Planning to Create a Math-Talk Community

general outline of lesson activities including homework assignment and formative assessment

Lesson Title: ____Special Functions______  Grade Level/Course: ___Alg II___

● Source Credit (if applicable):

Sub-unit: Piecewise
   Greatest Integer Function

Connection to Content Standards (include prior grade level standards if applicable):

● Primary: Write and graph piecewise functions
   (A2.1.4 Recognize that functions may be defined by different expressions over different intervals of their domains; such functions are piecewise-defined.)
   CCE - F-FI.7b Graph square root, cube root, and piecewise defined functions, including step functions and absolute value functions

● Secondary: Use piecewise functions to describe real-world situations
   CCE- A.CED1 Create equations and inequalities in one variable and use them to solve problems.

Connection to Mathematical Practice Standards:

● Primary:
   Standard 1: Make sense of problems and persevere in solving them
   Standard 4: Model with mathematics

● Secondary:
   Standard 2: Reason abstractly and quantitatively
   Standard 3: Construct viable arguments and critique the reasoning of others

What prior knowledge is important for students to understand before starting this lesson?
Graphing linear equations. Writing equations.
Materials Needed by Students and by Teachers (including worksheets, solution keys, power points, etc):

- graph paper.
- rulers
- calculators
- pencils

**PART 1: SELECTING AND SETTING UP A MATHEMATICAL TASK**

(i) What are your mathematical goals for the lesson (i.e., what do you want students to know and understand about mathematics as a result of this lesson)?

Students will be able to model a real world situation by writing and graphing piecewise functions

(ii) What is the rich task that students will explore?

Students will be provided with three different cell phone plan options. Students will write and graph the piecewise function for each plan. Students will make a decision on which plan would be the best for three different usage levels. Students will present their decisions to the class, being prepared to discuss and support their decision.

(iii) In what ways does the task build on students’ previous knowledge, life experiences, and culture?

What definitions, concepts, or ideas do students need to know to begin to work on the task? What questions will you ask to help students access their prior knowledge and relevant life and cultural experiences?

Definition: fixed cost, variable cost, break even point

Life experiences: Do you have a cell phone? Who pays the cell phone bill?

(iv) What are all the ways the task can be solved?

Students can graph the costs and use the graph to determine the best choice for each scenario. Students can write equations and use systems of equations to find the breakeven point and/or verify the results found by graphing
Which of these methods do you think your students will use? What misconceptions might students have? What errors might students make?

Students will probably be more comfortable starting with the graphing of the costs and then work backwards to write the piecewise function.

What particular challenges might the task present to struggling students? to students who are English Language Learners (ELL)? How will you address these challenges?

Students often struggle with piecewise functions. This will be addressed by looking at one “piece” at a time. Students will be asked to consider whether their solution makes sense.

What are your expectations for students as they work on and complete this task?
- What resources or tools will students have to use in their work that will give them entry into, and help them reason through, the task?
- How will the students work—individually, in small groups, or in pairs—to explore this task? How long will they work individually or in small groups or pairs? Will students be partnered in a specific way? If so, in what way?
- How will students record and report their work?

Students will be given the plan information, graph paper, rulers and calculators. Students will work in pairs to explore this task for 20 minutes and report back to the entire class.

How will you introduce students to the exploration task so as to provide access to all students while maintaining the cognitive demands of the task? How will you ensure that students understand the context of the problem? What will you hear that lets you know students understand what the task is asking them to do?

Introduction activity:


Follow up assignment:


PART 2: SUPPORTING STUDENTS’ EXPLORATION OF THE TASK
(i) As students work independently or in small groups, what questions will you ask to—
- help a group get started or make progress on the task?
  - How many pieces will there be on your graph? how do you know?
  - What will each piece look like? how do you know?
  - What scale would be appropriate to use for your graph?

  - focus students’ thinking on the key mathematical ideas in the task?
  - Which costs are fixed? which are variable?
  - What will the slope of a fixed cost look like?
  - What will the slope of a variable cost look like?

  - assess students’ understanding of key mathematical ideas, problem-solving strategies, or the representations?
  - What plan do you think is the best option for you if you are paying the bill? why?
  - What plan do you think is the best option for your parents? why?
  - What plan is the best overall value?

  - advance students’ understanding of the mathematical ideas?
  - Can you explain to me why each piece of the graph looks the way it does?
  - What plan do you think is the best option for you if you are paying the bill? why?
  - What plan do you think is the best option for your parents? why?

  - encourage all students to share their thinking with others or to assess their understanding of their peers’ ideas?
  - Each group will share out their choice for which plan is the best one for them.

(ii) How will you ensure that students remain engaged in the task?
- What assistance will you give or what questions will you ask a student (or group) who becomes quickly frustrated and requests more direction and guidance in solving the task?
  - Refer the student back to their graph.
  - Make sure they understand what the graph is representing.

  - What will you do if a student (or group) finishes the task almost immediately? How will you extend the task so as to provide additional challenge?
  - Have the students graph their own current plan, if they don’t have one or can’t remember their plan they can then find some other options online.
- Have the students find the cost of adding a data package for each plan and discuss have them redo the graphs in a different color.

  ● What will you do if a student (or group) focuses on non-mathematical aspects of the activity (e.g., spends most of his or her (or their) time making a poster of their work)?
- Redirect the students to get back to the mathematical aspects, recognizing that the conversation that comes from a real world problem is also valuable.

**PART 3: SHARING AND DISCUSSING THE TASK**

(i) How will you orchestrate the class discussion so that you accomplish your mathematical goals?

  ● Which solution paths do you want to have shared during the class discussion? In what order will the solutions be presented? Why? In what ways will the order in which solutions are presented help develop students’ understanding of the mathematical ideas that are the focus of your lesson?
- Monitor each group’s progress and then shortly before the start of the presentations, assign each group a specific problem to present to the class.
- The problems will be presented in the order they are asked on the handout, referring back to the graphs for clarification on any other parts.

  ● What specific questions will you ask so that students will—
    ○ make sense of the mathematical ideas that you want them to learn?
    ○ expand on, debate, and question the solutions being shared?
    ○ make connections among the different strategies that are presented?
    ○ look for patterns? begin to form generalizations?
- Which plan is best suited for different people and their particular situations?
- How does the previous question help you describe what the intersections of the graphs represent.
- Do you notice any similarities between the different graphs?

(ii) How will you ensure that, over time, each student has the opportunity to share his or her thinking and reasoning with their peers?
- Have each student fill out a peer review rubric discussing what part they did for the activity and what the other group members did. (See end of document for the peer review rubric.)

(iii) What will you see or hear that lets you know that all students in the class understand the mathematical ideas that you intended for them to learn?
- I will see the correct graphical representations of the three plans. I will hear the students discussing amongst themselves using the correct mathematical terms; domain, range, slope, intersection.
- I will hear them discussing their own plans and how they relate to the three given to them in the problem.

(iv) What closure will you bring to the lesson? If the lesson is a multi-day lesson, what are some
possible stopping points? What closure will you bring at these stopping points?
- Discuss with the students the different variables that go into choosing items when there are multiple options available.

(v) What assignment will you give students to do before the next class?
- The students will follow up with a brief assignment from their textbook that will be due the next class period.

(vi) What will you do tomorrow that will build on this lesson?
- The class will review piecewise functions in their warm up activity. After checking their assignment we will then move onto another special function.
How Did You Work?

Mark the boxes and complete the sentences that apply to your work.

1. Our group work was better than my own individual work □

   Our joint solution was better because ........................................................................................................

2. We checked our method □

   We checked our method by .......................................................... We could check our method by ..........................................................

3. In our method we assumed that: ........................................................................................................

4. Our method is similar to one of the sample responses □ OR Our method is different from all of the sample responses □

   Our method is similar to ..........................................................

   I prefer our method / the sample response method (circle)

   This is because ........................................................................

Student Materials

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