Mathematics: The Language of STEM
Half Off Pizza

SECTION 1: CONTENT AND TASK DECISIONS

Learning Objectives: Students will think about the concept of half as well as manipulating (adding or multiplying) halves. The teacher will be more informed of student misunderstandings about fractions and readiness to work with them. – could be used as a transition to multiplying or an intro to fractions to unveil student understandings

Indiana Mathematics Content Standards: 5.NS.2: Explain different interpretations of fractions, including: as parts of a whole, parts of a set, and division of whole numbers by whole numbers.

Indiana Mathematics Process Standards: PS.2: Reason abstractly and quantitatively.
Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects

Language Objectives: Students will argue their opinion using terms such as whole, part, and half. Students listen to the thoughts and opinions of peers to reexamine their own conclusion.

Task & Materials: Visual presentation of questions, attached worksheet or paper for drawing models to justify thinking, fraction tiles and other fraction manipulatives may help students demonstrate their thinking.

SECTION 2: THE LESSON

BEFORE: Ask students what kind of pizza is their favorite. Set the problem and ask key questions to students.

Teacher Actions

- **Activate prior knowledge:** Ask students what kind of pizza is their favorite. Have they ever purchased pizza with a coupon or on a special sale? Talk about a time you've recently bought pizza.
- **Be sure the problem is understood –** Tell the students that you (or someone) recently bought a pizza for dinner because your favorite pizza place was running a special for "half off" pizzas, meaning you bought one whole pizza, but paid only half the price. So, if a pizza were usually $20, on this special, it would cost $10. What a deal! Ironically, when you got home (or to a friend's house), they had also purchased the same pizza using the same deal. You ended up with two pizzas to eat since both of you bought a pizza.

  Key question for students to consider:
  Now that you have two pizzas and you both paid, is it still true that the price you paid was "half off?"

- **Establish clear expectations:** Each student will be responsible for finishing each statement as the activity progresses. They may work with a partner or small team, but make individual decisions and record their own thinking.

My mathematical instinct says….
Here's how I picture it…
Now I'm thinking….
After listening to my classmates I'm thinking….

Student Actions— Students listen to the problem and initially decide if they believe the price was still half off based on intuition or instinct.

DURING: This phase of the lesson should be designed for students to explore the focus task.

Student Actions— Students record their first answer to whether or not the pizza was still half off. Then, students may work individually, or in teams of 2 or 3 to make models of the situation.
Students may use tools and manipulatives to explore their thinking. Models will need drawn into the 2nd box of the worksheet.

Teacher Actions:
Look at student models and drawings to ensure correct interpretation of the problem
Notice students' mathematical thinking
Ask questions
Find a few varied strategies and ideas that will be shared

Look for students understanding of ½
Look for students stuck on the dollar amounts rather than prepared to work with fractions

When work time is done, direct students to write whether or not they believe the pizza was still half off. (box 3)

Describe how you will accomplish each of the following in your lesson:

- **Let go –** Give students time to think, justify, and make decisions. Circulate to monitor, ask students to tell their opinions and explain their models.
- **Listen actively –** allow students to ask the questions and argue with each other. Take notes on misunderstandings that may hinder future understanding.
- **Provide appropriate support**
  Ask questions for students to explain or justify their work. How do you know? Can you show me that another way? What makes that ½? Why isn't that ½?
- **Provide worthwhile extensions**.
  Suppose the pizza place was offering another special, buy one pizza, get one free. Is that a better deal?
  Suppose the pizza place was offering a special, buy four pizzas, get two free. Is this a better deal?
  What if both people had 25% off coupons, or had a 1/4th off discount? Would they have paid half the amount for the pizzas?

AFTER
Student Actions— Students present findings.
Students share noticings and ask questions as they listen to peer presentations.
Three preselected students with various methods (and hopefully opinions) share their models with the whole class. The class asks questions and tells what they like about the models and explanations.

Teacher Actions— Remind students that after the presentations, they will once again write whether or not the discount was truly half off after purchasing two pizzas.
Teacher facilitates presentations and discussions. Teacher asks questions/ leads to noticing in student strategies.
Teacher facilitates use of common terms.
Teacher summarizes strategies or may suggest clarifications for models with numbers and symbols

- **Promote a mathematical community of learners** 3-4 students should share their work, ideally with a variety of strategies and opinions
- **Listen actively without evaluation** Invite students to ask questions and make comments on the work of their peers
- **Make connections** What do you see in this model that makes sense to you? Tell a neighbor one way that this strategy is like or unlike yours. How does that effect the solution?
- **Summarize main ideas** Have students summarize their thinking by answering the final prompt - After listening to my classmates I'm thinking….
  Use student thoughts to plan for future fraction lessons.

Section 3: ASSESSMENT

Observe:
Look for students understanding of ½
Look for students stuck on the dollar amounts rather than prepared to work with fractions

Ask: Ask questions for students to explain or justify their work. How do you know? Can you show me that another way? What makes that ½? Why isn't that ½? What questions are you asking yourself?

See organizer with prompts

Mathematician:_____

Now that you have two pizzas and you have both paid, is it still true that the price you paid was "half off?"

1. My mathematical instinct makes me think

2. *Using numbers, symbols, or drawings, represent the situation.* Here's how I picture the problem:

3. Now that I've taken some time to make sense of the situation, now I'm thinking

4. After listening to my classmates, I'm thinking