## Advanced Algebra/ Algebra II

### COMPREHENSIVE COURSE OVERVIEW

#### Big Idea(s)/ Topic(s)

- Interpret the average rate of change of a function

#### Standard(s) Alignment

MGSE9-12.F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

#### Diagnostic Assessment

**Activity:** [Average Rate of Change](#)

Students will have the opportunity to display their prior knowledge of the average rate of change. They will be asked to find the average rate of change over various intervals on different function graphs. They will also be asked to calculate the average rate of change given only the equation and interval.

#### Instructional Design

**Desmos Activity:** [Emma's Average Rate of Change](#)

**Engage**

**Teacher Moves**

- **Lesson Goals:**
  - Identify average rate of change from a piecewise graph.
  - I can interpret average rate of change in the context of distance-time piecewise linear graph.
  - I can create an equation from a graph using two endpoints.
Emma is shown in black. "Average Emma" in red.

Press "Try It"

What do you notice?
What do you wonder?

Move the points and try again. Have Fun!

Teacher Moves

Consider pacing students on this screen to get everyone acclimated with this scenario. You may want to encourage students to move the points and make further observations.

"Average Emma" wants to walk at a steady pace the whole time but start and finish at the same time and place as Emma.

Write a speed for "Average Emma" in meters/second so that she meets this goal.

Note: Do not input units, just the number.

Teacher Moves

Discuss with students how they can simplify the scenario by focusing on the start point and end point.

Note the "thumbs Up" on the left side of the graph when Average Emma’s average rate of change is correct.

Sample Responses

\[ \frac{5}{4}, \frac{100}{80}, \text{ or } 1.25 \text{ meters per second} \]

- **Synchronous**: Complete during a classroom discussion while pausing the activity to highlight student responses.
- **Asynchronous**: Introduce the problem to students in a virtual platform; this can be done via e-document or video. Allow students to share responses within the Desmos platform and provide feedback via the teacher dashboard. Additionally, students could use audio/video to share. Provide feedback to individual student responses and highlight multiple strategies used by students.
- **Unplugged/Offline**: Provide the images on slides two and three for students to engage in the task. Have students share ideas through email/text/phone. Provide feedback to students and share other students’ ideas before engaging in the remaining sections.
Explore

4 Average Rates: Expl...

How did you find Average Emma’s speed?

You can show your work by drawing on the graph and explain in words using the text box.

Teacher Moves

Pause after this slide to COMPARE and CONNECT student responses. Ask students to share their observations with the class. Encourage students to explain their thinking.

5 Emma and "Average ...

The endpoints of the graph have been moved.

Write a speed to make "Average Emma" travel at Emma’s average speed.

Note: Do not input the units, just the number.

Sample Responses

\[
\frac{65}{83}. \text{ Responses from 0.7645883 to 0.764823 inclusive are accepted and marked correct on the dashboard.}
\]

6 Average Emma's ...

Now that the endpoints have been moved, how did you find Average Emma's speed?

You can show your work by drawing on the graph and explain in words using the text box.

Teacher Moves

Pause after this slide to COMPARE and CONNECT student responses. Encourage students to explain their thinking. Highlight the qualities of a good explanation.

- **Synchronous**: Complete the Desmos activity during synchronous learning, either face-to-face, virtual, or blended.
- **Asynchronous**: Using the teacher dashboard, unrestrict screens four through six. Give students time to complete the screens and provide feedback. Ensure that enough time is provided for students to participate and respond to your feedback and edit responses.
- **Unplugged/ Offline**: Provide printed scenarios and ask students to find the average rate of change as well as the slope-intercept equation of Average Emma’s journey.
Apply

7 Emma's Equations

Adjust the linear equation below to make Average Emma MATCH Emma's average speed.

1. **m** is Emma's Average Rate of Change
2. **b** is where Emma begins (distance)

**Teacher Moves**

What do students notice and wonder about average rate of change when points are moved?
How is average rate of change impacted when only the black points are moved?
How is average rate of change impacted when only the red points are moved?

**Sample Responses**

Answers will vary depending on where the start point randomly appears and end point is positioned.

8 Emma's *NEW* Equations

Adjust the linear equation below to make Average Emma MATCH Emma's average speed.

1. **m** should be Emma's Average Rate of Change
2. **b** should be where Emma begins (distance)

**Teacher Moves**

Students will be able to request hints to help them create their linear equations.

**Sample Responses**

Answers will vary depending on where the start point randomly appears and end point is positioned.

- **Synchronous:** Complete the Desmos activity during synchronous learning, either face-to-face, virtual, or blended.
- **Asynchronous:** Using the teacher dashboard, unrestrict screens seven through nine. Give students time to complete the screens and provide feedback. Ensure that enough time is provided for students to participate and respond to your feedback and edit responses as needed.
- **Unplugged/Offline:** Provide students with access to graph paper and allow students to engage in the questions presented on screens two through nine. Ask students to complete the questions and have them submit responses via email/text/phone. Provide feedback, share these responses with other students, and share other students’ responses with them.
Students will engage in a Number Talk based on the picture below, and how Emma’s scenario can be explained by slope-intercept form.

Variables
Describe a specific point

\[ y = mx + b \]

- **Synchronous: Number Talk.** Students will discuss how Emma and Average Emma’s scenarios can be represented using slope-intercept form. Encourage students to use vocabulary (head start, distance from home, time in seconds) specific to Emma’s scenario.
- **Asynchronous: Virtual Number Talk.** Students can document how Emma and Average Emma’s scenarios can be represented using slope-intercept form. Encourage students to use vocabulary (head start, distance from home, time in seconds) specific to Emma’s scenario.
- **Unplugged/Offline:** Provide students with printed discussion questions pertaining to Emma’s scenario.
Evidence of Student Success

Formative Assessment Questions:
- Can you calculate the average rate of change given two points?
- Can you interpret how the average rate of change varies as portions of the piecewise function are adjusted?
- Can you interpret the average rate of change in the context of a distance-time piecewise linear graph?
- How can Emma’s scenario be modeled using slope and y-intercept?

Student Learning Supports

Establish mathematics goals to focus learning.
- Make instructions and expectations clear for the activities.
- Make explicit connections between current and prior lessons or units.

Facilitate meaningful mathematical discourse.
- Explicitly model and teach good “discussion board” etiquette.

Pose purposeful questions.
- Predetermine when you will call on the student or use the pause feature within the activities.
- Break class into small discussion groups to work collaboratively and then have groups report back to the whole group.

Support productive struggle in learning mathematics.
- Offer outlines and other scaffolding tools and share tips that might help students learn.
- Provide feedback using the feedback feature within activities and offer corrective opportunities.
- Consider the pacing of the lesson.

Elicit and use evidence of student thinking.
- Anticipate any misconceptions or questions students might have about the task, materials or technology. Proactively address them with readily available and accessible resources such as this tutorial on average rate of change from Mathbits.
**Engaging Families**

**Average Rate of Change Activity**

Share the link with students (each automatically gets their own copy of the activity). Students will be asked to move the draggable red points along the function to create positive, negative, and zero rates of change. Families can engage in this activity together and discuss findings and calculations.

- *This introduction explains the average rate of change* pictorially and with algebra.