Beyond Algebra 2

rich tasks mathematics

Instructional mathematics tasks are accessible to all learners because they invite students to wrestle with a problem. Students share their ideas, ask questions of one another, use and apply multiple representations, and collaborate to develop various solution pathways. Then, teachers use students' solutions to make the math visible, connect prior learning, and forecast new mathematical learning.

Directions: Launch the tasks in a whole group to provide opportunities for students to discuss their understanding of the task and suggest strategies to solve. Organize the students in pairs or groups of four to encourage participation. Provide manipulatives, chart paper, and markers.

1

Topic

Build and interpret logistic models to solve real-world problems.

Task

Jasmine has a vitamin deficiency. Her bloodwork indicates that she typically starts her day with approximately 30 micrograms of the vitamin in her system. Her doctor has prescribed 15 milligrams of the vitamin per day to increase her levels. Due to the absorption rates of the vitamin in the body, only about 85% of the total amount will remain in her system at the end of each day. Explore the effects of the prescription on Jasmine's vitamin deficiency throughout the first month.

Facilitate

Prompt groups to use recursive reasoning and a graphical representation to explore the effects of the vitamin in her system throughout the first 30 days.

Make the Math Visible

Select student-generated representations to analyze the behavior of the function as a class. Compare and contrast the scenario and corresponding representations with an exponential model to introduce logistic growth and how it is similar to and different from exponential growth. Discuss the meaning of the carrying capacity and why it would matter in this and other real-world situations.

Notes

2

Topic

Solve real-world problems involving circular motion.

Task

Mario gets on a Ferris wheel that has 16 cars, each mounted to the ride by 15-meter arms. The cars take approximately 30 seconds to load and travel at a linear speed of about 4.75 meters per second while the ride is being loaded. Four cars after Mario have boarded the Ferris wheel, a fear of heights causes him anxiety. How much time must Mario spend on the ride before the ride's operator can safely unload him from the Ferris wheel?

Facilitate

Prompt groups to represent the scenario with a diagram in order to make sense of the information provided.

Make the Math Visible

Select specific group strategies to share and sequence them in a way that allows students to build a conceptual understanding of the relationship between linear and angular velocity.

3

Topic

Use conic sections to model real-world scenarios.

Task

The Ellipse in Washington, D.C., is a 52-acre park located to the south of the White House. It is bounded by a pedestrian walkway that has a major axis of approximately 350 yards and a minor axis of approximately 300 yards. If the President of the United States were to go on a jog around the perimeter of the walkway and a Secret Service Agent were to be placed in the center of the Ellipse for additional security, how far would the President be from the Agent during his jog?

Facilitate

Encourage students to use a graphical representation of the scenario to make sense of the problem, a symbolic representation to determine precise distances, and a tabular representation to organize their work.

Make the Math Visible

Discuss how the problem may be solved using the rectangular, polar, and/or parametric form of the equation for the ellipse.

4

Topic Solve problems involving the application of the derivative.

Task The Jackson family has decided to fill a large inflatable pool so their children can play outside in the heat. Their hose can generate about 1.2 cubic feet of water per minute, and the pool has a circular base with a 30-inch radius. How quickly is the water level rising?

Facilitate Prompt students to diagram the scenario and attend to precision when defining variables and using units. Encourage students to think about what the derivative means in the context of the scenario in order to help make sense of the problem.

Make the Math Visible Select students to explain their reasoning, paying particular attention to their explanation of the derivative to reinforce the understanding of the derivative as an instantaneous rate of change.

5

Topic Understand an accumulation function as the area under the curve of a derivative graph.

Task A local manufacturing company must monitor a tank that holds the excess condensation produced by their machines. The tank is filling with H_2O at a rate of $r(t) = \frac{1}{4}t^3 + 3$ gallons per day, where *t* is the number of days that the machines have been operating. How much condensation will the tank accumulate throughout the first 5 days of operation? How much will the tank accumulate on the sixth day of operation? If the tank has an 80-gallon capacity, when must the company empty the tank to avoid overflow?

Facilitate Prompt groups to use a graphical representation and their understanding of the meaning of an integral in order to make sense of the problem.

Make the Math Visible Discuss the graphical representation of the various accumulations addressed in the problem to strengthen the conceptual understanding of the integral.

Adapt-a-Mathematical TASK Tool

Do you have a task that is not quite right? Use this guide to adapt the task to meet your needs!

How does the task meet your STUDENTS' needs?

ACCESS and EQUITY: Ensure that the task is "responsive to students' backgrounds, experiences, cultural perspectives, traditions, and knowledge" (NCTM, 2014, para. 1, https://www.nctm.org/uploadedFiles/Standards_and_Positions/Position_Statements/Access_and_Equity.pdf). Consider students' language readiness, including access to mathematical vocabulary.

- How can you differentiate the context of the task to support the students' backgrounds, experiences, and cultural needs?
- How can you group students to engage the students' socio-emotional and developmental needs?
- How can you "open up" the task to encourage access to the task for all learners?
- How can you connect the task to the mathematics the students have learned and students' interests?

Notes

How do you PLAN for students to learn from the task?

MATHEMATICAL GOAL: The task should provide students opportunities to access new mathematical knowledge and to solidify, consolidate, or extend knowledge. Tasks can be changed to highlight multiple learning needs and content standards. Ensure that you strategically connect the learning goal to the task.

- What do your students know how to do right now?
- What do you expect your students to understand as a result of this task?
- What do you anticipate students will do? What changes might you make as a result of your anticipation?

FACILITATE: Task facilitation is critical to student success. Consider how you will organize students and **design** purposeful questions to help them discover and connect mathematics concepts and procedures.

- What **questions** are you going to ask? What tools will you provide? How will students be grouped?
- How and when will you provide opportunities for student **discourse**?

Notes

How do you move learning FORWARD?

FORMATIVE ASSESSMENT: Collecting information about student understanding will help you adjust instruction as you conduct the task.

- How will you listen, observe, and identify students' strategies?
- How will you respond to students' understanding?
- How will you provide feedback to students?
- How will you provide opportunities for students to provide feedback to one another?
- How will you provide opportunities for students to persevere and productively struggle through problems?
- How will you make the mathematics visible for your students?

Notes