How to Desmo-fy Your Math Lesson to Promote a Growth Mindset

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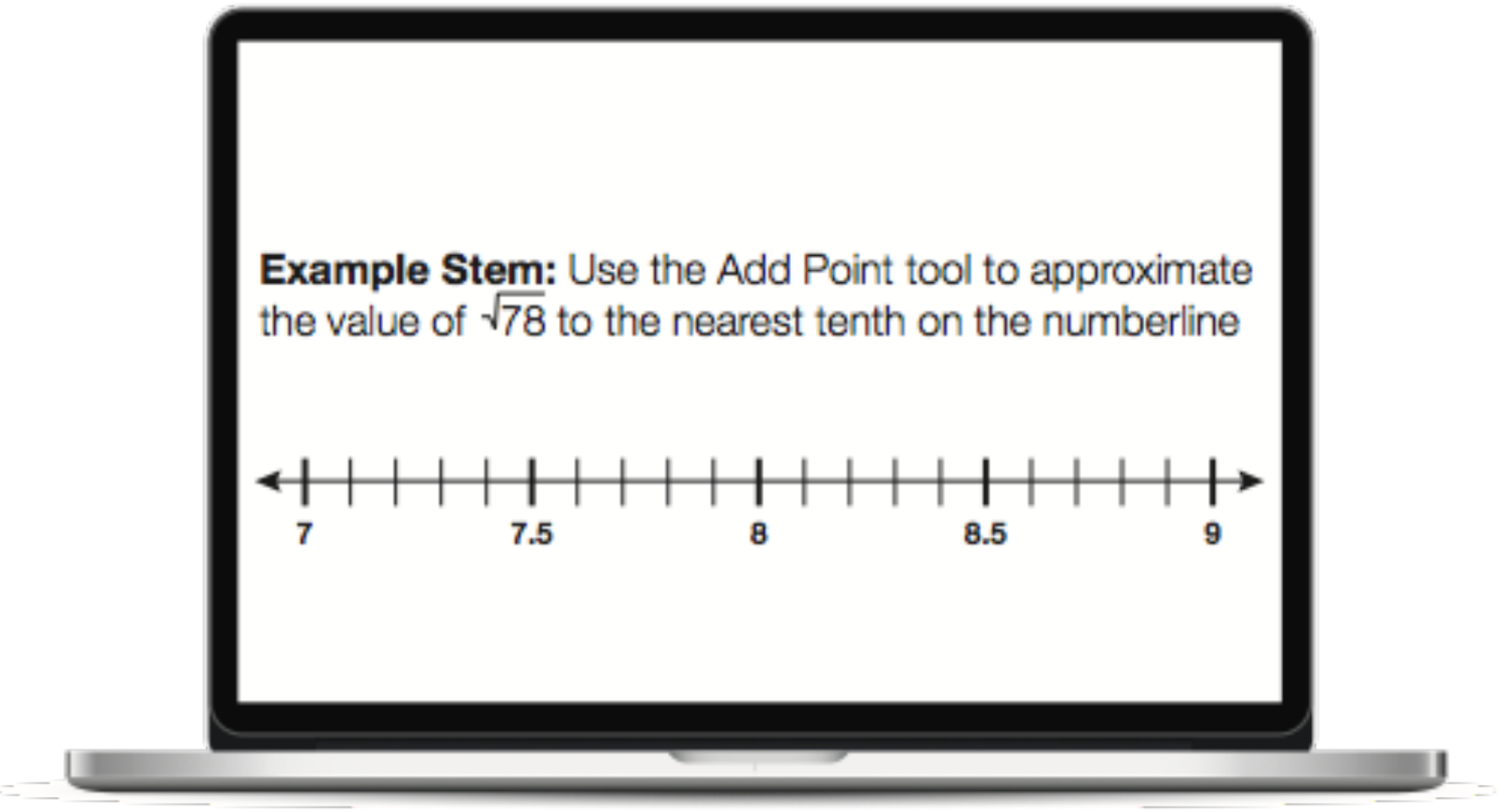
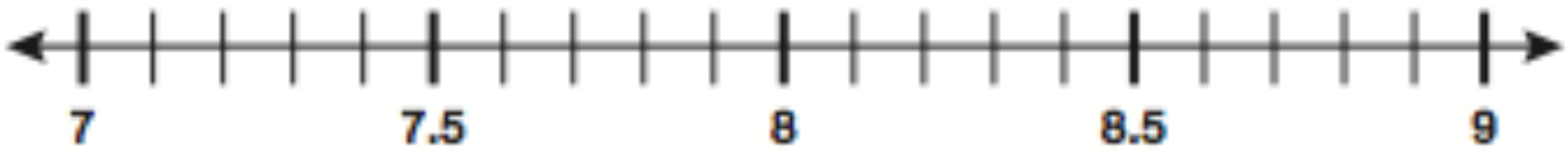
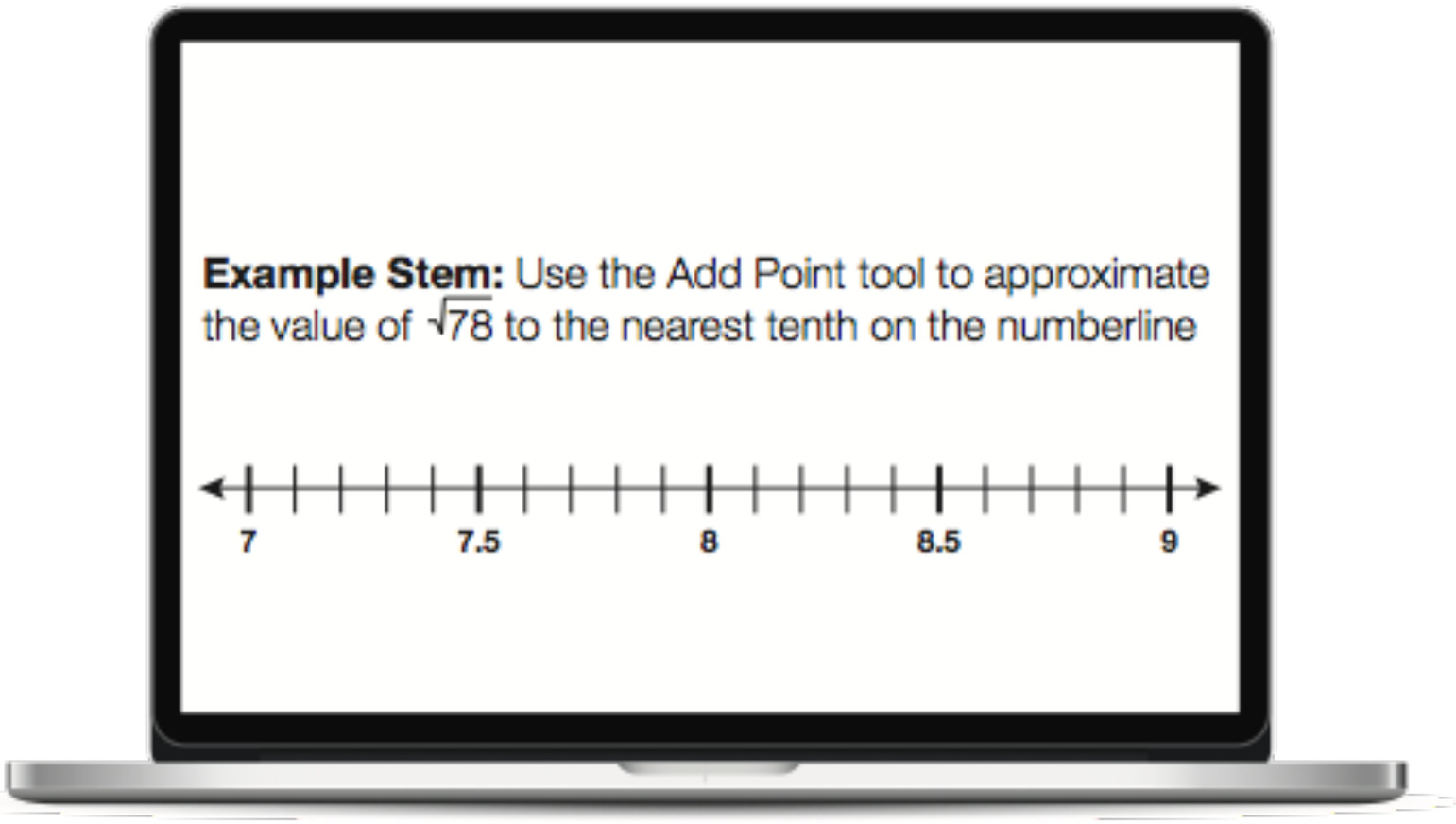


Today's Warm Up

Example Stem: Use the Add Point tool to approximate the value of $\sqrt{78}$ to the nearest tenth on the numberline





Today's Warm Up

- What might make this problem challenging for students?
- Why?

Actual Textbook Problem

- On a scale of 1 to 10, how well do you think this textbook activity helps students develop a growth mindset in solving the problem?
- Why?

Finding Square Roots and Cube Roots

The **square root** of a positive number p is x if $x^2 = p$. There are two square roots for every positive number. For example, the square roots of 36 are 6 and -6 because $6^2 = 36$ and $(-6)^2 = 36$. The square roots of $\frac{1}{25}$ are $\frac{1}{5}$ and $-\frac{1}{5}$. You can write the square roots of $\frac{1}{25}$ as $\pm\frac{1}{5}$. The symbol $\sqrt{\ }$ indicates the positive, or **principal square root**.

A number that is a **perfect square** has square roots that are integers. The number 81 is a perfect square because its square roots are 9 and -9.

The **cube root** of a positive number p is x if $x^3 = p$. There is one cube root for every positive number. For example, the cube root of 8 is 2 because $2^3 = 8$. The cube root of $\frac{1}{27}$ is $\frac{1}{3}$ because $\left(\frac{1}{3}\right)^3 = \frac{1}{27}$. The symbol $\sqrt[3]{\ }$ indicates the cube root.

A number that is a **perfect cube** has a cube root that is an integer. The number 125 is a perfect cube because its cube root is 5.

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EXAMPLE 3

CA CC 8.EE.2

Solve each equation for x.

A $x^2 = 121$

$x^2 = 121$ — Solve for x by taking the square root of both sides.

$x = \pm\sqrt{121}$ — Apply the definition of square root.

$x = \pm 11$ — Think: What numbers squared equal 121?

The solutions are 11 and -11.

B $x^2 = \frac{16}{169}$

$x^2 = \frac{16}{169}$ — Solve for x by taking the square root of both sides.

$x = \pm\sqrt{\frac{16}{169}}$ — Apply the definition of square root.

$x = \pm\frac{4}{13}$ — Think: What numbers squared equal $\frac{16}{169}$?

The solutions are $\frac{4}{13}$ and $-\frac{4}{13}$.

C $729 = x^3$

$\sqrt[3]{729} = \sqrt[3]{x^3}$ — Solve for x by taking the cube root of both sides.

$\sqrt[3]{729} = x$ — Apply the definition of cube root.

$9 = x$ — Think: What number cubed equals 729?

The solution is 9.

D $x^3 = \frac{8}{125}$

$\sqrt[3]{x^3} = \sqrt[3]{\frac{8}{125}}$ — Solve for x by taking the cube root of both sides.

$x = \sqrt[3]{\frac{8}{125}}$ — Apply the definition of cube root.

$x = \frac{2}{5}$ — Think: What number cubed equals $\frac{8}{125}$?

The solution is $\frac{2}{5}$.

Math Talk
Mathematical Practices

Can you square an integer and get a negative number? What does this indicate about whether negative numbers have square roots?

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Mathematical Practices

Can you square an integer and get a negative number? What does this indicate about whether negative numbers have square roots?

EXPLORE ACTIVITY

CA CC 8.NS.2, 8.EE.2

Estimating Irrational Numbers

Irrational numbers are numbers that are not rational. In other words, they cannot be written in the form $\frac{a}{b}$, where a and b are integers and b is not 0. Square roots of perfect squares are rational numbers. Square roots of numbers that are not perfect squares are irrational. Some equations like those in Example 3 involve square roots of numbers that are not perfect squares.

$x^2 = 2$ $\quad$ $x = \pm\sqrt{2}$ $\quad$ $\sqrt{2}$ is irrational.

Estimate the value of $\sqrt{2}$.

A Find two consecutive perfect squares that 2 is between. Complete the inequality by writing these perfect squares in the boxes.

$\square < 2 < \square$

B Now take the square root of each number.

$\sqrt{\square} < \sqrt{2} < \sqrt{\square}$

C Simplify the square roots of perfect squares.

$\square < \sqrt{2} < \square$

$\sqrt{2}$ is between _____ and _____.

D Estimate that $\sqrt{2} \approx 1.5$.

E To find a better estimate, first choose some numbers between 1 and 2 and square them. For example, choose 1.3, 1.4, and 1.5.

Actual Textbook Problem

- On a scale of 1 to 10, how well do you think this textbook activity helps students develop a growth mindset in solving the problem?
- Why?

EXPLORE ACTIVITY

CA CC 8.NS.2, 8.EE.2

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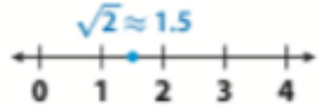


E To find a better estimate, first choose some numbers between 1 and 2 and square them. For example, choose 1.3, 1.4, and 1.5.

$1.3^2 =$ _____ $1.4^2 =$ _____ $1.5^2 =$ _____

Is $\sqrt{2}$ between 1.3 and 1.4? How do you know?

_____

_____

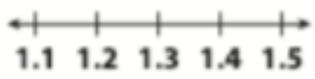
Is $\sqrt{2}$ between 1.4 and 1.5? How do you know?

_____

_____

2 is closer to _____ than to _____, so $\sqrt{2} \approx$ _____.

F Locate and label this value on the number line.



Snapshots

Meet Blu...

Meet Pur...

Imagine that

Hey, students!

Go to student.desmos.com
and type in:

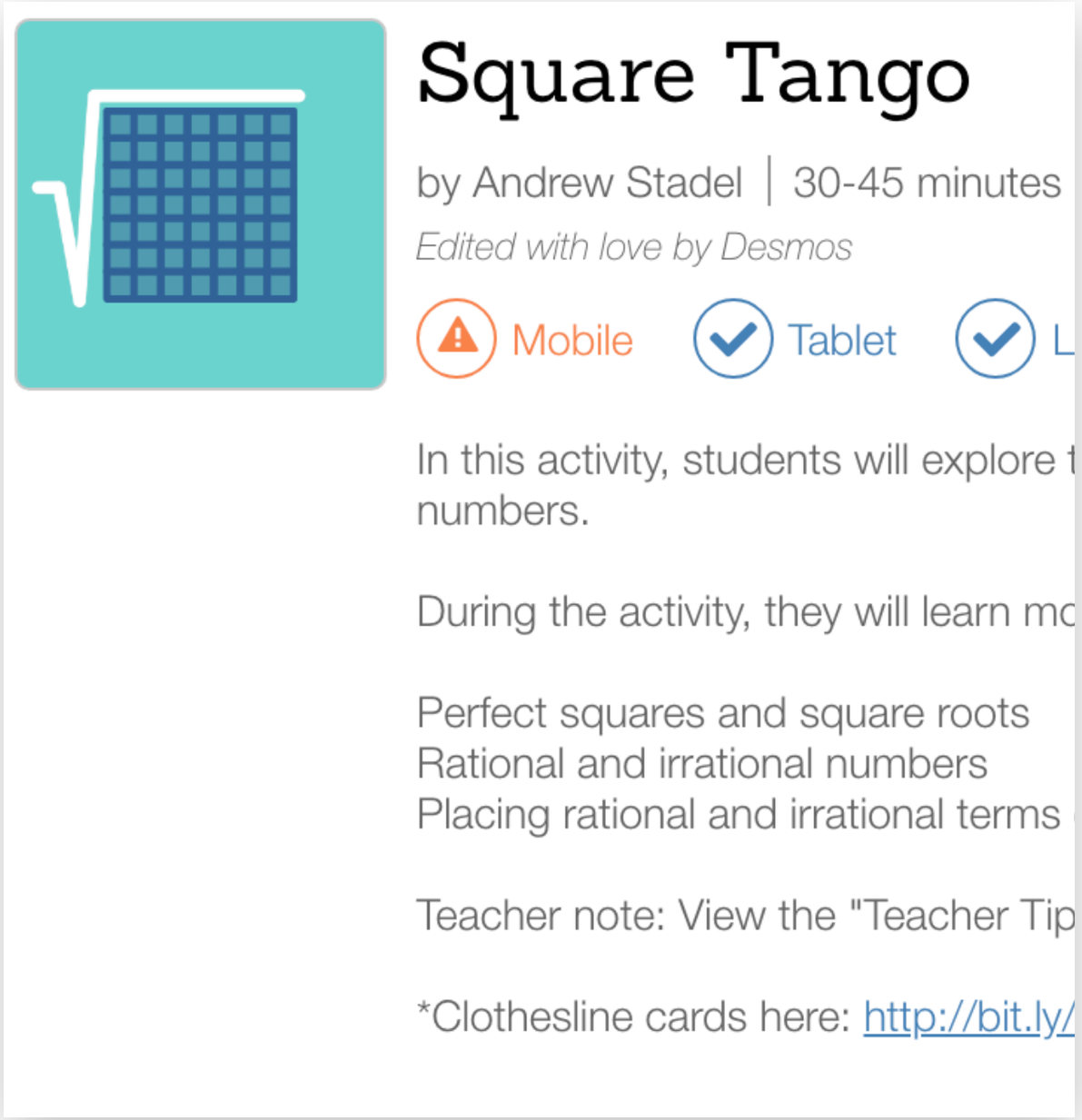
A22 84N

You can also share this link with your students:

https://student.desmos.com/?prepopulateC

What Were the Key Features of This Activity?

- "Safe" (what does that even mean?)
- Engaging
- Low floor (accessible, sense making)
- High ceiling (rigorous, reasoning)
- Open ended questions
- Multiple representations
- Multiple solution pathways
- Opportunities to explore and revise thinking



What Are the Key Features of These Activities?

ACTIVITY RUBRIC

TASK ALIGNMENT

#1 Does the task require mathematical activity? (Yes = 1 / No = 0) **Score #1 _____**

#2 Does the task go beyond memorizing or reproducing facts, rules, formulae, or definitions (e.g., recalling, repeating)? (Yes = 1 / No = 0) **Score #2 _____**

#3 Is the mathematical content of the task appropriate for the grade level standards being addressed? (Yes = 1 / No = 0) **Score #3 _____**

(Score #1 + Score #2 + Score #3) ➡ Subtotal 1_____

If "Subtotal 1" = 3 **CONTINUE** on to next sections

If "Subtotal 1" < 3 **DO NOT** continue and copy "Subtotal 1" to "Total" below

---

FOCUS **Focus Score _____**

The task or problem in the artifact…

0. focuses solely on arriving at ***the*** desired, correct answer, or
1. focuses on ***developing mathematical understanding*** on the way to arriving at ***the*** correct answer, or
2. focuses on ***developing mathematical understanding***, and allows for ***multiple solutions*** (correct and incorrect) to the task or problem.

EXPLORATION **Exploration Score _____**

The task or problem in the artifact…

0. has ***no ambiguity*** and relies solely on procedures that are specifically laid out in the activity OR procedures that rely on what students have already learned previously (e.g., instructions call on previous assignments or learning activities), or
1. has ***some* ambiguity** about what needs to be done and/or how to do it (e.g., room for trial and error), or
2. contains a ***higher level of ambiguity*** and engages students in *exploring and understanding* the nature of mathematical concepts, procedures, and/or relationships while coming to (a) solution(s) or (a)

Field Trip Problem

What are some of the most important ideas in teaching linear functions?

student.desmos.com code: PX9 5HX

Field Trip Problem

by Ivan Cheng Created by you

Edited with love by Matthew Kim

Mobile Tablet Laptop

This introductory activity explores the key featu
This activity could be used for 8.EE.5, 8.EE.6,

Fast and Furious

What are some of the most important ideas in teaching systems of equations?

student.desmos.com code: 4QE G95

Fast and Furious (Systems of Equations)

by Ivan Cheng Created by you

Mobile Tablet Laptop

This is an introductory activity to help students

Roller Coaster Parabola

What are some of the most important ideas in teaching parabolas?

student.desmos.com code: 3RB E8U

Roller Coaster Parabo

by Ivan Cheng Created by you

Mobile Tablet Laptop

In this activity, you will explore the relationship

The URL shortcut for this activity is https://tiny

Photo Album Transformation

What are some of the most important ideas in teaching dilations?

student.desmos.com code: TZM 9MQ

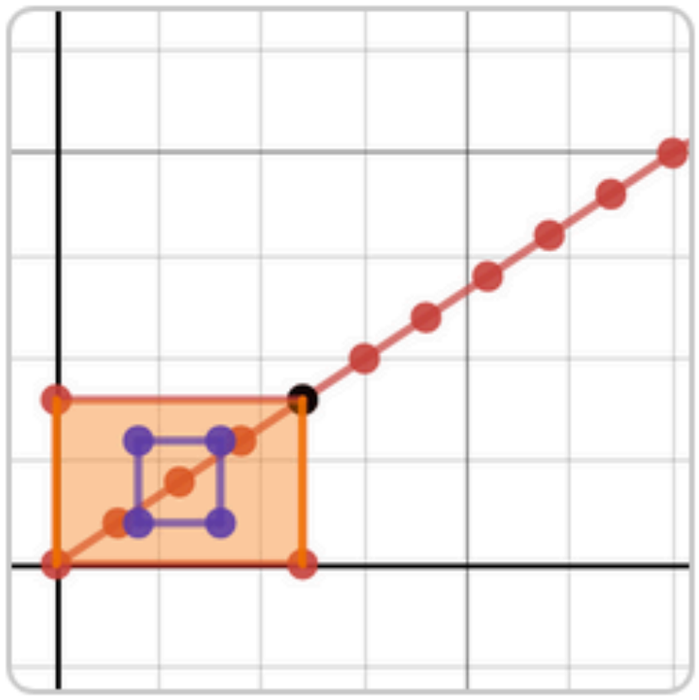


Photo Album Transfc

by Ivan Cheng Created by you

Mobile Tablet Laptop

Dilations can be explored through the example
distorting it.

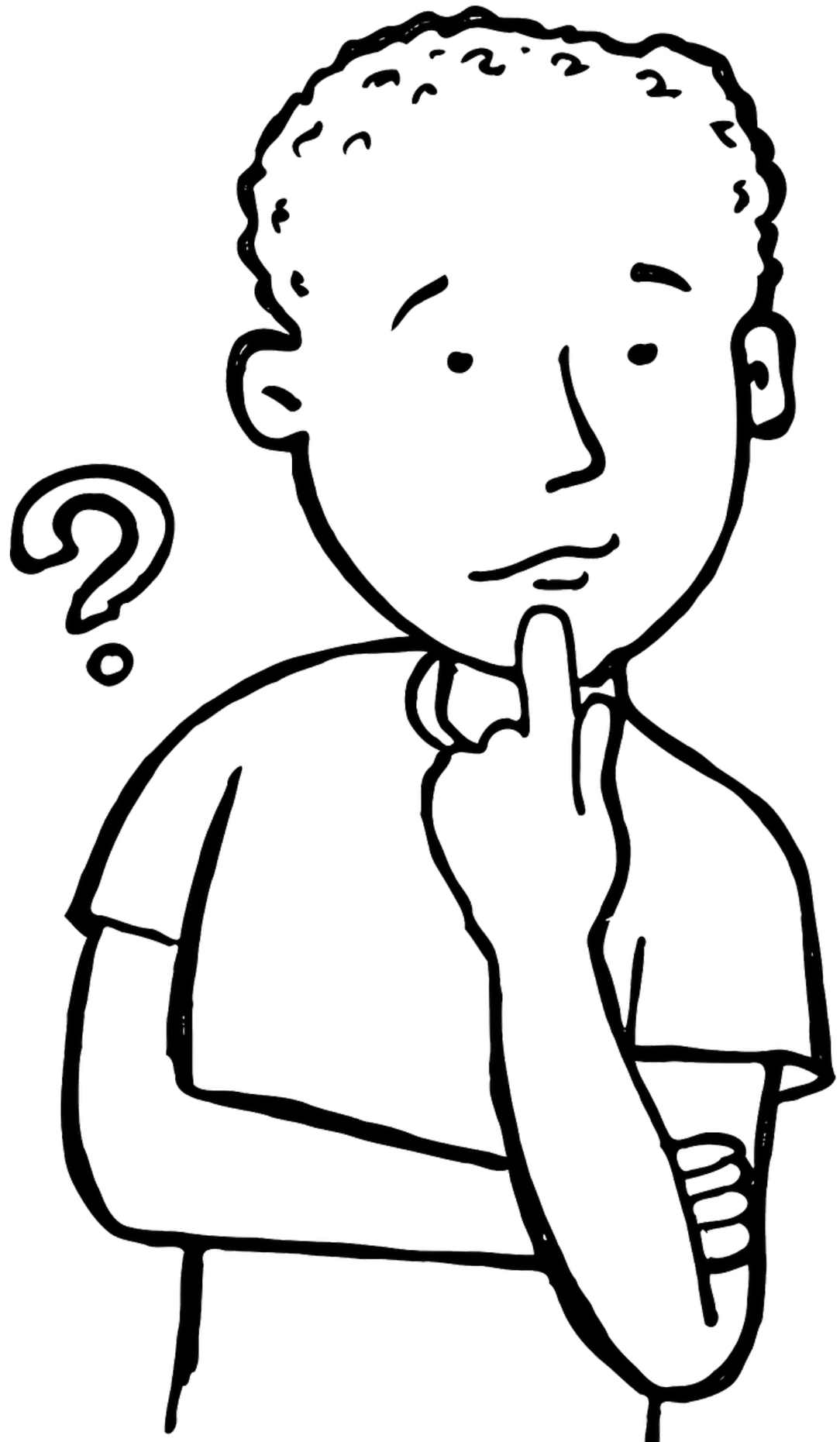
The URL shortcut for this activity is https://tiny

Tips

How to create Desmos activities that promote a growth mindset

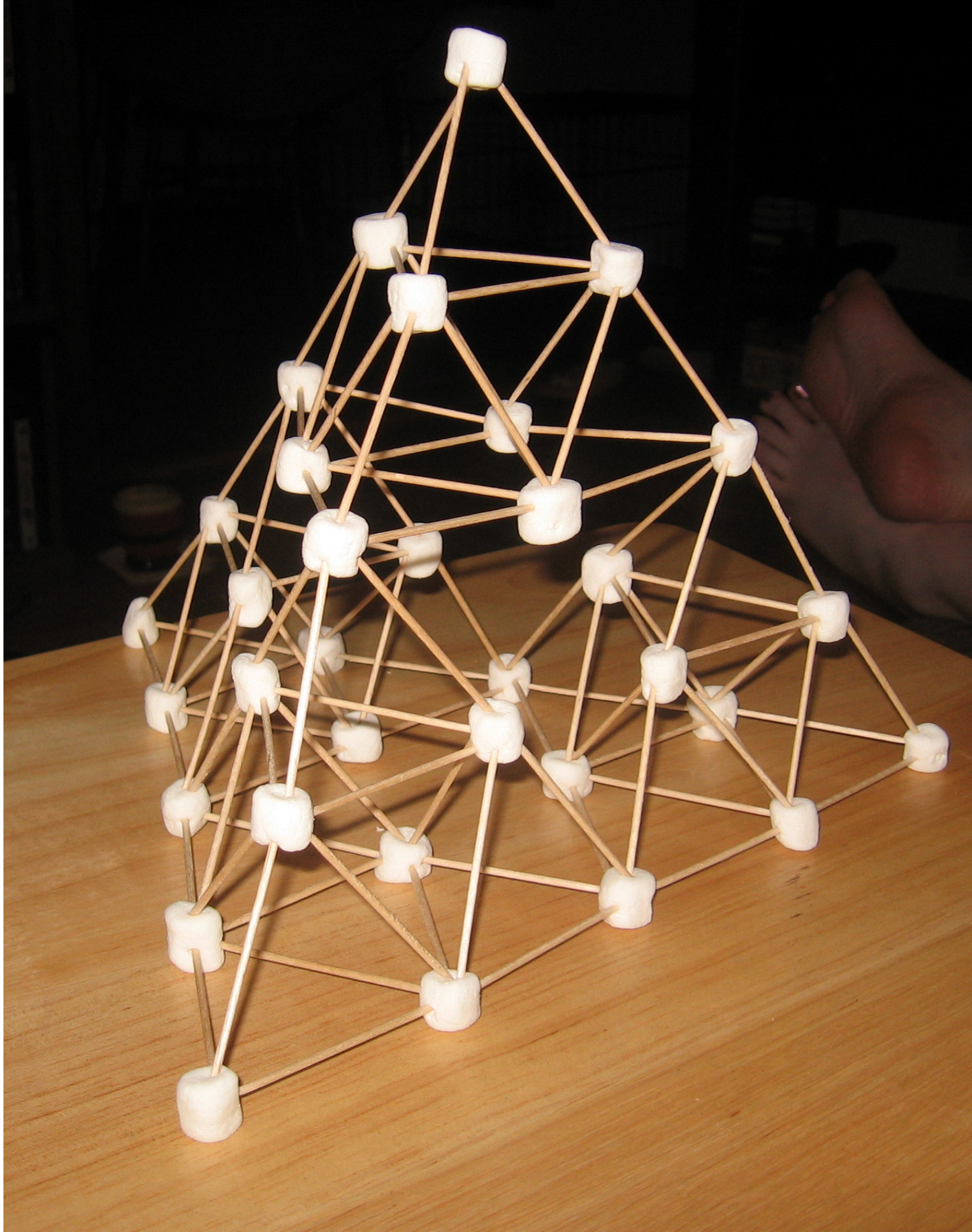
Start on Paper

Focus on "Noticings" and "Wonderings"



3 Copy What's Available

4 Modify and Build



5. Make it Dynamic

6. Let the Students…

Teach Themselves

Let's Build

What are some of the most important ideas in teaching slope?

Thank You!

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