

# Facilitation Guide for The Dynamic Tent and The Changing Kite Techivities

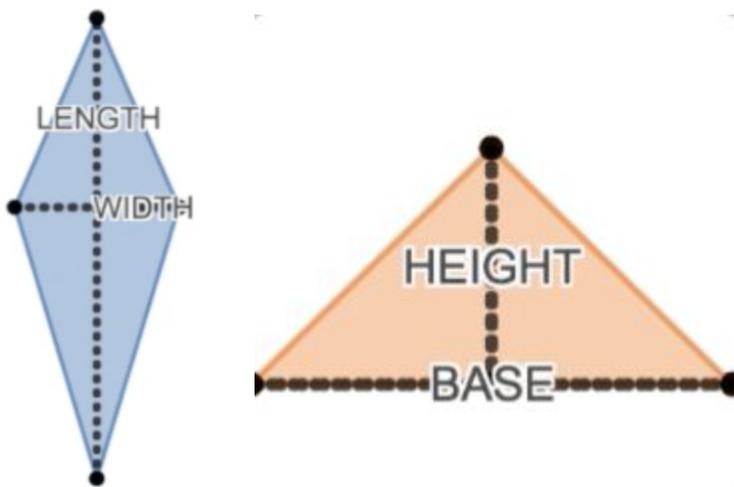
**Can a single point on a graph represent different moments in an animation?**

**(estimated time ~50 minutes for both Techivities)**

Students have many opportunities to use graphs to represent relationships shown in animations. In these activities, the animations “keep going,” while the graphs stay the same. The activities help students build on the key understanding that points represent relationships between variables.

If two variables have the same relationship in different moments of an animation, then the same point on a graph can represent both moments. For example, in the Dynamic Tent, the height gets larger, then smaller. When the height is getting larger, the relationship between the height and the base is the same as when the height is getting smaller. Therefore, a single point is enough to show the relationship in both moments. Even though the animation keeps going, the graph does not have to keep going along with it.

In the Dynamic Tent, the height is a function of the base, and the base is a function of the height. In the Changing Kite, the length is a function of the width, and the width is a function of the length. In these activities, students can reason about relationships between variables to investigate inverse functions. However, students do not need to be familiar with inverse functions to use these activities.



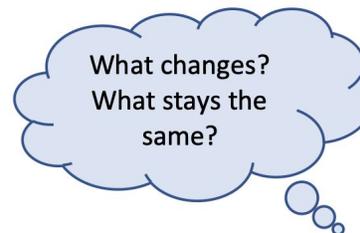
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The Dynamic Tent and Changing Kite use Teacher Desmos. If you are new to Teacher Desmos, start with the Techivities User Guide (on the last page) to set up your class code and prepare for the use of Techivities.

## Facilitation Guide for The Changing Kite

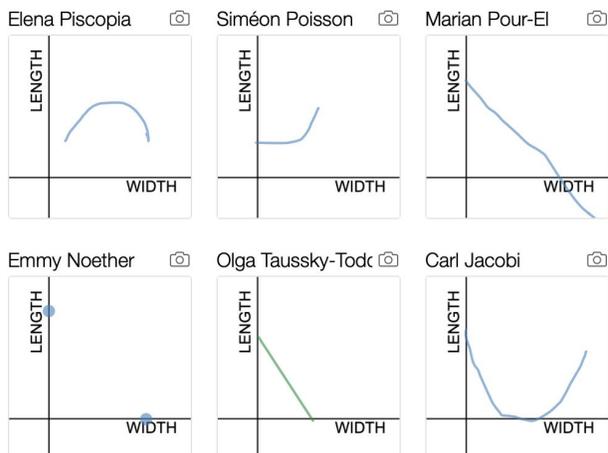
### 1. Set Teacher Pacing

After students sketch their own graphs, they can see a computer graph. To give students opportunities to reflect on their graphs, set up [teacher pacing](#). To begin, restrict students to Screens 1-5, so students cannot rush through the activity. If students finish their graphs early, tell them to share their graphs with other students.



### 2. Show Student Work, then Discuss.

Show different students' graphs to give a range of possible responses. Choose graphs with features that students can compare and contrast. For example, some students may sketch graphs with a smooth curve. Other students may sketch line graphs.



From the teacher dashboard, go to Screen 5. Select “Responses” to display individual student graphs. Before projecting responses, anonymize student names.

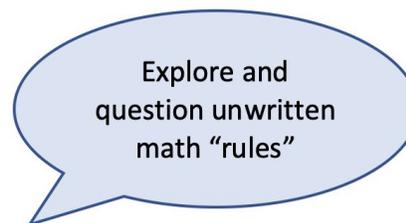
Once students see others' graphs they may want to change their answers. Tell students to avoid “fixing” their graphs.

To encourage student talk, post discussion questions. Tell students to discuss in small groups or write down their reflections. Below are a few sample questions.

- *How are the graphs similar? How are they different?*
- *Describe the relationship between the length and width in one of the graphs above.*
- *The graph on the lower left shows two points. What would a kite represented by each of those points look like? How do you know?*

### 3. Promote Student Reasoning

Now restrict students to Screens 1-12. When students see the computer graph on Screen 6, they may want to fix their graph. Tell students not to erase the graph they drew first. Encourage students to explain their thinking in the box on Screen 7. Students may be surprised by the way the graph in Screen 6 retraces itself.

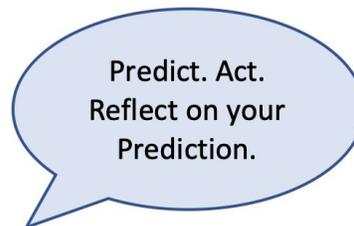


Students may think that a static graph is not enough to show the kite getting smaller and larger. Ask students if the same size kite happens more than once in the animation. Encourage them to explore and ‘break the rules’ to make sense of the situation.

4. *Focus on Student Thinking*

Have students engage in a three part process: Predict, Act, and Reflect on the Prediction.

On Screen 8 students **predict** whether there are any different widths that have the same length for this kite. Next students **act** on their predictions. Tell them to share their prediction with a partner. Now students **reflect** on their predictions. Display sample responses that highlight student thinking. Highlight sample responses that link the attributes of width and length to what they see happening in the animation.



5. *Debrief the Techtivity*

On the final screen, students reflect on a statement from a hypothetical student, Cam. Students respond before they see class results.

From the teacher dashboard, teachers can view the total number of students in each response category. Once most students have responded, display the responses.

Students may want to change their mind after they see others' responses. Allow students to do this. If students change their minds, ask them what convinced them.

Cam noticed that the length and width of the kite decreased and increased. Cam wonders how the graph shows this.

How would you respond to Cam?

Julia Robinson

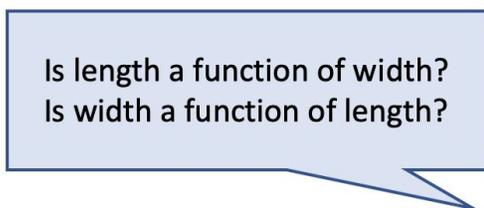
if you move along the decreasing direction of the length, you will notice the width is also decreasing.

Grigory Margulis

Since the graph traces over itself this graph can model more than one situation. We can't tell where the graph starts or ends since we don't have time as a parameter.

6. *After the Techtivity*

Give students an opportunity to reflect on their work and make further connections. You can do this with a "[convince yourself, convince a friend, convince a skeptic](#)" activity.



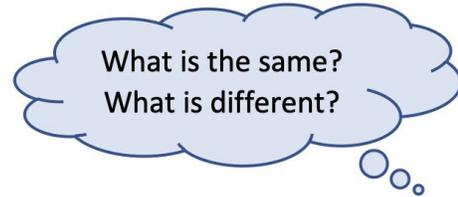
Focus on two questions: Is length a function of width? Is width a function of length? First, have students convince themselves. Then have students convince a friend. Then, ask students to be skeptics, to ask questions of each other. For example, "What does it mean for length to be a function of width?" "How can you tell?"

\*For more on the "Convince yourself, Convince a friend, Convince a skeptic" activity, see: Boaler, J. (2019). Prove it to me! *Mathematics Teaching in the Middle School*. 24(7), 422-428.

## Facilitation Guide for The Dynamic Tent

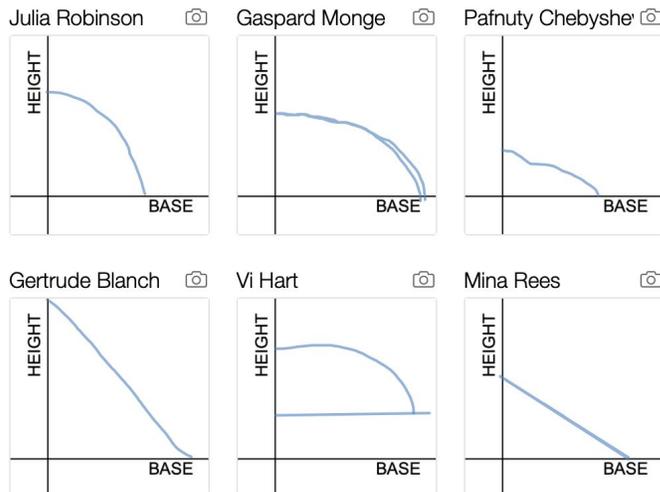
### 1. Set Teacher Pacing

To begin, restrict students to Screens 1-5, so they cannot rush through the activity. If students finish their graphs early, encourage them to share their graphs with other students. Have students compare what is similar and what is different.



### 2. Focus on Relationships

From the teacher dashboard, go to Screen 5. Select "Responses" to display individual student graphs. Before projecting responses, anonymize student names.



Show different students' graphs to give a range of possible responses. Choose graphs with features that students can compare and contrast.

Write questions on the board, and tell students to discuss in small groups. Walk around the room and listen to student responses. When you hear an interesting response, ask permission to call on that student and have them share their reasoning with the whole class. Below are some sample questions:

- What do you notice about these graphs? What do you wonder?
- What is happening with Gaspard Monge's graph? Is it okay for it to retrace itself?
- How can you decide whether a graph should be a line or a curve?

### 3. Promote Student Reasoning

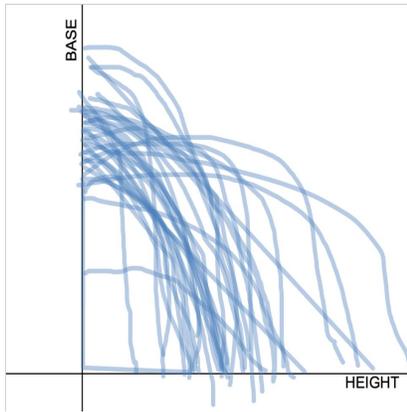


Now restrict students to Screens 1-12. When students see the computer graph on Screen 7, they may want to fix their graph. Tell students not to erase the graph they drew first. Tell students that their explanation in Screen 8 is more important than their graph accuracy.

Ask questions to learn what students notice. For example, the question "What surprised you?" opens possibilities for a range of responses.

4. *Allow Classroom Discourse*

Vary discussion questions and pedagogical strategy to de-center the teacher as the only expert in the room and allow all voices the opportunity to be heard.



Once students have sketched their second graph on slide 12, display a graph overlay (shown at left).

To promote students' expertise, use an instructional routine, such as think-pair-share. Have students partner up. Tell each student to talk with their partner for one to two minutes. Then have 2-3 pairs volunteer to share out with the class.

Post discussion questions to guide students' talk. Below are a few sample questions:

- *What trends do you see in the overlay?*
- *Where is the length of the base the greatest? Why?*
- *How do the graphs show the changing height and base?*

5. *Debrief the Activity*

After students discuss Screen 12, turn off teacher pacing so students can see all screens. On Screen 15, students are asked to respond to a hypothetical student Dee. *Dee wonders if different heights of this tent could have the same length for the base.*

Éva Tardos

No, this is because for every different height there is a different length. One can see that on this graph it passes the vertical line test and the horizontal line test.

Benjamin Baneker

No, the graph passes both the horizontal and vertical line test.

Reflecting on responses, such as the ones above, can help students form their own definitions. Ask students: Is height is a function of length? Is length a function of height? When students convince themselves that both are correct, introduce new vocabulary: one-to-one functions and inverse functions.

Students are experts in their math thinking. Make room for students' voices.

In the sample responses to the left that both students are using vertical line test to determine if base is a function of height and horizontal line test to determine if height is a function of base. To focus on sense making, ask students why passing both tests shows that each height has its own unique length.

Build vocabulary from students' sense making.

# *Techtivities Start-Up Guide*

## *1) Register for a Desmos Teacher Account*

You will first need to register for a Desmos teacher account (if you have an existing account sign in through teacher Desmos). These accounts are free and allow you to create a classroom environment where your students can work on the activities in the same shared space. To create a new account:

- a) Go to [teacher.desmos.com](https://teacher.desmos.com)
- b) Select the Create Account icon and fill in the required information

## *2) Access the Activities*

Once registered and logged in to teacher Desmos, you can find all of the Techtivities at <https://itscore.cu.studio/techtivities/english/>. There are 7 provided on this landing page and clicking on any will bring you to the associated activity in teacher Desmos.

## *3) Create your Class Code and Access the Teacher Guide*

In order for your students to participate in the activity together, click the Create Class Code icon. This will generate a 6-character code which will allow your students to access the activity in the same virtual classroom environment. If you plan on using the activities with more than one class, we suggest creating multiple class codes to keep them separate.

After creating your class code, you can explore the activity in more detail by looking through the student preview and accessing the associated Teacher Guide. This guide provides a helpful checklist for best practices facilitation of the activity along with instructions on how to use the Pacing and Pause features in Desmos.

## *4) Customize your Classroom Activity*

Customizing your techtivity will allow you to set parameters to guide the student experience. Start by clicking on the 6-digit classroom code you generated earlier. This will bring you to the activity landing page for your specific class. Once inside your classroom activity you can utilize the following customization tools to your advantage.

- a) Anonymize. This option allows you to anonymize each individual student by assigning them a random mathematician pseudonym.
- b) Pacing & Pause. The pacing and pause options allow you to control the speed which the class goes through the activity. These options also allow you to create stopping spots to bring the class together for whole class discussion on important topics.
- c) Snapshots. This option allows for you to take screen captures of student work and sequence them in an order beneficial to discussion.

## *5) Facilitation Start-Up*

It is important that students are given previous notice about the activities so they can be prepared by bringing in a laptop or tablet. Most activities also work well on a smartphone, but they are not optimized for all ios systems. Students can also work in pairs to complete the activities if there is a device shortage. On activity day students will need to do the following:

- a) Go to [student.desmos.com](https://student.desmos.com)
- b) Enter the 6-character classroom code
- c) Either sign in with their Desmos account or continue on as a Guest
- d) Enter their name or codename