**Facilitation Guide for Toy Car**

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 1-6, so students cannot rush through the activity. If students finish their graphs early, tell them to share their graphs with other students.

   How do students "see" the toy car's distance from the shrub?
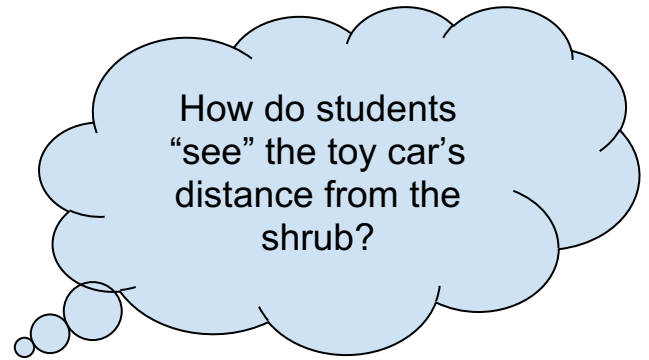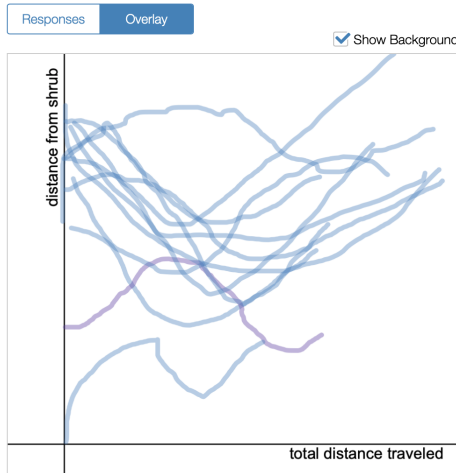
2. *Graph Overlay*

   Show students an overlay of all of the graphs. From the teacher dashboard, go to Screen 6. Select "Overlay" to show all of the graphs. A sample overlay for Screen 6 is on the left. Next, ask discussion questions to allow students to think about the relationships and justify their reasoning. You may write questions on the board, and tell students to discuss in small groups first. Then, students can share in whole group. Here are some sample questions:

   > *"What kinds of graphs do you see?"*

   > *"What is different about the starting place on the y-axis for each graph? What could this mean for the toy car?"*

   > *"Would anyone like to adjust their graph after seeing this overlay? How? Why?"*

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. Encourage students to explain their thinking in the box on Screen 8. Focus more on students' reasoning than on their graph accuracy.

   Use the Desmos anonymize feature to share and discuss student work.
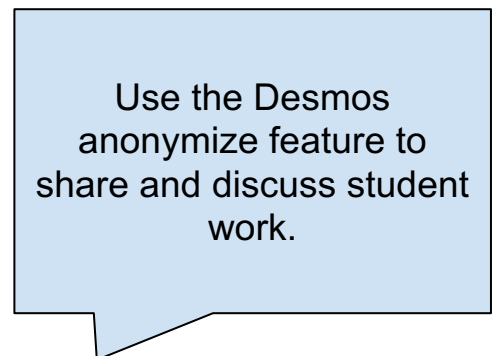
4. *Allow Classroom Discourse*

   Once students have sketched a second graph, show another overlay, or have students look at a sample of individual student graphs (see samples at left). Vary the discussion questions to promote student talk. Below are some sample questions:
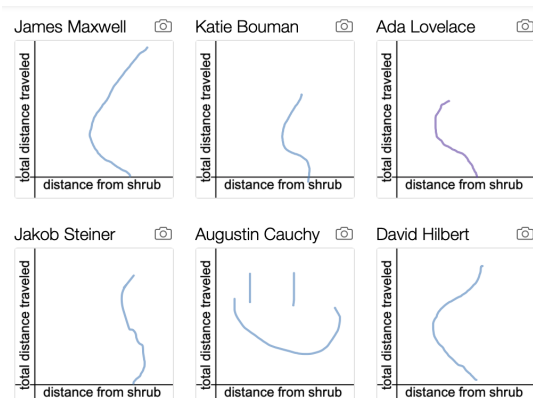
   > *"What patterns do you notice?"*

   > *"What do you wonder?"*

   > *"What are the similarities and differences between the graphs of Ada Lovelace and James Maxwell?"*

Olson, G., Gardner, A., & Johnson, H. L. (2019). Facilitation guide for toy car. Retrieved from https://itscore.cu.studio/techtivities/

5.   *Debrief the Activity*

After students discuss Screen 12, turn off teacher pacing, so students can see all screens. On Screen 14 students respond to the following question: *Did you expect the graph to look like this? Why / why not?*

Students will see other students' responses in real time. From the teacher dashboard, teachers can view the total number of students in each response category. Before projecting responses, anonymize student names. This can allow students to feel less anxious about having their responses and explanation on display to the whole class.

Debrief the activity, with a focus on students' reasoning. Have students turn and talk to a partner. Here are some sample questions to guide students' work:

"What do you think Katie Bouman meant by, 'we swapped the axes from the previous grouping'?"

"Was there a response that helped inform or clarify your thinking? What was it? How did it help?"

Did you expect the graph to look like this? Why / why not?

Yes

| 12 students |

James Maxwell, Katie Bouman, Ada Lovelace, Jakob Steiner, Augustin Cauchy, David Hilbert, Dorothy Vaughan, Ernst Kummer, Noriko Yui, Peter Dirichlet, Hermann Weyl, Johann Lambert

No

0 students

James Maxwell

Yes | Having both dynamics segments move at the same shows what the graph should look like by following the imaginary intersection

Katie Bouman

Yes | we swapped the axes from the previous grouping

Ada Lovelace

Yes | It was similar to the first section.

6.   *After the Techtivity*

After the techtivity, give students an opportunity to reflect on their work. This is a good time to solicit feedback about any further questions the students may have. An exit ticket is a great way to do this. Below are some sample questions:

Rather than "Is this a function?"

Ask instead "Is y a function of x?"

"What questions do you have about the toy car?"

"What are the key ideas you gained from the Toy Car techtivity?"

"How do the Toy Car and Cannon Man help you to think about function? What was your greatest 'aha' moment?"

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