equal parts as well to preserve the proportionality (1/10 of 7.4 beats per minute).

b. Write an equation that models these data.

c. Express the equation in b. in function notation by using *P*(*A*).

d. Find the value of *P*(18) and explain what it would mean.

e. Solve 120 = *P*(*A*) and explain what it means.

f. What is your slope and what does it mean?