Engaging Students in Algebra Courses by Connecting Content to Context

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NADE

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A Little About Virginia Wesleyan University (VWU)

- Virginia Wesleyan has ≈1400 students
- Changed to university status May 2017
- 400 freshmen each year
- Chartered in 1961
- 4-year private liberal arts
- New online program: degree completion, MBA, Master's in Education
- Located in Virginia Beach

Presentation Components

- Literature on Connecting content to Relevant word problems
- Examples of Context activities
- Participant Context activities
- Results

What are Context Activities?

- Context activities provide a setting that is experientially relevant to the student.

(Gravemeijer, 1999)

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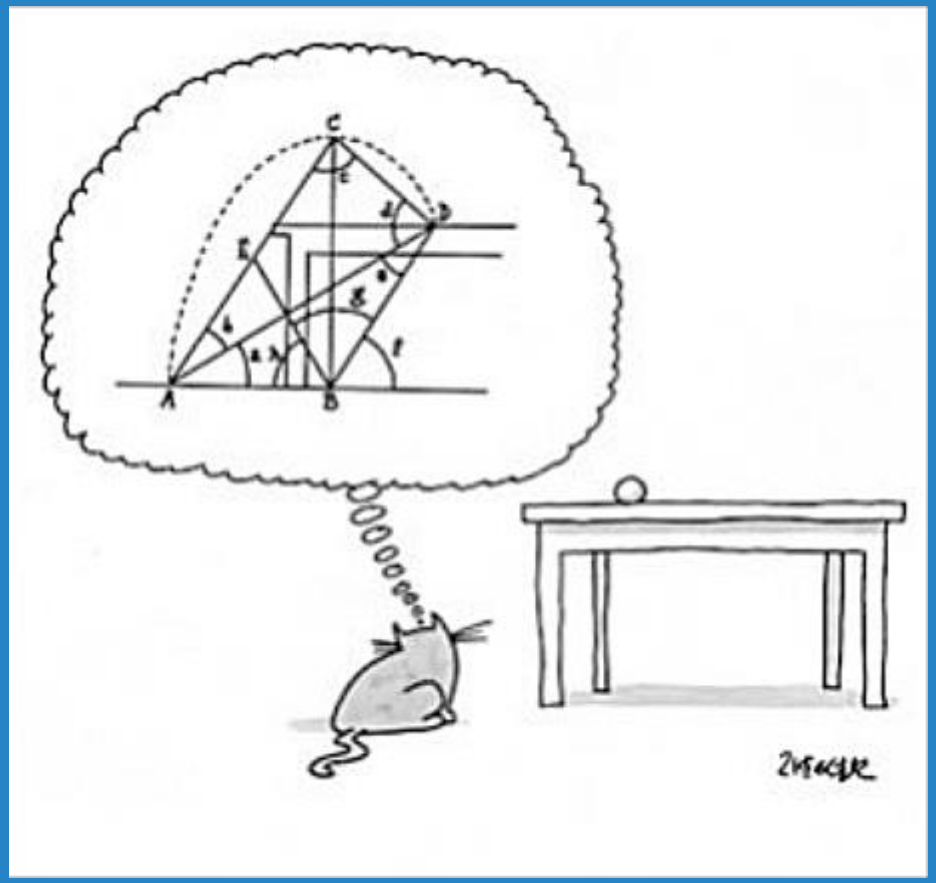
“Context” in a Cartoon



What are the Benefits?

On your notecard, write a benefit of implementing contextual activities in an algebra or mathematics class.

Content to Context

- Since context activities provide a setting that is experientially relevant to the student...

- These activities allow students to transfer a real world problem to a mathematical problem, and in the process, empower students to be active participants in the teaching-learning process.

(Gravemeijer, 1999)

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Why Contextual?

What would be the benefit of introducing the concept of slope with this image?

Slope = $\frac{\text{Rise}}{\text{Run}}$

Relatable Mathematics

NCTM stresses the importance of teaching mathematical topics to students in relatable ways that:

- Help clarify concepts, and
- Promote mathematical reasoning through student engagement and collaboration

(NTCM, 2014.)

Relatable Mathematics

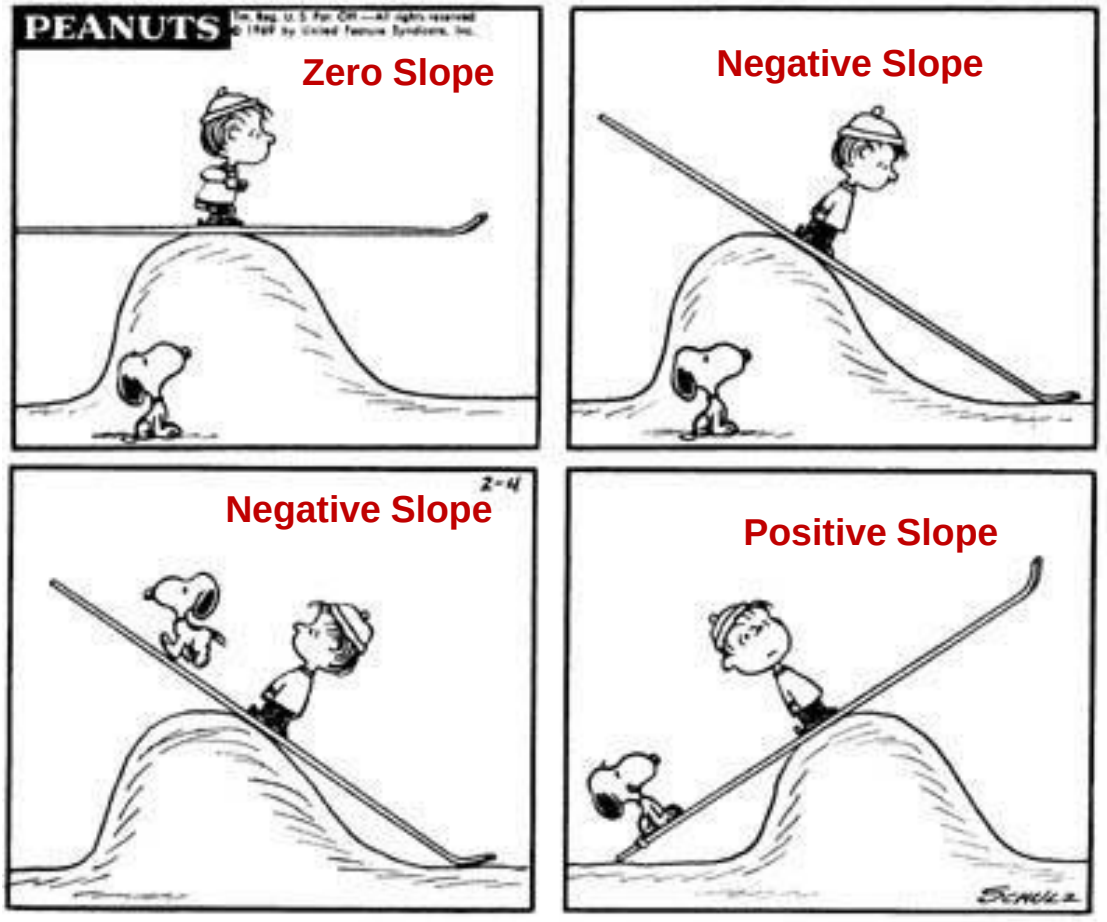
Additionally, there is value in incorporating:

- Real world problems, or
- Problems that are experientially relevant and familiar to students

(Gravemeijer, 1999)

Examples of Context Activities

Stories and Slopes



Which represents a positive slope?

Which represents a negative slope?

Which represents a zero slope?

Stories and Slopes

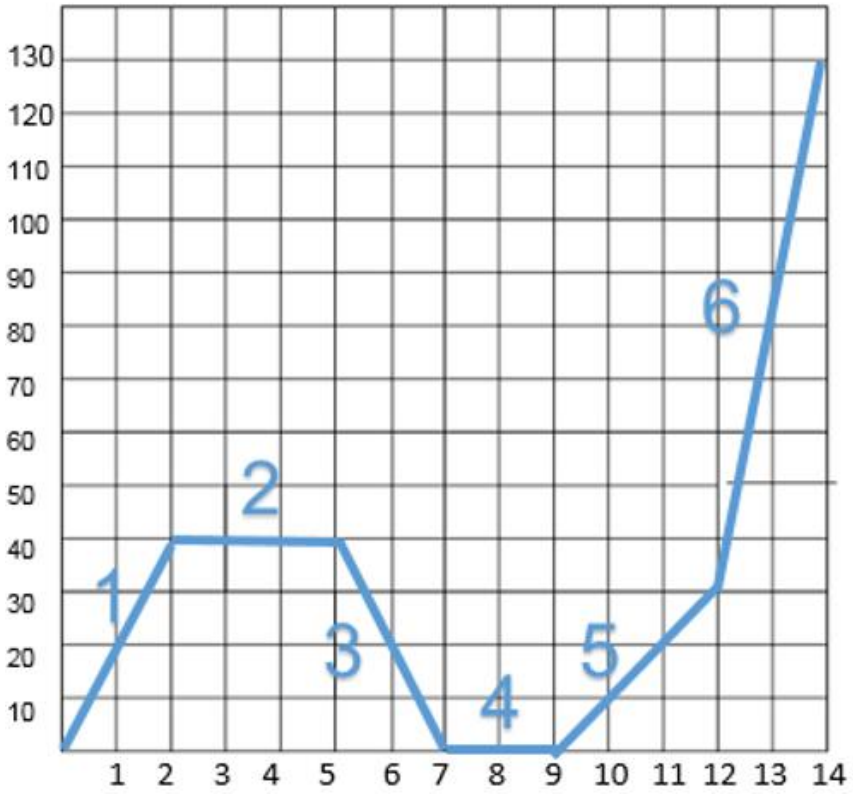
Begin the activity with an explanation of the definition of slope:

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}}$$

Continue with a few examples.

Stories and Slopes

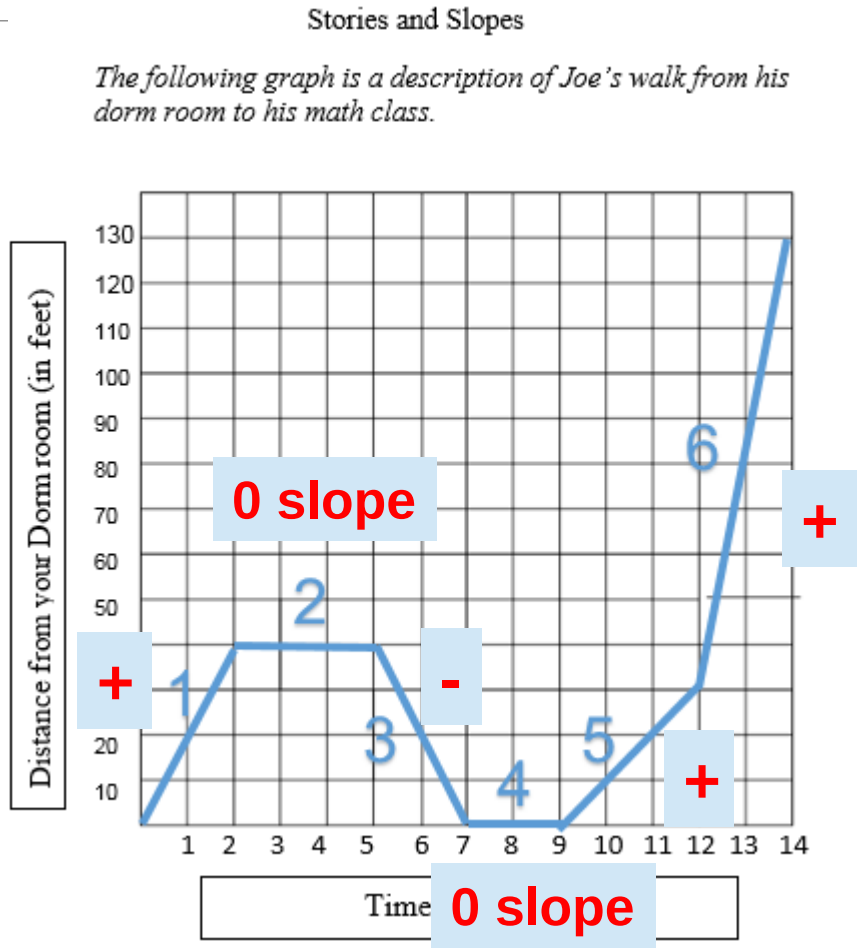
What does this graph represent? What story does it tell?



Stories and Slopes

Now what story can we tell?

Can you determine which of these slopes are positive, which are negative?

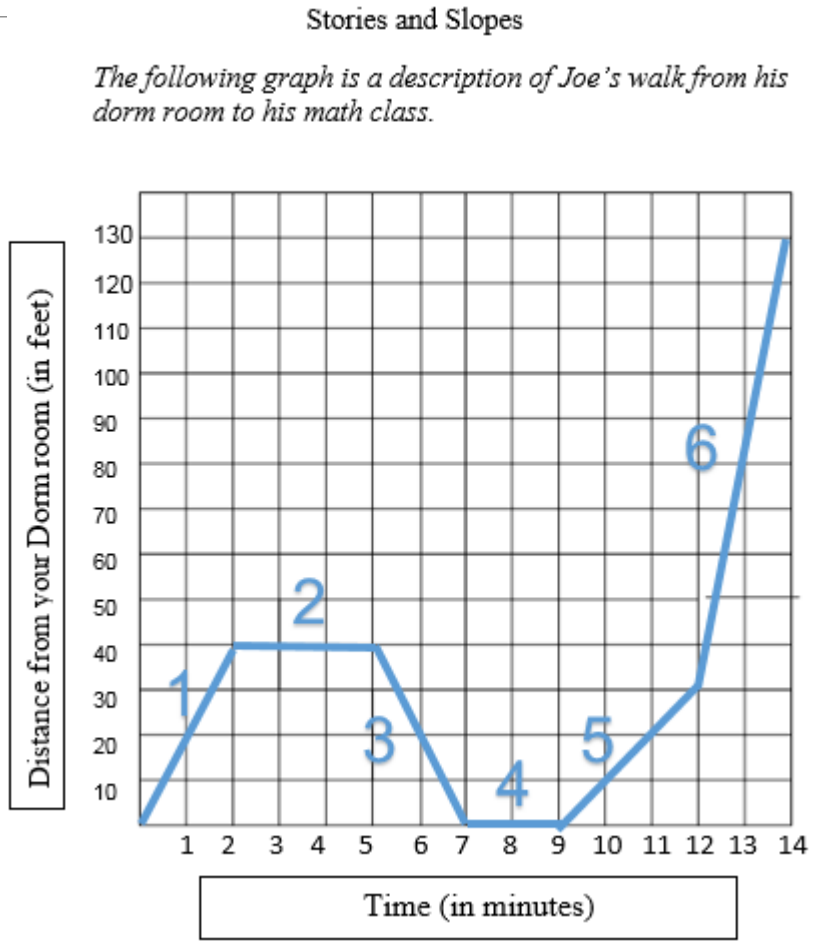


What about line segment #2 and #4?

Stories and Slopes

What else do we know?

Can you determine the **slope** of each line segment?



1) 40/2=20 ft/min

2) 0 slope

3) -40/2=-20 ft/min

4) 0 slope

5) 30/3=10 ft/min

6) 100/2=50 ft/min

Stories and Slopes

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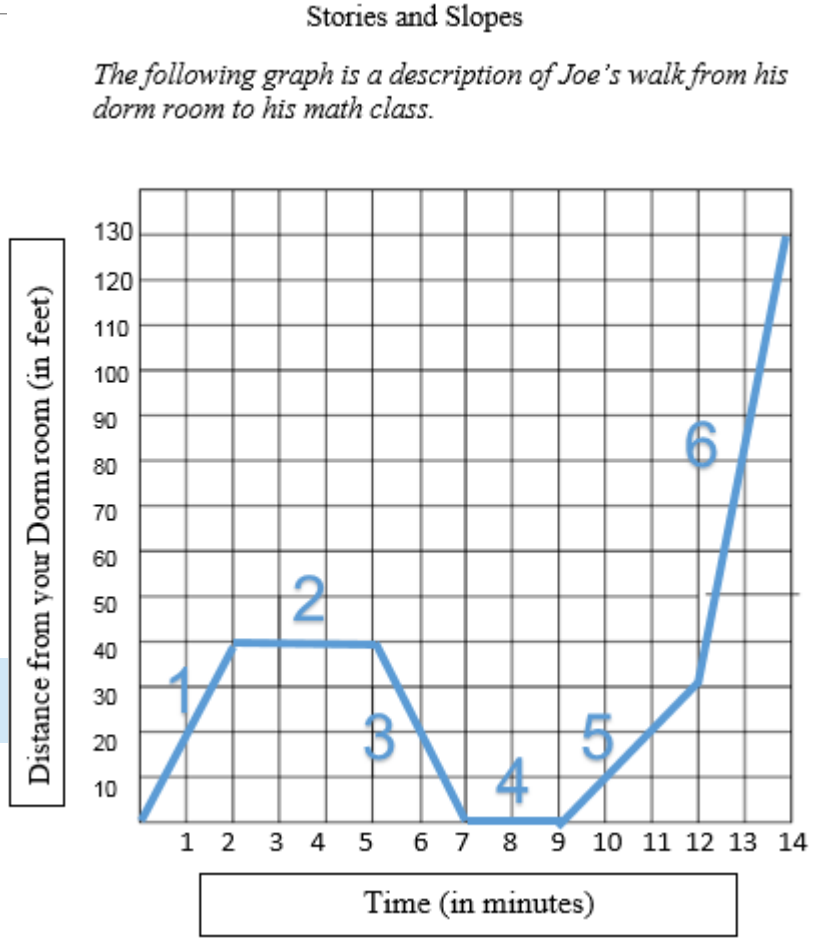


Now can you determine the **direction?** When is Joe walking: Away from his dorm?

Segments: #1,5,6

Toward his dorm?

Segment: #3

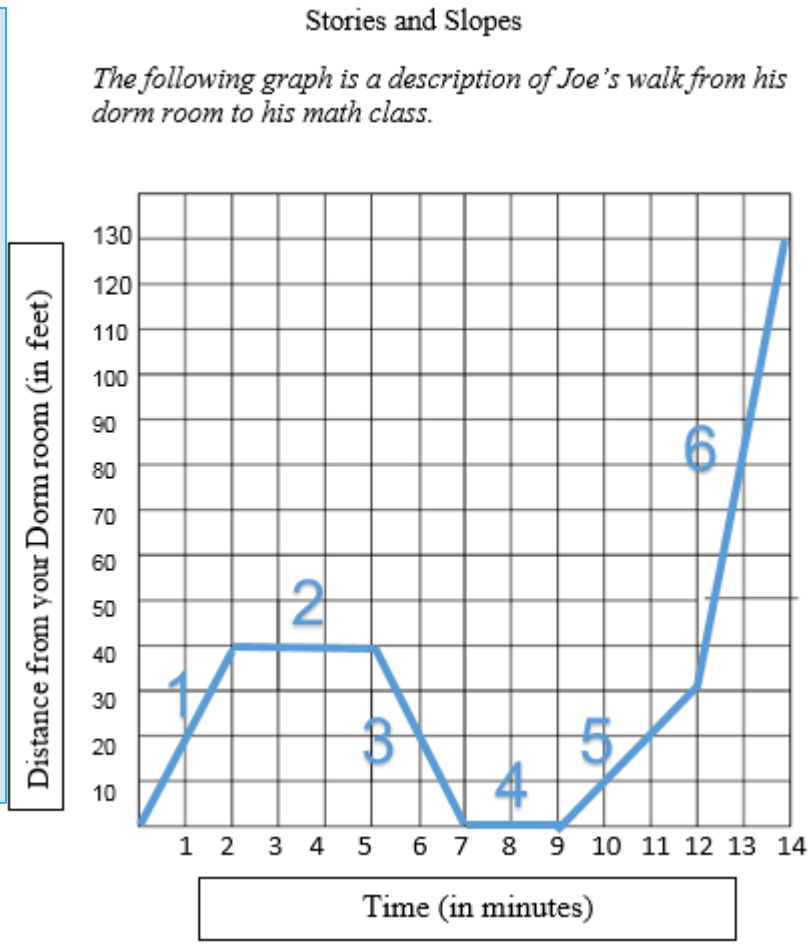
What about for segments #2and 4?

He's standing still.

Stories and Slopes

Story Time

Now students work in groups to create and **write their story of Joe walking to class** as reflected by the graph in the text box below.



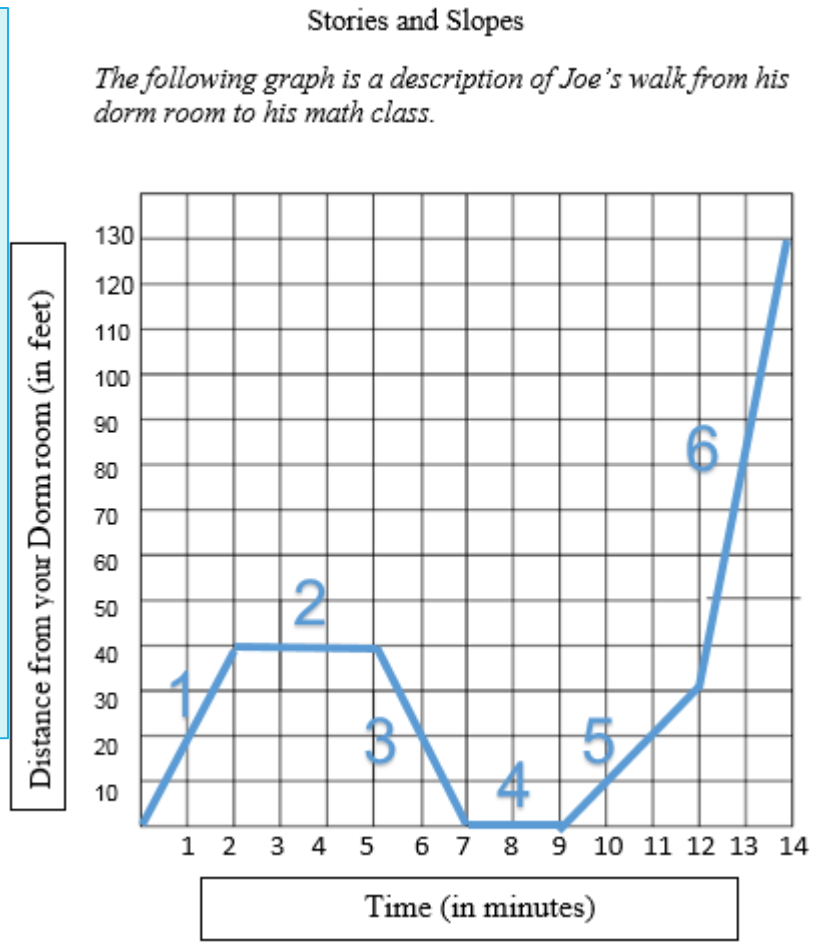
Students are required to include six sentences – each describing one of the six intervals. Your first sentence should read "Joe left his dorm room and travelled to his math class at a rate of 20 ft/min."

Stories and Slopes

Now tell your story

NADE ACTIVITY

In your group, create and **write your story of Joe walking to class** as reflected by the graph in the text box below.



You should include six sentences – each describing one of the six intervals. Your first sentence should read "Joe left his dorm room and travelled to his math class at a rate of 20 ft/min."

Stories and Slopes

Sample story

Joe left his dorm room and travelled to his math class at a rate of 20 ft/min, but ran into Sally who needed his notes for Biology class. Joe stopped to talk with Sally for 3 minutes and then realized that he left his graphing calculator in his dorm room. Because he was still on time for class, Joe returned to his room at the same rate of 20 feet/min. It took him 2 minutes to find his graphing calculator where he ran into Jeff, his roommate. Together Joe and Jeff walked to the math building at a leisurely rate of 10 feet/min. After 3 minutes, Joe looked at his Fit Bit and noticed that he was late for class so he increased his pace to 50 ft/min and hurried to his math class.

Benefits of Storytelling

Telling stories allows us to:

- Entertain and motivate our audience,
- Communicate information,
- Foster creativity,
- Connect with new friends, and
- Helps us understand the world.

- With these beneficial aspects in mind, the engagement of storytelling may enhance student learning.

(Alterio, 2003)

Stories and Slopes

And there's more: Find the equation of each line segment

Segment	Slope (label ft/min)	Ordered pair of first point of segment	Ordered pair of last point of segment	Equation of line: y = mx+b
1	20 ft/min	(0, 0)	(2, 40)	Y = 20x + 0
2	0 ft/min	(2, 40)	(5, 40)	Y = 40
3	-20 ft/min	(5, 40)	(7, 0)	Y = -20x + 140
4	0 ft/min	(7, 0)	(9, 0)	Y = 0
5	10 ft/min	(9, 0)	(12, 30)	Y = 10x - 90
6	50 ft/min	(12, 30)	(14, 130)	Y = 50x - 570

Stories and Slopes
And there's more: Further investigation

- During what period of time did Joe travel the fastest?
- How far was Joe's math class from his room?
- How long was Joe standing still and not moving?
- How far was Joe from his dorm after 4 seconds?

Operations on Polynomials and Factoring: Campus Mapping

A Map of Virginia Wesleyan University is shown below. A series of parallel and perpendicular lines are drawn in different colors with corresponding expressions representing various distances on campus. Use this map in order to answer the corresponding questions.

Operations on Polynomials and Factoring: Campus Mapping

-Find the **distance** it would take to get from the front of Blocker Hall to the front of Clarke Hall.

(2x-1)+(2x-3)+(x-5)+(3-5x^2+4x) =

-5x^2 + 9x - 6

-Find the **perimeter** of the Library.

(x^2+3x) + (x-5) + (x^2+3x) + (x-5) =

2x^2 + 8x - 10

--Find the **area** of the Library.

(x^2+3x)(x-5) = x^3+3x^2-2x-15x =

3x^3 - 2x^2 - 15x

Operations on Polynomials and Factoring: Campus Mapping

-Find the **distance** from point B to Eggleston Commons.

(x^2 + 5x - 3) - (x^2 + 3x) =

2x - 3

-Given that the area of Clarke is x^2 - x - 20, **determine the length** of Y in terms of x.

x^2 - x - 20 = ____(x – 5) =

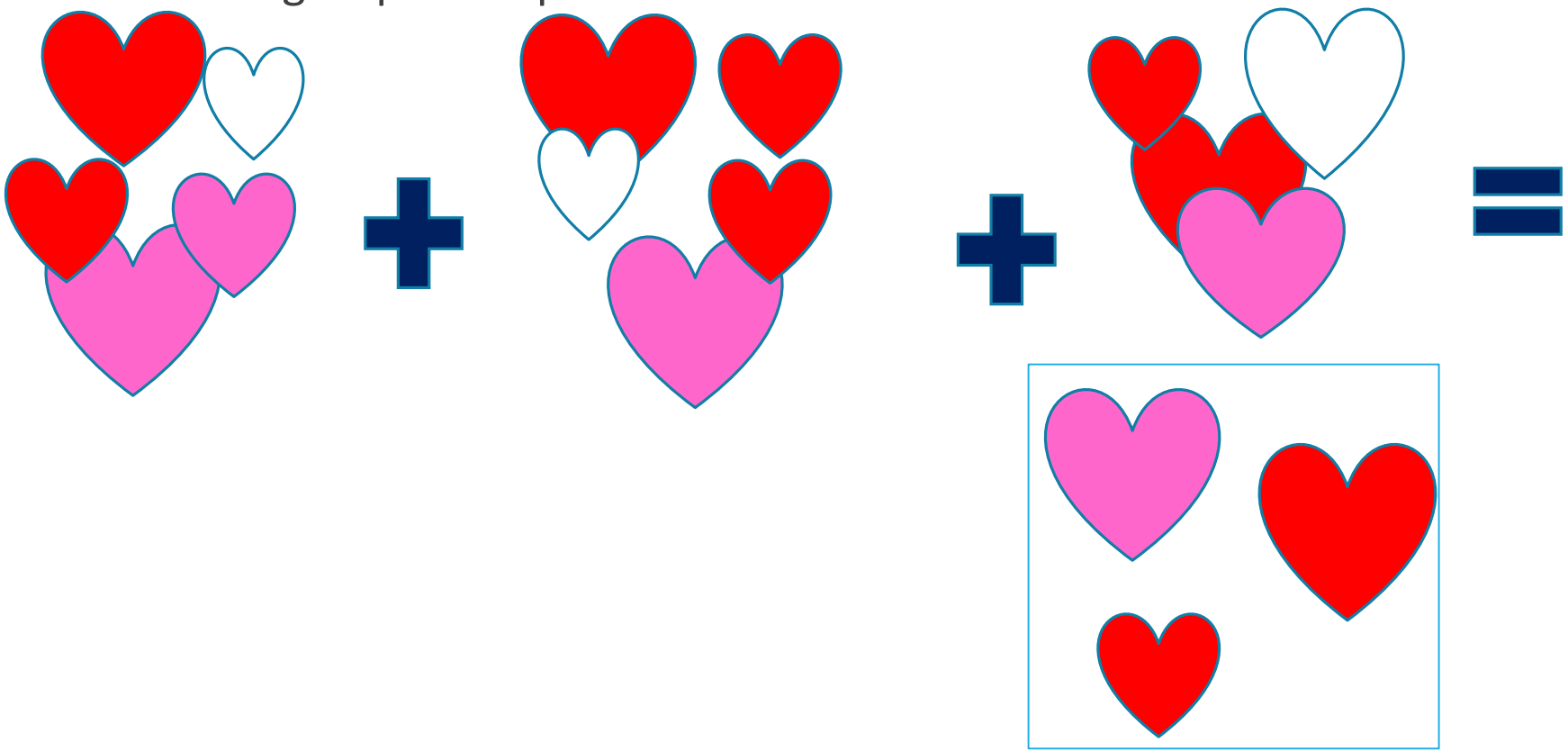
(x +4)(x - 5)

Y = x + 4

For the Love of Algebra: What's the Common Factor

Step 1

Step 1: Students find the Great Common Factor of common factor of size, shape and color in their group. Example below.



For the Love of Algebra: What's the Common Factor

Step 2: Each group finds a **UNIQUE common characteristic for each common heart** that is shared by each member of the group.

Examples:

-Has the same major and/or minor;

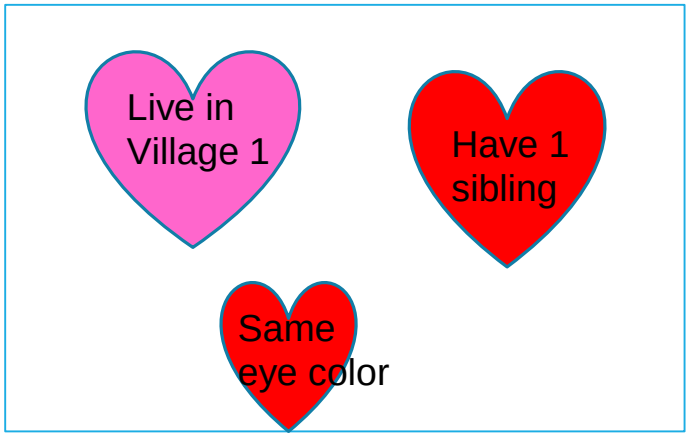
-Lives in the same residential hall; Is a commuter;

-Owns the same type of pet; Has the same number of siblings;

-Plays on a VWU sports team ; Belongs to the same or similar club or organization;

-Has a tattoo; Shares the same eye color or hair color;

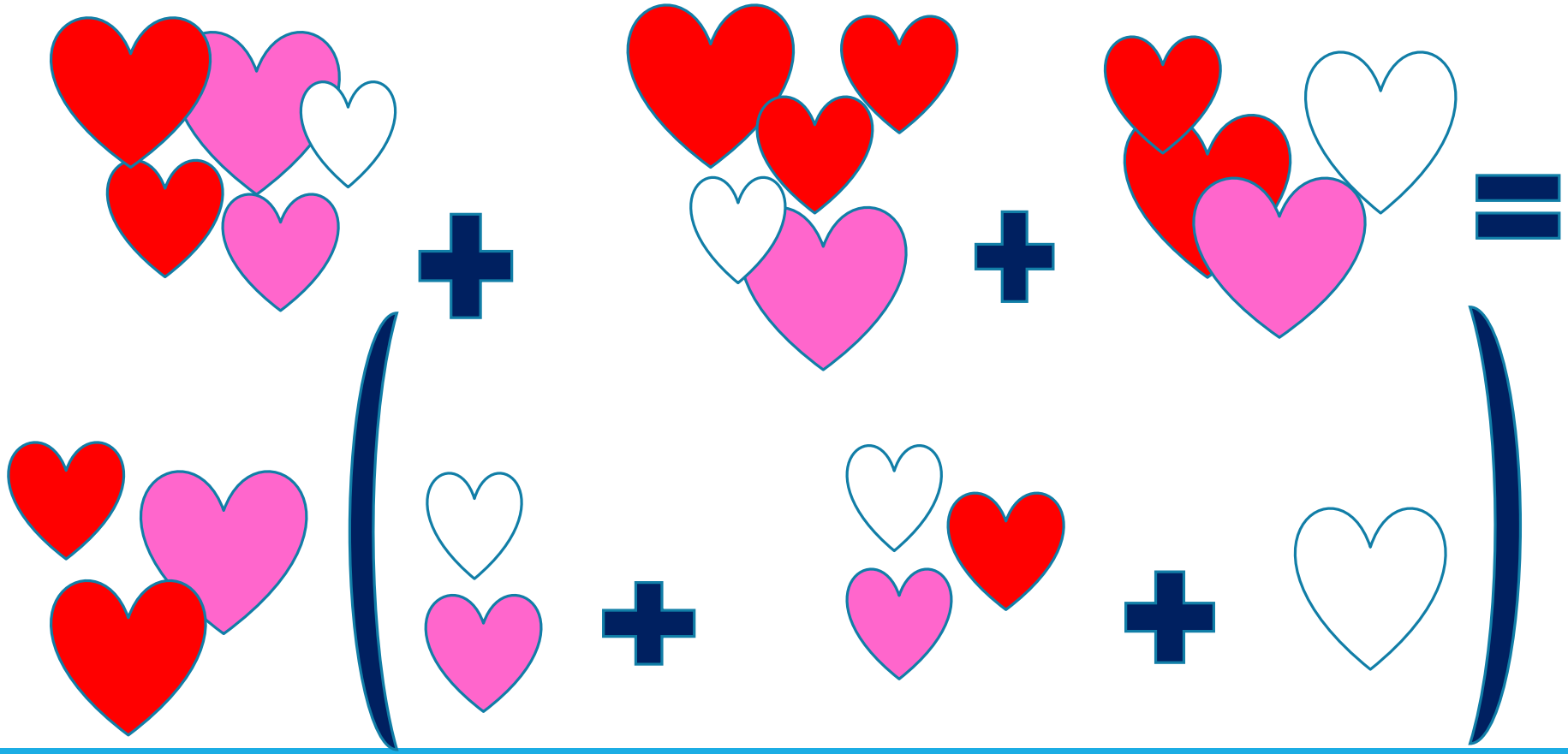
-Shares the same favorite book or movie



For the Love of Algebra: What's the Common Factor

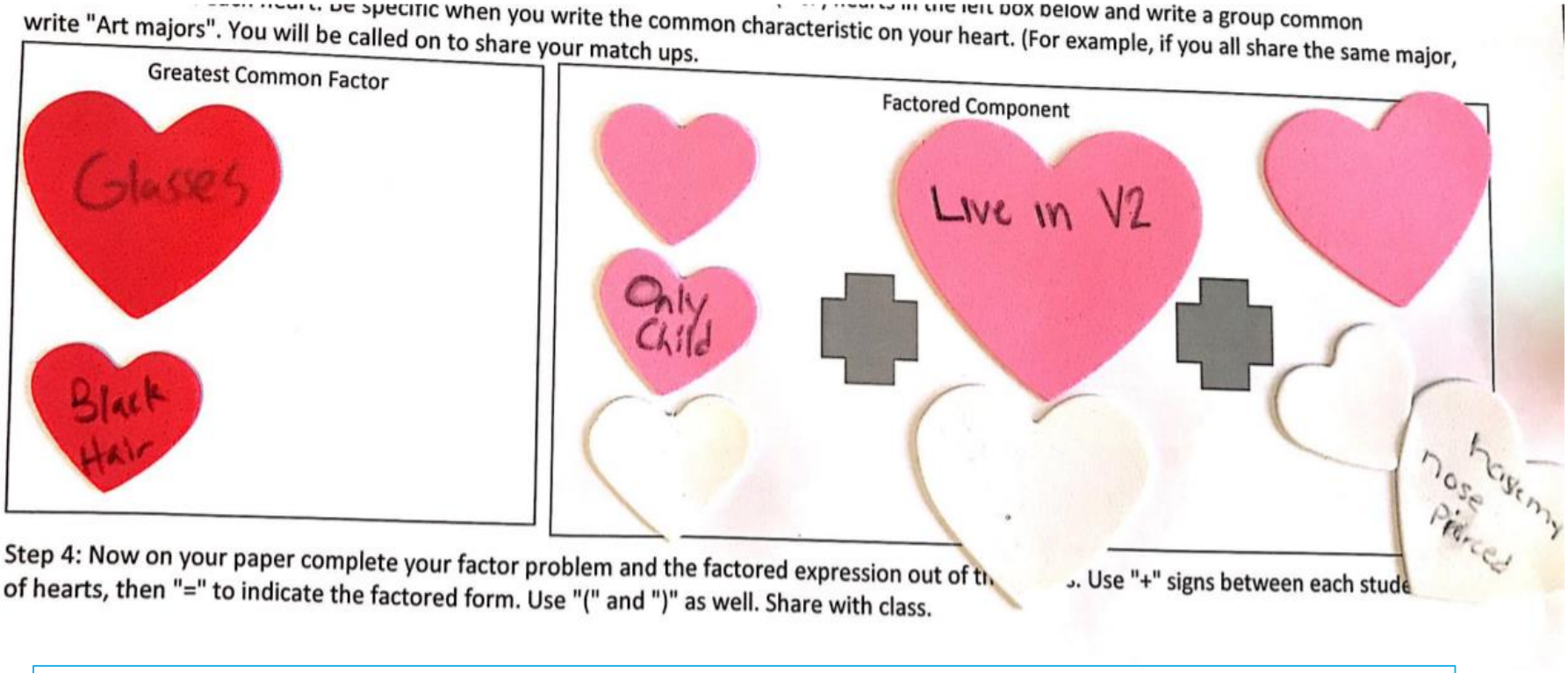
Content

Step 3: Students now create a factor problem using common hearts.



For the Love of Algebra: What's the Common Factor

Class Example

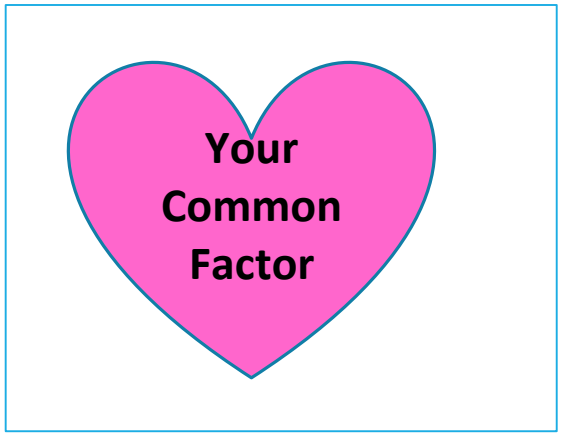


Possible Step 4:
Now label one UN-commonality for each student in your group on a heart.

For the Love of Algebra: What's the Common Factor

Name ONE Common Factor for Your Group

In your designated group, find ONE greatest Common factor using the information below. **Everyone in your group:**



- Graduated with the same major;
- Lives in the same state;
- Owns the same type of pet;
- Has the same number of siblings;
- Plays a similar sport; Belongs to a similar organization;
- Has a tattoo; Shares the same eye color or hair color;
- Shares the same favorite book or movie

Math + Community Engagement

- Relatable movie outing – Hidden Figures.

-Field trip to an escape room.

-Service to an elementary or afterschool program through tutoring or mathematics activity.

Research says…

Analysis of research compared how children learned mathematics: Math taught through routine vs learned through contextual activities.

Results: The significant difference was not about the speed and retention of learning but “what” was learned
Conclusion:
-Students who learn only by routine knowledge may not recognize when it is relevant in the situation.
-Students who learned by contextual did a better job recognizing underlying concepts.

Nunes, T.,

Results from my course…

Quiz results on students' understanding supported the value of the activity:

- After the activity, students were given an application-based quiz problem on the slope concept to solve individually.
- Ninety-one percent of the students who completed the quiz mastered the problem and answered it correctly.

Feedback from my course…(1/2)

Student feedback from an anonymous survey on their "Stories and Slopes" experiences:

Students reported:

- Their understanding of the material through their participation in the activity was improved.
- The hands-on approach was engaging and helped them remember the information.
- They could better recognize how the concept of "slope" could be applicable in the real world and applied to everyday life.

Feedback from my course…(2/2)

Student feedback from an anonymous survey on their "Stories and Slopes" experiences:

Students reported:

- The activity made it possible for them to visualize the "slope" concept in a different and helpful way.
- The storytelling has been an important part of his/her culture.
- Their appreciation for the creative aspect and group interaction of telling a group's story, as well as the value of the writing component.

Student feedback of My Math 104 Algebra and Its Applications

Journal Writing Responses:

"I like the class. Everyone supports each other and it is a very friendly class. I really enjoy the hands-on group exercises and enjoy the discussions, and how open we are to questions."

"I like that we do group projects. I feel as if I learn better with my peers."

"I like that we do different things to learn the same problems."

"I like the fun activities."

Sources

Alterio, M., & McDrury, J. (2003). *Learning through storytelling in higher education: Using reflection and experience to improve learning*. Routledge.

The Consortium for Foundation Mathematics. (2012). *Mathematics in action.* Boston, MA: Pearson Education, Inc.

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Questions?