

**Instructional Day:** 3**Topic Description:**

This lesson introduces four main phases of the problem-solving process.

**Objectives:**

The students will be able to:

- Name and explain the steps in the problem-solving process
- Solve a problem by applying the problem-solving process
- Explain what the word algorithm means

**Outline of the Lesson:**

- Candy bar activity (25 minutes)
- Discussion of solutions (10 minutes)
- Introduction of the steps in the problem-solving process (15 minutes)
- Journal Entry (5 minutes)

**Student Activities:**

- In groups, participate in the candy bar activity.
- Participate in discussion of solutions.
- Reflect on the candy bar activity as it relates to the problem-solving process.
- Complete journal entry.

**Teaching/Learning Strategies:**

- Candy bar activity
  - Divide the students into groups of 2 or 3. Give each group a candy bar.
  - Explain that their task is to determine how many "breaks" it will take to break the candy bar into 12 equal pieces. One break of one piece of the candy bar will result in that one piece being divided into two pieces. Demonstrate a "break" by breaking the bar into two pieces. Then stack the two pieces together and break or cut the two pieces into four.
  - At this point, have each student write in their journal the number of breaks they think it will take to break the bar into 12 equal pieces. This should be done without talking to their partner or group members.
  - Working together with their partner or group, have the students discuss and then write their plan for solving the problem. They may revise their guess at this point.
  - Once this is completed, the students should implement the plan by opening the candy, breaking the candy, and counting the number of breaks it takes to get 12 equal pieces.
- Discussion of solutions
  - Choose a group to present their plan to the class.
    - Sample questions to ask—Was your guess correct? What process did you use to come up with your guess? Did working with your group and creating your plan

- change your guess? How many breaks did it take (11 is the answer)? Did your plan work?
- How do the steps they used match what they wrote in their journal?
  - Introduction to steps in the problem-solving process (Note: These steps are as defined by G. Polya in *How to Solve it*. Other “definitions” exist. The purpose is for students to be able to articulate what happens in each phase rather than have a specific definition.)
    - How do the steps they used relate to the “formal” steps of the problem-solving process?
      1. Understand the problem—read or listen to the problem statement.
      2. Make a plan to solve the problem—use pictures, charts, graphs, systematic lists, objects, or act out the solution to help you devise a plan to solve the problem
        - In Computer Science we call this plan an **algorithm**.
      3. Carry out the plan—once the plan is conceived and understood, follow the plan. If you have planned well, this is the easy part.
      4. Review and reflect on how the problem was solved—once the problem is solved, reflect on the plan that was used.
  - Extend breaking the candy into N pieces.
    - Post the Number of Pieces/Number of Breaks Chart (without solutions), including N and have students give you the # of breaks needed for each number of pieces.
    - As you go through the chart, ask questions that lead students to the following understandings.
      - One problem-solving strategy used in solving a problem is to solve a problem for specific values, find the pattern and then generalize the solution. In this case, they are generalizing the solution for an unknown positive number of pieces.
  - Reflections on the candy bar problem: Ask the students to reflect on the candy bar problem. Why is this problem an important problem to solve for: a carpenter, a chef, a teacher?
  - Journal Entry: How is solving this kind of problem the same/different from how you solve a problem in “real life”?
    - Discuss what makes a problem solvable by computer—being able to provide a step-by-step algorithm is one important piece, but context matters. Think back to unit 1 and making a peanut butter and jelly sandwich. Even if we refined our algorithm would a computer be able to make one? No, but a robot could. (Foreshadow Unit 6.)

#### Resources:

- Polya, G. How to Solve It. 2nd. Princeton, NJ: Princeton University Press, 2004.
- Candy bar problem suggested by Dr. Manuel Blum, Carnegie Mellon University
- Candy bars for student groups to use
- Number of Pieces/Number of Breaks Chart

**Number of Pieces/Number of Breaks Chart**

<b>Number of Pieces</b>	<b>Number of Breaks</b>
<b>1</b>	<b>0</b>
<b>2</b>	<b>1</b>
<b>3</b>	<b>2</b>
<b>4</b>	<b>3</b>
<b>5</b>	<b>4</b>
<b>6</b>	<b>5</b>
<b>7</b>	<b>6</b>
<b>8</b>	<b>7</b>
<b>9</b>	<b>8</b>
<b>10</b>	<b>9</b>
<b>11</b>	<b>10</b>
<b>12</b>	<b>11</b>
<b>N</b>	<b><i>N-1</i></b>