Pieces of Your Paycheck

FICA and Functions

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Grade Level	10th – 11th Grade	**Time Frame**	85-100 minutes
Subject	Mathematics	**Duration**	2 class periods
Course	Intermediate Algebra		

Essential Question

How can we represent real-world scenarios with piecewise functions?

Summary

In this lesson, students will explore the relationship between piecewise functions and payroll taxes, specifically FICA (Federal Insurance Contributions Act) taxes. Students will learn how piecewise functions can be represented verbally, algebraically, graphically, and numerically. The tax information used in this lesson is from 2024.

Snapshot

Engage

Students are introduced to payroll taxes.

Explore

Students explore Social Security tax and consider how to represent it algebraically.

Explain 1

Students learn how to write piecewise functions using proper notation.

Extend 1

Students apply their learning to represent Medicare tax with a piecewise function and learn about how a payroll manager uses this knowledge in his career.

Explain 2

Students continue to increase their vocabulary regarding discontinuous piecewise functions.

Extend 2

Students apply their understanding to match real-world scenarios, graphs, and equations through a Card Matching activity.

Evaluate

Students demonstrate their understanding by modeling a real-world situation graphically.

Attachments

- Guided Notes (Model Notes)—Pieces of Your Paycheck.docx
- Guided Notes (Model Notes)—Pieces of Your Paycheck.pdf
- Guided Notes—Pieces of Your Paycheck - Spanish.docx
- Guided Notes—Pieces of Your Paycheck - Spanish.pdf
- Guided Notes—Pieces of Your Paycheck.docx
- Guided Notes—Pieces of Your Paycheck.pdf
- Tax Proposal—Pieces of Your Paycheck - Spanish.docx
- Tax Proposal—Pieces of Your Paycheck - Spanish.pdf
- Tax Proposal—Pieces of Your Paycheck.docx
- Tax Proposal—Pieces of Your Paycheck.pdf

Materials

- Guided Notes handout (attached; one per student; printed front/back)
- Guided Notes (Model Notes) document (attached; for teacher use)
- Tax Proposal handout (attached; one per student; printed front only)
- Pencils
- Paper
- Straightedge
- Student devices with internet access

5 minutes

Engage

Teacher's Note: Desmos Classroom Activity Preparation

To use this Desmos Classroom activity, select the following link: "Pieces of Your Paycheck." Create an account or sign in under the "Activity Sessions" heading. After you log in, the "Assign" dropdown button will be active. Click the arrow next to the word "Assign," then select "Single Session Code." After making some setting selections, select "Create Invitation Code" and give the session code to students. For more information about previewing and assigning a Desmos Classroom activity, go to https://k20center.ou.edu/externalapps/using-activities/.

For more detailed information about Desmos features and how-to tips, go to https://k20center.ou.edu/externalapps/desmos-home-page/.

To set up the activity's pacing for students, select "View Dashboard" (next to the session code). In the upper-left corner of your screen, select the icon above the word "Pacing." Desmos Classroom should then prompt you to select the first and last screens that you want students to see. When prompted to set a range, select screens 1 and 2. Select "Restrict to Screens 1–2" to confirm your selection. This allows students to access only screens 1–2 at this time. For more information about teacher pacing, go to https://k20center.ou.edu/externalapps/pacing-activities/.

Provide students with your session code. Then, have students go to student.ampify.com/join and enter the session code.

Teacher's Note: Sign-in Options

If students sign in with their Google or Desmos accounts, then their progress is saved, and they can resume the activity or view their work later. If students continue without signing in, they can complete the activity, but they must do so in one sitting. It is strongly recommended that students sign in; otherwise, they risk losing their work.

Introduce the lesson using **screens 1-2**, which display the lesson's essential question and learning objectives. Review each of these with students to the extent you feel necessary.

Ask students to find a partner or assign partners yourself. On the Dashboard, press the orange plus sign three times to enable students to progress through **screens 3-5**. Here students learn about the purpose of taxes, specifically FICA taxes from one's paycheck.

10 minutes

Explore

Teacher's Note: Guiding the Lesson

Often Social Security and Medicare taxes change rates. The tax rates used in this lesson are from 2024.

Press the orange plus sign twice to enable students to progress to **screens 6-7**. Give each student a copy of the attached **Guided Notes** handout. Direct students' attention to the front of their handout: *Social Security Tax*. Have them record whatever salary values they entered on **screen 7** and the corresponding Social Security tax amount. Once students complete the table, they are prompted on the screen to plot the points from their table and create a line graph (where points are connected with a straightedge and not a line of best-fit).

Once students have completed the graphs, press the orange plus sign to enable students to progress to **screen 8** where they check their work. Give students time to compare their graph with the one on the screen and make corrections and/or ask questions.

Teacher's Note: Guiding the Activity

At this point, answer questions that help students see why their graph differs from that on screen 8. However, do not yet answer questions about why the graph looks "different" (different from the graph of a linear function) or yet use vocabulary related to piecewise functions. Emphasize that the green dots on their graph on screen 8 are the ones they typed into the table from the previous screen, so that should match their handout.

Use the attached **Guided Notes (Model Notes)** document for a sense of what students should be recording on this handout.

Some students may recall piecewise functions from Algebra 1, so they may use that vocabulary. If this is the case, let them use the vocabulary first. Use what you hear to help determine your focus for the Explain portions of the lesson.

Encourage pairs to discuss what they notice about the graph and brainstorm ways to represent it algebraically (like an equation). After students have had a chance to discuss, guide students to submit their thoughts on screen 8. Remind students that it is okay if they are unsure but that you would like to read their thinking. Now, ask for volunteers to share their thoughts.

Sample Student Responses:

- The graph goes up then goes flat. We need to do something different from $y = mx + b$.
- Maybe we need to write 2 equations because there seems to be 2 different slopes/pieces/lines.

25 minutes

Explain 1

On the Dashboard, press the orange plus sign four times to enable students to progress through **screens 9-12**. Here students are introduced to the vocabulary of a *piecewise function* and its notation. Then they begin writing their piecewise function for Social Security tax using a verbal model. On screen 12, students are asked the value of the "maximum amount" and will receive feedback after submitting their answer. Make sure students understand how to calculate the maximum amount of Social Security tax anyone would pay before progressing with the Desmos Classroom activity.

Press the orange plus sign on the Dashboard four times to enable students to progress through **screens 13-16**. Here students continue to transform their verbal model into an algebraic model. Encourage students to take notes on their Guided Notes handout as they progress through the screens. Once students complete screen 16, ask for volunteers to share what the piecewise function on the screen means. Encourage students to not only share how to read it, but also share what it represents in the context of Social Security tax.

On the Dashboard, press the orange plus sign twice to enable students to progress through **screens 17-18**. Here students are asked about "that point" where the graph changes. As students complete screen 18, ask for volunteers to share their reasonings with the class.

Teacher's Note: Desmos Classroom Tip

Desmos will not be able to read an ordered pair that has multiple commas. Even though we would write $168,600 with a dollar sign and comma, the ordered pair should be entered as (168600, 10453.2) for screen 18.

Next press the orange plus sign once on the Dashboard and direct students' attention to **screen 19**. Explain to students the significance of this transitional point where the graph transitions from the first "piece" of the function to the second.

Teacher's Note: Guiding the Lesson

Since this is an example of a continuous function, screen 19 has information about the options for inequality symbols. During the second Explain portion of this lesson, students will be formally introduced to the vocabulary: *continuous* and *discontinuous*. So, if at this point students have questions, encourage them to jot down their question on their Guided Notes handout and ask them if they are still unanswered before the second Extend portion of the lesson.

On the Dashboard, press the orange plus sign once and direct students' attention to **screen 20**. Have pairs try to use the function to determine the Social Security tax for a person with a salary of $64,000. After a couple of minutes, press the orange plus sign once again. Direct students' attention to **screen 21** and explain to students how to evaluate a piecewise function.

Teacher's Note: Guiding the Lesson

Students may ask questions about why there is a “maximum amount” for Social Security tax. Help students understand that there are valid arguments for and against it. Some who support the cap argue that those who would pay in more (higher-income individuals) will receive the same amount of Social Security benefits as those who paid in less, which does not sound very fair. Those who are against the cap argue that those who would pay in more will likely live longer and therefore receive more Social Security benefits, so they should have to pay in more (*Payroll Taxes*, 2023).

15 minutes

Extend 1

Press the orange plus sign on the Dashboard twice to enable students to progress through screens **22-23**. Here students are to work in pairs to apply what they have learned about piecewise functions to Medicare taxes.

As pairs work, remind them to take notes on their Guided Notes handout. As you notice students completing their graphs, press the orange plus sign on the Dashboard to enable students to navigate to **screen 24** and check their graph. After making corrections and asking questions, if needed, have students write the piecewise function for this tax.

After a few minutes, press the orange plus sign to enable students to check their equation with what is on **screen 25**. Give students time to compare their equation with the one on the screen and make corrections and/or ask questions. This is the time to ensure that students know how to write a piecewise equation given a graph.

Teacher's Note: Guiding the Activity

Students may struggle to begin to write the second piece of the piecewise function for Medicare taxes. Encourage students to start with verbal models, then use the verbal models to write the algebraic models shown in the Guided Notes (Model Notes) document. For example:

- One approach: 1.45%·(salary) + 0.9%·(salary over \$200,000) = $0.0145x + 0.009(x - 200{,}000)$
- Another approach: 1.45% · (first \$200,000) + (1.45% + 0.9%) · (salary over \$200,000) = $0.0145(200{,}000) + 0.0235(x - 200{,}000)$

Either approach will simplify to $0.0235x - 1{,}800$.

Press the orange plus sign on the Dashboard to enable students to progress to **screen 26**. Have students watch the "Payroll Taxes and Piecewise Functions" video where Sean Thurmond, a payroll manager, shares how he uses math in his career.

Embedded video

https://youtube.com/watch?v=u6NlajjzJi0?si=kBOVa7rIfPQEeVmL

10 minutes

Explain 2

On the Dashboard, press the orange plus sign three times to enable students to progress through screens **27-29**. Here students learn about the differences between continuous and discontinuous functions. On screen 29, students are given two graphs and three facts and are asked to justify why the statements are true. Have students type their reasoning on the screen. Remind students that it is okay if they are unsure but that you would like to read their thinking.

Press the orange plus sign on the Dashboard to enable students to progress to **screen 30** and check their work. Ask for volunteers to share their reasoning.

On the Dashboard, press the orange plus sign twice to enable students to progress through **screens 31-32**. Here students go into more detail about the difference between an open and closed circle, recalling how that works on a number line (with one variable). Let students know whether you expect them to take notes on these vocabulary words on their Guided Notes handout. Use this time to answer any questions about piecewise functions.

15 minutes

Extend 2

On the Dashboard, click the orange “Stop” button; now students can complete the Desmos Classroom activity at their own pace. Introduce students to the Card Matching instructional strategy, then direct their attention to **screen 33**. Here students are asked to match scenario cards with their corresponding graph and equation cards, creating two sets of three cards. When students correctly match the cards, they receive feedback at the top of their screen indicating that they are to proceed to the next screen. If students proceed to the next screen without having matched the cards correctly, they receive feedback on the next screen and are not allowed to begin the next card matching activity. In other words, students must accurately complete the card matching activity before being allowed to begin the next one, as they increase in difficulty. Have pairs collaborate on the first card matching activity, and continue to work together to complete two additional card matches on **screens 34-35**.

Teacher's Note: Guiding the Activity

If students struggle with Card Matching on screen 34, consider asking guiding questions to get them to compare the steepness of the lines with the slopes of the equations or have them find the y-values for the transitional *x*-values (make a table) to see which function should have larger vertical gaps on the graph, as the scales on the two graphs are the same.

Use the Dashboard to monitor students’ progress. As pairs complete the card matching activity, direct students’ attention to **screen 36**. Randomly assign (or have pairs choose) a type of scenarios to compare: rentals, shirt orders, and elevator trips. Make sure that at least one pair has selected each of the three types of scenarios. Direct pairs to select one type of scenario on the screen, then work together to answer the question on the screen. Tell pairs that they need to be ready to share their answer with reasoning with the class.

Have different pairs share their answers and reasonings with the whole class. If working with a shy group of students, consider having some students share their answers while other students share the corresponding reasoning. A student may feel more comfortable sharing the reasoning if they know their answer matches someone else’s.

5 minutes

Evaluate

Use the Exit Ticket strategy to individually assess what students have learned from the lesson. Give each student a copy of the attached **Tax Proposal** handout and direct their attention to **screen 37**. Read the scenario on the screen then ask students to circle the graph on their handout that best represents the scenario and to write their reasoning.

In 2022, 6.2% of your salary was set aside for Social Security taxes for the first $147,000 you earned. The proposal was to keep this, then not apply the tax until you earned $400,000 or more, then the 6.2% tax would resume.

Collect student responses and use them to determine whether students need additional practice or are ready to move on to the next topic. Help students see that Graph D is a better choice over Graph A since 6.2% of $147,000 is less than $10,000, while Graph B and Graph C imply that someone earning $200,000 either pays $0 in Social Security taxes or pays an unknown or undefined amount.

Resources

- K20 Center. (n.d.). Bell ringers and exit tickets. Strategies. https://learn.k20center.ou.edu/strategy/125
- K20 Center. (n.d.). Card matching. Strategies. https://learn.k20center.ou.edu/strategy/1837
- K20 Center. (n.d.). Desmos classroom. Tech tools. https://learn.k20center.ou.edu/tech-tool/1081
- K20 Center. (n.d.). Payroll taxes and piecewise functions. Video. YouTube. https://www.youtube.com/watch?v=u6NIajjzJi0&ab_channel=K20Center
- *Payroll Taxes: What Are They and What Do They Fund?* (2023, May 1). Peter G. Peterson Foundation. https://www.pgpf.org/budget-basics/budget-explainer-payroll-taxes