Lesson: Using addition and subtraction to solve word problems

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Standards:
1.OA.2
Solve addition and subtraction word problems, and add and subtract within 10 (e.g., by using objects or drawings to represent the problem).

1.OA.6
Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions (e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem).

Purpose of Instruction:
What key concepts or procedures will be taught?
- Problem solving processes (e.g., decomposing numbers, part-whole thinking)
- Inverse operations
- The concept of an unknown value

*What **purposes** or objectives will I explicitly communicate to students?*
- Add and subtract up to 20
- Use problem solving strategies to accurately decode and perform calculations to solve word problems

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Materials Needed:
*What **materials** will be needed?*
- Challenge Problem (copied or displayed)
- Play money, place value mat and chips
    - o Optional materials: paper for fraction bars, scissors, markers, colored pencils

What advance preparation is needed?
- Materials for teacher demonstration (Note: If unfamiliar with place value mat and chips, practice is needed.)

Time Needed:
How much time will be spent assessing for necessary foundational competencies?
- 10 – 15 minutes

How much time will be devoted to direct, explicit instruction?
- 15 – 20 minutes

How much time will be devoted to small group and/or individual work?
- 20 – 30 minutes

Lesson plan template modified from Standards in Action (OVAE, 2009)

Introduction & Explanation:
How will I get and hold students' attention?

> CHALLENGE PROBLEM: Sarah needs to pay the babysitter for 2 hours of work. The babysitter earns $6 per hour for a total of $_____. Sarah only has two $10 bills in her wallet, but she keeps extra cash in the cookie jar. Sarah goes to make change for her $10 bills to pay the babysitter. How much does Sarah have left to put back in her wallet?

How will I tie lesson objectives to student interests and previous classroom activities?
- Relate to the drill and practice of adding and subtracting whole numbers within 20
- Repeat vocabulary of decomposing or regrouping
- Demonstrate various strategies to arrive at the solution

What questions might I ask to stimulate student thinking?
- What is the connection of a number to an equation or expression?
- How are word problems connected to an equation or expression?
- How are problem solving strategies and/or properties connected to number relationships?
- How can word problems be decoded into equations or expressions?

*How will I **introduce and explain** key skills and concepts (e.g., inductive method, mini-lecture, demonstration, notes, etc.)?*
- Teacher demonstration utilizing think-alouds and model drawings

Modeling:
*How will I **model** this skill or strategy for my students (e.g., exemplars, demonstrations, discussions)?*
- Use technology (possibly a document camera) to model the use of the place value mat to decompose numbers up to 20

How will I break complex skills or bodies of information into understandable components?
- Vocabulary relating to problem solving situation
- Performing a demonstration using new vocabulary (think-alouds)

Guided Practice:

*How will students **practice** using the skill or concept targeted by the standard?*

- Students will be asked to write a short word problem in one variable utilizing whole numbers to add or subtract up to 20.
- Students will be working with partners or within small groups and will trade questions and discuss strategies for solving.

How will I gradually withdraw support as students become capable of independent performance?

- As students work with partners or in small groups, the teacher will monitor conversations that are taking place, problem solving strategies that are being used and paths to solutions; mastery becomes evident.

Evaluation of Student Understanding:

How will I correct misunderstandings and reinforce learning?

- If students are struggling with their problem solving strategies or solution paths, then some individual and/or small group re-teaching may be needed.

*How will I **evaluate** students' understanding and their readiness to move forward?*

- Reusing the word problems the students created, students will justify and/or explain why their problem solving strategies are consistent with the teacher demonstrated model(s)

What activities will I suggest for enrichment and remediation?

- Individual and/or small group presentations demonstrating conceptual understanding of word problems in one variable utilizing whole numbers to add or subtract up to 20
- Peer teaching using problem solving strategies and/or models

Reflection, Closure, & Connection:

*How will I engage students in **reflecting** on what they have learned?*
- Ask students how their process for solving problems in this lesson relates to their real world situations.
- Ask students how they could improve their problem solving strategies based on outcomes of attempting to solve the problems presented.
- Ask students what judgments they would make about the problem solving strategies they used.

*What will I use to **draw ideas together** for students at the end?*
- Ask students how the problem solving strategies and/or vocabulary used contributed to generating solutions.
- Ask students to compare and contrast the problem solving strategies presented.

*What lessons can I **preview** for students that will follow as a result of this lesson?*
- Ask students, "What if Sarah had a $100 bill?" in the challenge problem that was presented.
- One variable word problems written as linear expressions or equations

Lesson: Solving Two-Step Word Problems

Standard:
2.OA.12
Solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. This standard is limited to problems posed with whole numbers and having whole number answers; students should know how to perform operations in the conventional order when there are no parentheses to specify a particular order (order of operations).

Purpose of Instruction:
What key concepts or procedures will be taught?
- Determine (i.e., decode) what information is necessary, extraneous, and/or missing in order to solve the word problem
- Determine the appropriate operation to use to solve the word problem
- Construct and solve an equation for a word problem
- Assess the reasonableness of a solution

*What **purposes** or objectives will I explicitly communicate to students?*
- Decoding of a problem and the construction an equation to solve the given problem
- Strategies to assess the reasonableness of the solution

Materials Needed:
*What **materials** will be needed?*
- Challenge Problem (copied or displayed)
- Place value mat and chips
  - Optional materials: algebra tiles, paper for fraction bars, scissors, markers, colored pencils

What advance preparation is needed?
- Materials for teacher demonstration (Note: If unfamiliar with place value mat and chips, practice is needed.)

Time Needed:
How much time will be spent assessing for necessary foundational competencies?
- 10 – 20 minutes

How much will be devoted to direct, explicit instruction?
- 10 – 15 minutes

How much time will be devoted to small group and/or individual work?
- 20 – 30 minutes

Introduction & Explanation:
How will I get and hold students' attention?
> Challenge Problem: The number of students signed up to go a job fair is 37. Each college van will only hold 15 people legally. How many vans will be needed to transport all of the students to the job fair?

How will I tie lesson objectives to student interests and previous classroom activities?
- Using word problems that are based in the real world

What questions might I ask to stimulate student thinking?
- How does an equation represent an unknown quantity?
- How can the reasonableness of a solution be evaluated?
- How does fluency with the basic mathematical operations help in problem solving situations?

*How will I **introduce and explain** key skills and concepts (e.g., inductive method, mini-lecture, demonstration, notes, etc.)?*
- Teacher demonstration utilizing think-alouds and multiple solution pathways

Modeling:
*How will I **model** this skill or strategy for my students (e.g., exemplars, demonstrations, discussions)?*
- Use technology (possibly a document camera) to model a solution path
- Use think-alouds at the front of the room to demonstrate other solution paths
- Use mental strategies, such as decomposing numbers, to assess reasonableness and/or draw an appropriate conclusion

How will I break complex skills or bodies of information into understandable components?
- Differentiating between an answer and a solution
- Check the reasonableness of the answer

Guided Practice:

*How will students **practice** using the skill or concept targeted by the standard?*
- Students will be asked to write a short two-step word problem in one variable utilizing whole numbers.
- Students will be working with partners or within small groups and will trade questions and discuss strategies for solving.

How will I gradually withdraw support as students become capable of independent performance?
- As students work with partners or in small groups, the teacher will monitor conversations that are taking place, problem solving strategies that are being used and paths to solutions; mastery becomes evident.

Evaluation of Student Understanding:

How will I correct misunderstandings and reinforce learning?
- Reusing the word problems the students created, students will justify and/or explain why their problem solving strategies are consistent with the teacher demonstrated model(s).
- Misunderstandings will be corrected by leading questions and discussions with other students who do understand the concepts.

*How will I **evaluate** students' understanding and their readiness to move forward?*
- If students are struggling with their problem solving strategies or solution paths, then some individual and/or small group re-teaching may be needed.

What activities will I suggest for enrichment and remediation?
- Individual and/or small group presentations demonstrating conceptual understanding of two-step word problems in one variable utilizing whole numbers
- Peer teaching using problem solving strategies and/or models

Reflection, Closure, & Connection:

*How will I engage students in **reflecting** on what they have learned?*
- Ask students how their process for solving problems in this lesson relates to their real world situations.
- Ask students how they could improve their problem solving strategies based on outcomes of attempting to solve the problems presented.
- Ask students what judgments they would make about the problem solving strategies they used.
- Encourage reflection by having students name 2-3 ways they will use this knowledge.

*What will I use to **draw ideas together** for students at the end?*
- Ask students how the problem solving strategies and/or vocabulary used contributed to generating solutions.
- Ask students to compare and contrast the problem solving strategies presented.

*What lessons can I **preview** for students that will follow as a result of this lesson?*
- Word problems using geometry, decimals and fractions

Lesson: Multiplying and Dividing Fractions

Standards:
3.NF.13
Solve real world problems involving multiplication of fractions and mixed numbers (e.g., by using visual fraction models or equations to represent the problem).

3.NF.14c
Solve real-world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions (e.g., by using visual fraction models and equations to represent the problem). For example, how much chocolate will each person get if 3 people share a one-half pound of chocolate equally? How many one-third cup servings are in 2 cups of raisins?

Purpose of Instruction:
What key concepts or procedures will be taught?
- New fractions can be found by multiplying or dividing by a whole number or another fraction.

*What **purposes** or objectives will I explicitly communicate to students?*
- Understand the strategies, operations, and properties of multiplication and division of and with fractions

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Materials Needed:
*What **materials** will be needed?*
- Challenge Problem #1 and #2 (copied or displayed)
- Place value mat and chips
  - Optional materials: algebra tiles, paper for fraction bars, scissors, markers, colored pencils

What advance preparation is needed?
- Materials (fraction bars and document camera) for teacher demonstration
- Teacher will need to decide whether to use Challenge Problem #1 and #2 individually or as a small group exercise.

Time Needed:
How much time will be spent assessing for necessary foundational competencies?
- 10 – 15 minutes

How much will be devoted to direct, explicit instruction?
- 10 – 15 minutes

How much time will be devoted to small group and/or individual work?
- 15 – 20 minutes

Lesson plan template modified from Standards in Action (OVAE, 2009)

Introduction & Explanation:

How will I get and hold students' attention?
- Set the stage by describing how caterers – especially chefs – need to adjust their favorite recipes to meet a specific number of people for a special occasion.
- Explain how "not enough" food could leave people hungry and too much food can go to waste.

How will I tie lesson objectives to student interests and previous classroom activities?
- This activity will build upon the students' understanding of what a fraction is. Furthermore, it will build on new knowledge; to either multiply or dividing by a common factor.

What questions might I ask to stimulate student thinking?
- When will I know to multiply to obtain the correct amount?
- When will I know to divide to obtain the correct amount?
- What are the effects of multiplying by quantities greater than one compared to the effects of multiplying by quantities less than one?

*How will I **introduce and explain** key skills and concepts (e.g., inductive method, mini-lecture, demonstration, notes, etc.)?*
- Evaluate a recipe based on the number of servings and the number of servings needed.

Modeling:

*How will I **model** this skill or strategy for my students (e.g., exemplars, demonstrations, discussions)?*
- Challenge Problem #1
  - Perform multiplication and division of unit fractions discussing (using think-alouds) different steps of the computations.
  - Draw or construct fraction bars to demonstrate multiplication and division of the fraction bars.

How will I break complex skills or bodies of information into understandable components?
- Challenge Problem #1
  - Given small or unit fractions demonstrate through model drawings and think-alouds how multiplication and division by whole numbers affect the original fraction.
  - Given small or unit fractions demonstrate through model drawings and think-alouds how multiplications and division by fractions affect the original fraction.

Guided Practice:

*How will students **practice** using the skill or concept targeted by the standard?*
- Challenge Problem #2
  - o Perform multiplication and division of unit fractions discussing (using think-alouds) different steps of the computations.
  - o Draw or construct fraction bars to demonstrate multiplication and division of the fraction bars.

How will I gradually withdraw support as students become capable of independent performance?
- As students work with partners or in small groups, the teacher will monitor conversations that are taking place, problem solving strategies that are being used and paths to solutions; mastery becomes evident.

Evaluation of Student Understanding:

How will I correct misunderstandings and reinforce learning?
- Using Challenge Problems #1 and #2, students will justify and/or explain why their problem solving strategies are consistent with viable and reasonable solution paths.
- Misunderstandings will be corrected by leading questions and discussions with other students who do understand the concepts.

*How will I **evaluate** students' understanding and their readiness to move forward?*
- If students are struggling with their problem solving strategies or solution paths, then some individual and/or small group re-teaching may be needed.

What activities will I suggest for enrichment and remediation?
- Individual and/or small group presentations demonstrating conceptual understanding of two-step word problems in one variable utilizing whole numbers
- Peer teaching using problem solving strategies and/or models
- Ask each student to bring in one of their favorite recipes; changing the ingredients so that at least 50 or more servings can be made using their recipe.
- Optional activities:
  - o Suggest that one or more students seek out a caterer or chef from the Culinary Arts department at your program to see how recipes are altered to feed various large groups of people.
  - o If a student or group can, ask them to alter one of their favorite recipes for a class taste testing; showing the original recipe and how it was altered to feed all students within the class.

Reflection, Closure, & Connection:

*How will I engage students in **reflecting** on what they have learned?*
- Ask students how their process for solving problems in this lesson relates to their real world situations.
- Ask students how they could improve their problem solving strategies based on outcomes of attempting to solve the problems presented.
- Ask students what judgments they would make about the problem solving strategies they used.

*What will I use to **draw ideas together** for students at the end?*
- Ask students how the problem solving strategies and/or vocabulary used contributed to generating solutions.
- Ask students to compare and contrast the two recipes (e.g., number of servings, size of servings, cost per serving, etc.)

*What lessons can I **preview** for students that will follow as a result of this lesson?*
- Word problems using ratios, proportions, and percents

Challenge Problem #1

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Mrs. C's Fantastic Chocolate Chip Cookies

Makes 3 dozen (36 cookies)

o   1/2 cup butter (softened)
o   1 egg
o   2 teaspoons vanilla extract
o   1 cup brown sugar, packed
o   3 tablespoons sugar
o   1/2 teaspoon baking soda

o   1/2 teaspoon baking powder
o   1/4 teaspoon salt
o   1 cup all-purpose flour
o   3/4 cup whole-wheat flour
o   1/2 cup uncooked oatmeal
o   10 oz. package chocolate chips

Directions

1. Mix together butter (softened) and sugars. Add egg and vanilla and continue mixing. Slowly add the flours, baking powder, baking soda and salt. With a wooden spoon, mix in the oatmeal and chocolate chips.

2. Cook at 375° F for 10-12 minutes.

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Directions for Student Activity Challenge Problem #1:

1. Set the stage by discussing the above recipe (Note – make sure students are aware that one cookie equals one serving and one batch makes 36 cookies.)
2. Inform the class that this recipe needs to be altered to make 180 cookies.
3. Have students determine how one ingredient's quantity will need to be changed so that 180 cookies can be made.
4. Have students determine how much of each ingredient will be needed if one-half of the recipe is made.
5. Have students determine the amount of each ingredient from the recipe that would make 54 cookies.

Mrs. C's Fantastic Chocolate Chip Cookies

Ingredients to serve 180 people

_____ cup butter (softened)   _____ egg

_____ teaspoons vanilla extract   _____ cup brown sugar, packed

_____ tablespoons sugar   _____ teaspoon baking soda

_____ teaspoon baking powder   _____ teaspoon salt

_____ cup all-purpose flour   _____ cup whole-wheat flour

_____ cup uncooked oatmeal   _____ oz. package chocolate chips

Ingredients needed to bake "one-half" of the recipe

_____ cup butter (softened)   _____ egg

_____ teaspoons vanilla extract   _____ cup brown sugar, packed

_____ tablespoons sugar   _____ teaspoon baking soda

_____ teaspoon baking powder   _____ teaspoon salt

_____ cup all-purpose flour   _____ cup whole-wheat flour

_____ cup uncooked oatmeal   _____ oz. package chocolate chips

Ingredients needed for 54 servings

_____ cup butter (softened)   _____ egg

_____ teaspoons vanilla extract   _____ cup brown sugar, packed

_____ tablespoons sugar   _____ teaspoon baking soda

_____ teaspoon baking powder   _____ teaspoon salt

_____ cup all-purpose flour   _____ cup whole-wheat flour

_____ cup uncooked oatmeal   _____ oz. package chocolate chips

Challenge Problem #2

Carrot Pumpkin Bars

Makes 24 bars
One square equals one serving

Filling:
2 cups flour
1 1/4 teaspoon pumpkin pie spice
2 teaspoon baking powder
1 teaspoon baking soda
1 cup sugar
1/3 cup light butter/margarine, softened
1/2 cup brown sugar
2 eggs
2 large egg whites
1 can (15 oz.) pumpkin pie filling
1 cup carrot, finely shredded

Cream cheese topping:
4 oz light cream cheese, softened
1/4 cup sugar
1 tablespoon skim milk

Directions

Pre-heat oven to 350. Grease 15 x 10 jellyroll pan.

Prepare Filling. In small bowl, combine flour, pumpkin spice, baking powder & baking soda.

In larger bowl, beat sugar, butter and brown sugar until crumbly. Add eggs, egg whites, pumpkin pie mix and carrots. Beat until well blended. Add flour mixture and mix until well blended. Spread onto greased pan.

Prepare Cream Cheese topping. Mix together cream cheese, sugar and milk until thoroughly blended.

Drop rounded teaspoon portions of topping over pumpkin batter and swirl mixture with a knife.

Bake for 25-30 minutes. Let cool and cut into 24 equal size portions.

Lesson plan template modified from Standards in Action (OVAE, 2009)

Directions for Student Activity Challenge Problem #2:

1. Set the stage by discussing the above recipe (Note – make sure students are aware that one bar equals one serving and one batch makes 24 bars.)
2. Inform the class that this recipe needs to be altered to make 180 bars.
3. Have students determine how one ingredient's quantity will need to be changed so that 180 bars can be made.
4. Have students determine how much of each ingredient will be needed if one-half of the recipe is made.
5. Have students determine the amount of each ingredient from the recipe that would make 54 bars.

Carrot Pumpkin Bars

Ingredients needed for 180 servings

_____ cups flour

_____ teaspoon pumpkin pie spice

_____ teaspoon baking powder

_____ teaspoon baking soda

_____ cup sugar

_____ cup light butter/margarine, softened

_____ cup brown sugar

_____ eggs

_____ large egg whites

_____ can (15 oz.) pumpkin pie filling

_____ cup carrot, finely shredded

Cream cheese topping:

_____ oz light cream cheese, softened

_____ cup sugar

_____ tablespoon skim milk

Ingredients needed to bake "one-half" of the recipe

_____ cups flour

_____ teaspoon pumpkin pie spice

_____ teaspoon baking powder

_____ teaspoon baking soda

_____ cup sugar

_____ cup light butter/margarine, softened

_____ cup brown sugar

_____ eggs

_____ large egg whites

_____ can (15 oz.) pumpkin pie filling

_____ cup carrot, finely shredded

Cream cheese topping:

_____ oz light cream cheese, softened

_____ cup sugar

_____ tablespoon skim milk

Lesson plan template modified from Standards in Action (OVAE, 2009)

Ingredients needed for 54 servings

_____ cups flour

_____ teaspoon baking powder

_____ cup sugar

_____ cup brown sugar

_____ large egg whites

_____ cup carrot, finely shredded

_____ teaspoon pumpkin pie spice

_____ teaspoon baking soda

_____ cup light butter/margarine, softened

_____ eggs

_____ can (15 oz.) pumpkin pie filling

Cream cheese topping:

_____ oz light cream cheese, softened

_____ tablespoon skim milk

_____ cup sugar

Lesson: Surface Area (Geometry)

Standard:
4.G.10
Solve real-world and mathematical problems involving area, volume and surface area of two-dimensional and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes and right prisms.

Purpose of Instruction:
What key concepts or procedures will be taught?
- Properties of two-dimensional shapes can be used to solve problems involving three-dimensional shapes.
- Two-dimensional and three-dimensional shapes can be defined by their properties; real world and geometric structures can be composed with these shapes.
- Surface area is a measurement that relates to the properties of a three-dimensional figure.
- Algebraic reasoning is applied when solving geometric problems (surface area).

*What **purposes** or objectives will I explicitly communicate to students?*
- Understand the strategies, operations, and properties of mathematics as it applies to surface area
- Algebraic and quantitative reasoning

Materials Needed:
*What **materials** will be needed?*
- GED® 2014 Formula sheet
- Challenge Problems #1 and #2 (copied or displayed)
- Calculators

What advance preparation is needed?
- Teacher will need to decide whether to use Challenge Problem #1 and #2 individually or as a small group exercise.
- Practice converting three-dimensional figures into two-dimensional figures.

Time Needed:
How much time will be spent assessing for necessary foundational competencies?
- 10 – 15 minutes

How much will be devoted to direct, explicit instruction?
- 15 – 20 minutes

How much time will be devoted to small group and/or individual work?
- 15 – 20 minutes

Introduction & Explanation:
How will I get and hold students' attention?
- Refer to Challenge Problem #1

How will I tie lesson objectives to student interests and previous classroom activities?
- This activity will build upon the students' understanding of area from a two-dimensional figure. (Note: The whole is equal to the sum of its parts.)

What questions might I ask to stimulate student thinking?
- Have you ever wanted to change the color/paint a room in your home to a different color?
- How can you visualize, describe, or draw the room to be painted?
- If you have drawn the room, how many faces are in the drawing?
- Once you have a model, how can you use information to begin the problem-solving process?

*How will I **introduce and explain** key skills and concepts (e.g., inductive method, mini-lecture, demonstration, notes, etc.)?*
- Explaining what the p, h, and B means within the surface area formula
- Relate area of each wall to **total** surface area formula
- Show how the area of each wall minus the windows and entrance can be found the "long way". (The long way is to subtract the area of the windows and entrance from the sum of the area of each wall added together.)
- Compare the surface area formula on the GED® 2014 formula sheet to the sum of the areas of the parts of a rectangular prism.

Modeling:
*How will I **model** this skill or strategy for my students (e.g., exemplars, demonstrations, discussions)?*
- Challenge Problem #1
  - o Determine the area of a three-dimensional figure using the concept of "the whole is equal to the sum of its parts".

How will I break complex skills or bodies of information into understandable components?
- Challenge Problem #1
  - o Show how the area of each wall minus the windows and entrance can be found the "long way". (The long way is to subtract the area of the windows and entrance from the sum of the area of each wall added together.)
  - o Compare the results of the "long way" computations to the solution found using the surface area formula on the GED® 2014 formula sheet.

Lesson plan template modified from Standards in Action (OVAE, 2009)

Guided Practice:

*How will students **practice** using the skill or concept targeted by the standard?*

- Challenge Problem #2
  - o Determine the area of a three-dimensional figure using the concept of "the whole is equal to the sum of its parts".

How will I gradually withdraw support as students become capable of independent performance?

- As students work with partners or in small groups, the teacher will monitor conversations that are taking place, problem solving strategies that are being used and paths to solutions; mastery becomes evident.

Evaluation of Student Understanding:

How will I correct misunderstandings and reinforce learning?

- Using Challenge Problems #1 and #2, students will justify and/or explain why the whole is equal to the sum of its parts and how it relates to the surface area formula on the GED® 2014 formula sheet.
- Misunderstandings will be corrected by leading questions and discussions with other students who do understand the concepts.

*How will I **evaluate** students' understanding and their readiness to move forward?*

- If students are struggling with their problem solving strategies or solution paths, then some individual and/or small group re-teaching may be needed.

What activities will I suggest for enrichment and remediation?

- Individual and/or small group presentations demonstrating conceptual understanding of how to determine the surface area of a three-dimensional figure.
- Peer teaching using problem solving strategies and/or models

Reflection, Closure, & Connection:
*How will I engage students in **reflecting** on what they have learned?*
- Ask students how their process for solving problems in this lesson relates to their real world situations.
- Ask students how they could improve their problem solving strategies based on outcomes of attempting to solve the problems presented.
- Ask students what judgments they would make about the problem solving strategies they used.

*What will I use to **draw ideas together** for students at the end?*
- Ask students how the problem solving strategies and/or vocabulary used contributed to generating solutions.
- Ask students to compare and contrast the two methods for computing the surface area of a three-dimensional figure.

*What lessons can I **preview** for students that will follow as a result of this lesson?*
- Surface areas of other three-dimensional figures
- Discuss what concept could be used if wallpaper or a wallpaper border was desired.
- The concept of surface area means the combined area of the faces of a three-dimensional figure versus volume, which is the measure of the quantity needed to fill a three-dimensional figure (e.g., the glass that makes up a fish tank versus the water inside the fish tank).

Challenge Problem #1

Rob Kenwood wants to paint his living room walls. Rob's living room is 12 feet wide, 18 feet long and has a height of 8 feet. He is going to paint only the walls and the ceiling, not the floor of this room.

In his living room, there are some places that Rob will not paint. These places are the two windows and an entrance to this room. If each window measures 3.0 feet long by 5.0 feet wide and the entrance measures 4.0 wide feet and 7.0 feet long, how many gallons of paint will Rob need for this job? (Note: A gallon of paint covers 320 ft^2.)

Directions for Student Activity Challenge Problem #1:

   Ask students:
   - o Would you purchase four or five gallons of paint?
   - o What happens if these four or five gallons of paint were not enough to paint the room?
   - o Would the painter have to make a second trip to the paint store?
   - o What problems could happen if not enough paint was purchased initially?
   - o Would you purchase ten gallons of paint to paint the room?
   - o What happens if ten gallons of paint were too much to paint the room?
   - o What problems could happen if too much paint was purchased initially?

Solution for Challenge Problem #1

1. Find the surface area of the "ENTIRE ROOM." This means finding the surface area of a rectangular prism.

    SA = perimeter times the height of the room plus TWICE the Base Area
    = (12 + 18)(8) + 2(12 x 18)
    = 8(30) + 2(216)
    = 240 + 432
    = 672 SQUARE FEET

2. Find the area of the windows, entrance and floor of this room.
    Windows: Remember there are TWO.
    3 feet x 5 feet = 15 square feet x 2 = 30 square feet

    Entrance: 4 feet x 7 feet = 28 square feet

    Floor: 12 feet wide x 18 feet long = 216 square feet

3. Take all answers in "second" part and add together.
    30 square feet + 28 square feet + 216 square feet = 274 square feet

4. Subtract the answer obtained in "third" part from the answer obtained in the "first" part to determine what is the surface area that Rob will be painting.
    672 square feet — 274 square feet = 398 square feet

To complete the problem the number of gallons needs to be found. This is done by taking the answer in step four and dividing this answer by 320 square feet. (Note: Answer MUST BE a WHOLE NUMBER because the problem asks for number of gallons.)

    398 square feet ÷ 320 square feet = 1.24375 gallons of paint

CORRECT ANSWER: 2 gallons of paint

Lesson plan template modified from Standards in Action (OVAE, 2009)

Challenge Problem #2

Rob Kenwood wants to paint his living room walls. Rob's living room is
16 feet wide, 20 feet long and has a height of 8 feet. He is going to paint only the walls
and the ceiling, not the floor of this room.

In his living room, there are some places that Rob will not paint. These places are the
two windows and an entrance to this room. If each window measures 3.0 feet long by
5.0 feet wide and the entrance measures 4.0 wide feet and 7.0 feet long, how many
gallons of paint will Rob need for this job? (Note: A gallon of paint covers 320 ft^2.)

Directions for Student Activity Challenge Problem #2:

Ask students:
- Would you purchase four or five gallons of paint?
- What happens if these four or five gallons of paint were not enough to paint the room?
- Would the painter have to make a second trip to the paint store?
- What problems could happen if not enough paint was purchased initially?
- Would you purchase ten gallons of paint to paint the room?
- What happens if ten gallons of paint were too much to paint the room?
- What problems could happen if too much paint was purchased initially?

Solution for Challenge Problem #2

1. Find the surface area of the "ENTIRE ROOM." This means finding the surface area of a rectangular prism.

   > SA = perimeter times the height of the room plus TWICE the Base Area
   >   = (16 + 20)(8) + 2(16 x 20)
   >   = 8(36) + 2(320)
   >   = 288 + 640
   >   = 928 SQUARE FEET

2. Find the area of the windows, entrance and floor of this room.
   > Windows: Remember there are TWO.
   > 3 feet x 5 feet = 15 square feet x 2 = 30 square feet
   >
   > Entrance: 4 feet x 7 feet = 28 square feet
   > Floor: 12 feet wide x 18 feet long = 216 square feet

3. Take all answers in "second" part and add together.
   > 30 square feet + 28 square feet + 216 square feet = 274 square feet

4. Subtract the answer obtained in "third" part from the answer obtained in the "first" part to determine what is the surface area that Rob will be painting.

   > 928 square feet — 274 square feet = 654 square feet

To complete the problem the number of gallons needs to be found. This is done by taking the answer in part "four" and dividing this answer by 320 square feet. (Note: Answer MUST BE a WHOLE NUMBER because the question asks for the number of gallons.)

> 654 square feet ÷ 320 square feet = 2.04375 gallons of paint

CORRECT ANSWER: 3 gallons of paint

Lesson: Interpreting Categorical and Quantitative Data (Statistics and Probability)

Standard:
5.S.ID.3
Interpret differences in shape, center, and spread in contact of the data sets, accounting for possible effects of extreme data points (outliers).

Purpose of Instruction:
What key concepts or procedures will be taught?
- What is a data set?
- How can data be used to reach conclusions?
- How can data be gathered on a specific subject?
- How can data be represented? Graphs? Units? Scale?
- Vocabulary and concepts: inferences, representation, randomization, outliers, relationships between two quantities
- Creating data tables

*What **purposes** or objectives will I explicitly communicate to students?*
- Representing data accurately
- Making connections between data sets
- Which data collection methods are appropriate for different situations?
- How to read graphic representations of data sets

Materials Needed:
*What **materials** will be needed?*
- Samples of various types of data sets (or sources that data tables could be created from)
- Calculators
- Graph paper
- Colored pencils, markers
- Cardstock, tape, and safety pins for buttons

What advance preparation is needed?
- Time will be spent selecting examples of data gathering and display
- Time will be spent copying, cutting and creating buttons
- Students will need to identify and seek participation from others in their lives 2 days before the exercise begins.

Time Needed:
How much time will be spent assessing for necessary foundational competencies?
- 10 – 15 minutes

How much will be devoted to direct, explicit instruction?
- 15 – 20 minutes

How much time will be devoted to small group and/or individual work?
- 20 – 30 minutes during class (more time spent "infecting" others outside of class

Introduction & Explanation:
How will I get and hold students' attention?
- Refer to Challenge Problem #1

How will I tie lesson objectives to student interests and previous classroom activities?
- Look back at data that was examined at the beginning of the lesson and ask students the following questions in a large group discussion:
  - What do you notice about how you represented your data compared to the data that was provided?
  - Can you think of other ways to represent your data that you didn't try yet?
  - What conclusions can you reach about how data is represented?

What questions might I ask to stimulate student thinking?
- When students have completed Challenge Problem #1and shared their findings, begin a large group discussion:
  - What trends in "infection rates" can be identified?
  - Do the random groupings have an effect to delay or increase infection rates? (e.g., do students live in the same part of town, take the same bus, have significant others who work together, shop in the same places, etc.)

*How will I **introduce and explain** key skills and concepts (e.g., inductive method, mini-lecture, demonstration, notes, etc.)?*
- The discussion on data and its representations will begin with asking students how they use data currently
- Students will be shown examples of data and its graphical representation

Modeling:

*How will I **model** this skill or strategy for my students (e.g., exemplars, demonstrations, discussions)?*

- Show examples of data collection and representation
- Challenge Problem #1
  - Discuss with the class the objectives of the Zombie Apocalypse
  - Launch the Zombie Apocalypse

How will I break complex skills or bodies of information into understandable components?

- Challenge Problem #1
  - Follow the directions in Challenge Problem #1 and gather data based on your own actions during the game, along with those whom you chose
  - Think about the following questions as you begin to get data:
    - How will I know who is who when they give me their data?
    - How will I keep track of all the data I am going to get?
    - How can I organize my data so that when I have to use it to make decisions, it will be in a usable form?

Guided Practice:

*How will students **practice** using the skill or concept targeted by the standard?*

- Challenge Problem #2
  - Choose the best way to represent your data graphically, present your findings to a small group, and be prepared to justify your choice of graph style.

How will I gradually withdraw support as students become capable of independent performance?

- As students work in small groups, students will work independently or with their group members to decide on the best way to represent their data; the teacher will monitor conversations that are taking place, observe students making the conversion of data to a graphical representation, and will be in tune to students' decisions and justifications.

Evaluation of Student Understanding:
How will I correct misunderstandings and reinforce learning?
- As students present their graphic representations of their data, they will discuss their decision-making process for recording, organizing and displaying their data. The intent of this exercise is to provide an opportunity for students will self-disclose the difficulties they had with data organization, representing their data graphically, and reconciling what they predicted with what actually occurred.

*How will I **evaluate** students' understanding and their readiness to move forward?*
- Based on the large group presentations and the discussion that follows, the instructor will be able to assess for readiness to move forward.

What activities will I suggest for enrichment and remediation?
- Ask students some of the following questions for enrichment:
    o What do you think would have occurred if you all lived in the same area?
    o What would have happened (or did happen) if those you asked to participated did not follow through?
    o What happened to your predictions about the spread of the infection?
    o What does the representation of data have to do with its acceptance?

Reflection, Closure, & Connection:
*How will I engage students in **reflecting** on what they have learned?*
- Ask students if the conclusions they drew from their data could be replicated on a larger scale, and what that would mean.
- Ask students about the validity of their data and conclusions.

*What will I use to **draw ideas together** for students at the end?*
- Ask students to discuss how they interact with data on a daily basis

*What lessons can I **preview** for students that will follow as a result of this lesson?*
- Making inferences from data
- Justifying conclusions with data
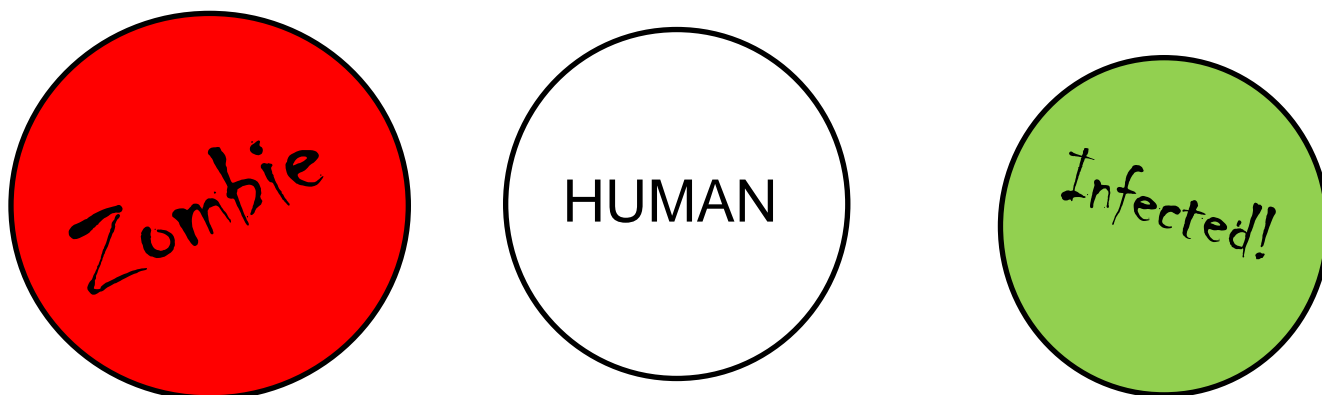- Using probability and statistics to make predictions

Lesson plan template modified from Standards in Action (OVAE, 2009)

Challenge Problem #1:   The Zombie Apocalypse

Two to three days before starting the exercise, students will be asked to identify people in their life who will participate with them in the exercise (and be willing to report data in a timely fashion). The exercise will "be live" for one week, then the final data will be compiled and analyzed during class.

Launching the Zombie Apocalypse: Students will be given five sets of 6 buttons. Each set of buttons contains one "HUMAN" button, one "Zombie" button, and four "Infected" button. Students will immediately pin the "HUMAN" button on themselves. **<u>*NO infections can take place in class!</u>**

1. Ask students to make and record predictions about how they think the infection will spread.
2. Students will leave class, and throughout the rest of the day, will deliver the other sets of buttons to those in their lives who have committed to participating in the exercise.
3. Once all students have distributed their sets of buttons, they are ready to begin the exercise.
4. Students will hand out the "Infected" buttons. Once they have passed out all the infected buttons, they become a zombie and must pin on the "Zombie" button.
5. Students will gather info regarding the people to whom they have given an "Infected" button –where they live and/or work and the number of potential "infectees" at their home and/or work environment. ***No explicit instruction will be given to the students as to how they should record the data regarding the number of people they infected, or how many _those_ people then infect.**

Lesson plan template modified from Standards in Action (OVAE, 2009)

Challenge Problem #2

Choose the best way to represent your data graphically, present your findings to a small group, and be prepared to justify your choice of graph style.

Directions for Student Activity Challenge Problem #2:

Form small (random) groups of students and give the following directions:
- o Examine your record keeping and determine if it was adequate to your needs
    - Is the data organized?
    - What do you know now about recording data and keeping it organized?
    - How will you use your data to "tell your story"?
- o Determine the best way to represent your findings graphically
- o Create a graph of your and discuss within your small group what your data tells you
- o Be prepared to explain your choices of graph, data collection methods and data organization

Lesson: Interpreting Categorical and Quantitative Data (Statistics and Probability)

Standard:
6.S.CP.5
Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.

Purpose of Instruction:
What key concepts or procedures will be taught?
- Finding the probability of independent and dependent events
  $P(A + B) = P(A) \times P(B)$
- Demonstrate how the following equations can be used to solve probability problems:
  - $P(A + B) = P(A) \times P(B)$ for independent events
  - $P(A + B) = P(A) \times P(B \ after \ A)$ for dependent events

*What **purposes** or objectives will I explicitly communicate to students?*
- How the game of "index cards" is played. (See Game #1)

Materials Needed:
*What **materials** will be needed?*
- Index cards or pieces of construction paper in two colors of the same shape and size
- A bag or other container (not able to be seen through) for each group of students playing.
- Each bag or container per group should contain a 3:1 ratio of colored pieces of paper. (3 of a color, and 1 of another color).
- A tally sheet (notebook paper is fine) the Recording Student will use to keep track of points earned.

What advance preparation is needed?
- Discuss with students how to find the probability of single events prior to introducing the game.

Time Needed:
How much time will be spent assessing for necessary foundational competencies?
- 10 – 15 minutes

How much will be devoted to direct, explicit instruction?
- 10 – 15 minutes

How much time will be devoted to small group and/or individual work?
- 20 – 30 minutes during class

Introduction & Explanation:

How will I get and hold students' attention?
- Refer to Game #1

How will I tie lesson objectives to student interests and previous classroom activities?
- Ask students – prior to the game – what predictions they can make.

What questions might I ask to stimulate student thinking?
- Based on the rules of the game for the first selection, will the probabilities for each Student One be the same? Why or why not?
- Based on the rules of the game for the first selection, will the probabilities for each Student Two be the same? Why or why not?
- Based on the rules of the game, regarding each group playing, will the probabilities for Student One and Student Two be the same? Why or why not?
- Can each group predict who within their group will score the most points?

*How will I **introduce and explain** key skills and concepts (e.g., inductive method, mini-lecture, demonstration, notes, etc.)?*
- Tell the students this is not a "fair" game; one student will clearly have an advantage.
- Ask the class who might be at an advantage and why.
- Explain the point of activity is not to win, but to examine what the advantage is the winner has.

Modeling:

*How will I **model** this skill or strategy for my students (e.g., exemplars, demonstrations, discussions)?*
- Show examples of single variables probabilities (flipping a coin).
- Flip a coin 15 times and record whether the result was heads or tails.
- Ask students to predict what the next five flips of the coin will be based on the previous results. (They won't be able to as the two sides of a coin are independent variables.)

How will I break complex skills or bodies of information into understandable components?
- Discuss the results of the game – how did the students find the probability of a single event?
- How will the results of the game be used for additional discussions?

Guided Practice:

*How will students **practice** using the skill or concept targeted by the standard?*
- After the game has been played, ask students to apply their knowledge and experience when additional pieces of paper are added to the bag. (Add 2 more pieces of both colors of paper into the bag.)
- Have all students play the game again, ensuring each student goes through each role again.

How will I gradually withdraw support as students become capable of independent performance?
- As students begin the second round of the game, most of them will be able to complete the task independently and with little supervision.

Evaluation of Student Understanding:

How will I correct misunderstandings and reinforce learning?
- As student participation is monitored, misunderstandings can be corrected with guidance and large group discussions will reinforce the lesson content.

*How will I **evaluate** students' understanding and their readiness to move forward?*
- Review the concept of probability of a single event and how it relates to the current game.

What activities will I suggest for enrichment and remediation?
- After the game has been played twice, ask students how adding more colored pieces (both scenarios of the equal and unequal addition of colored pieces should be explored) might affect future outcomes.

Reflection, Closure, & Connection:

*How will I engage students in **reflecting** on what they have learned?*

- Check the results and predictions made and see how close the students came prior to playing either game.

*What will I use to **draw ideas together** for students at the end?*

- Reveal how the equations shown below can be used to solve probability problems in the future:
    - $P(A + B) = P(A) \times P(B)$ for independent events
    - $P(A + B) = P(A) \times P(B \text{ } after \text{ } A)$ for dependent events

*What lessons can I **preview** for students that will follow as a result of this lesson?*

- Use the time to reinforce previously learned concepts, ask students which situation – doing text book problems or performing a model of the concepts – displayed theoretical or experimental probability.

Game #1:

NOTE: Each group of students will be doing this game three times to ensure that they all have a chance to play the game, and each student serves as the Student Recorder once.

In groups of 3 students:
1. Decide roles for the game: Student One, Student Two, and Recording Student
2. Student One will pick a card from the bag, then put the drawn card back in the bag.
3. When the first drawn card is returned to the bag, Student One draws another card from the bag.
4. Recording Student will give Student One a point if both cards he or she drew from the bag are the same color. (No points will be given if the cards drawn are different colors.)
5. After Student One has drawn both of his or her cards, Student Two will draw his or her first card.
6. Student Two will draw a second card **without returning the first card drawn to the bag.**
7. Recording Student will give Student Two a point if both cards he or she drew from the bag are the same color. (No points will be given if the cards drawn are different colors.)

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