ECT Lesson Plan: Solving a Guessing Game with Data

Lesson plan at a glance...

Core subject(s)	Computer Science, Mathematics
Subject area(s)	Logic, Software Development Fundamentals
Suggested age	8 to 12 years old
Prerequisites	*None*
Time	**Preparation:** 10 to 22 minutes **Instruction:** 65 to 70 minutes
Standards	**Core Subject:** CCSS Math **CS:** CSTA, UK, Australia

In this lesson plan…

Lesson Overview

In this lesson, students will play a guessing game with one of their peers. In the first game, one student in each pair will be the host and the other will be the guesser. For the second game, students switch roles. Students will use **data collection** to collect data while they play, **data representation** to chart the results in table format, and possibly **pattern generalization** to use patterns in their questions, similes, or answers. Students will then use **data analysis** to analyze the results, **algorithm design** to draw a flowchart of the steps of the game, and **pattern recognition** to observed patterns in the questions and answers that resulted from the game

Materials and Equipment

- □ For the teacher:
  - *Required:* Hard copies of photos required for Activity 1

    OR
  - *Required:* Internet-connected computer, projector and projector screen or other flat projection surface
  - *Required:* Digital copies of photos required for Activity 1
- □ For the student:
  - *Required:* Journal
    - If using Google Docs (http://docs.google.com) or a wiki
      - Internet-connected computer (one (1) computer per student recommended)
    - If not using a computer-based collaboration tool
      - Markers/Whiteboard or Paper and Pen/Pencil

Preparation Tasks

	Gather photos and write a 2 word description for each	10 to 15 minutes
	Confirm that computers are on and logged-in (if using)	1 to 3 minutes
	Confirm that your projector is turned on and is projecting properly (if using)	1 to 4 minutes

The Lesson

Warm-up Activity: Warm it up!	5 to 10 minutes
Activity 1: Playing the game	30 minutes
Wrap-up Activity: Analysis and reflection	30 minutes

Warm-up Activity: Warm it up! (5 to 10 minutes)

Activity Overview: In this activity, students will complete a warm-up exercise incorporating student choice and encouraging student-teacher interaction to prepare for the Guessing Game.

Activity:
Have students vote on one of the activities below. Each activity is designed to focus your students' attention on the lesson, activate prior knowledge, increase student engagement, and/or prepare them for the following activities.

1. Think-Pair-Share: Instruct students to fill in the blanks in these statements to create interesting similes (comparisons) *individually,* and then pair with one or more classmates to refine the comparison *collaboratively*. Provide a few based upon things in the classroom. Examples: My desk is like a table (flat); the pencil sharpener is like a blender (grinds things).
    - A ball is like _____.
    - A helicopter is like _____.
    - A _____ is like the sun.
    - A _____ is like a horse.

    After students compare their examples with partners, invite them to create 1 or 2 of their own.

2. 4-S Brainstorming: Students respond to the following prompt by generating various answers: Describe an elephant (or other object) by listing as many things as you can that show a similarity. For instance, it is like a giant (big) and it is like a cloudy day (gray).

- Four students will be selected to play a specific role in helping the class generate the maximum number of responses.
    - *Accelerator* - Student encourages classmates to generate more ideas ("Let's get more ideas, only two minutes left")
    - *Acceptor* - Student helps classmates commit to an idea ("All ideas are OK, write that one down")
    - *Exaggerator* - Student encourages classmates to generate different kinds of ideas ("We need some silly ideas")
    - *Connector/recorder* - Student makes the connection between different ideas and writes them down ("Which ideas are connected to that?")

Assessment:
Formatively assess by observing that all students participate. Encourage those that are more reluctant by giving them some ideas to get them started.

Activity 1: Playing the game (30 minutes)

Activity Overview: In this activity, students will play a guessing game and take turns being the guesser and the host. Students will use **data collection** to collect data while they play, **data representation** to chart the results in table format and possibly **pattern generalization** to use patterns in their questions, similes, or answers. Students analyze the patterns in responses and generalize into an algorithm for solving this type of problem.

Notes to the Teacher:
1. Find photos that each represent a simple object, an animal, or a plant (one for every student in the class).
2. Together with the photo, each student receives a verbal description of the photo. This description has to be of the form [adjective] [noun] (examples: "blue flower", "black hammer", "brown squirrel").
3. Divide students into groups of two and give one photo with its description to each student; they should not show their photos to each other.

Activity:
In the first game, one student is the *guesser* and has to guess the verbal description of the photo received by the other student, called the *host*.

The goal, as a host, is to give information which will help the guesser guess the verbal description of your photo. The host tries to guide the guesser to the correct answer by adhering to the following steps:

a. The host gives a *simile* about the object. A simile compares two things using the words “like” or “as”:
   Examples of similes:
   i. *[Simile] The object is like a basketball. (suggests bouncing ability or round shape)*
   ii. *[Simile] The object is like the sun. (suggests luminosity or heat)*
   iii. *[Simile] The object is like a tomato. (suggests round shape or red color)*
b. The guesser may ask two types of questions: “guess” questions and “Yes or No” questions.
   i. Examples of “guess” questions:
      1. *[Guess] Is the object a red ball?*
      2. *[Guess] Is the object a black lantern?*
   ii. Examples of “Yes or No” questions:
      1. *[Question] Is the object larger than a bread box?*
      2. *[Question] Is the object blue?*

Additional rules:

1. A guesser can make as many guesses or as few guesses as he or she likes.
2. A guesser is *only* allowed to submit another guess after his/her previous guess has been answered by the host.
3. A host may only answer with “Yes” or “No” to a “guess” question. A host may answer with “Yes”, “No" or “Don’t Know” to a “Yes or No” question.
4. After the guesser has asked a question, the host must answer.
5. After the host has answered a “Yes or No” answer, the host must continue to post another simile.

Repeat the steps until a correct guess is made.

Record your exchange in a table like the one below:

Object: Blue bottle		
Host	[Simile]	The object is like the sky
Guesser	[Yes or No question]	Is the object blue?
Host	[Answer]	Yes
Host	[Simile]	The object is like a vase
Guesser	[Yes or No question]	Does the object hold water?
Host	[Answer]	Yes
Host	[Simile]	The object is like a whiffle ball
Guesser	[Yes or No Question]	Does the object have holes?
Host	[Answer]	Yes
Host	[Simile]	The object is like a screw

Guesser	[Guess question]	Is the object a blue bottle?
Host	[Answer]	Yes

In the second game, the two students change their roles. The goal now is to guess the verbal description of the second photo (the one kept by the initial guesser who is now the host).

Teaching Tips:

- To encourage students that might struggle to link computational thinking with the guessing game, select photos that reflect the culture of your classroom or local community.
- Instead of photos, small and easily identifiable objects (e.g. toy hammer, stapler) could be used to accommodate visually-impaired students or to differentiate the challenge for visually-able students. Be sure to choose an adjective that does not rely on sight (e.g. smooth, heavy)!

Assessment:
Determine or assess whether students successfully produce similes that help the guesser and if the photo is correctly identified.

Wrap-up Activity: Analysis and reflection (30 minutes)

Activity Overview: In this activity, students will analyze the guessing game to make bigger insights. Students will use **data analysis** to analyze the results, **data representation** and **algorithm design** to draw a flowchart of the steps of the game, and **pattern recognition** to observed patterns in the result questions and answers.

Notes to the Teacher:
Hold a class discussion in groups. Divide the class into groups of 8-10 students. The original partners should be together in this larger group.

Activity:
Instruct the students to respond (discuss in their group) to the following questions from their roles as hosts and then as guests. Have them document the answers in a journal.

Q1: First focus on your role as a host:

a. **Did your similes help the guesser? How would you improve your similes so that guessing can be completed in fewer steps?**
b. **How would you change your similes if the guesser was visually impaired and couldn't understand visual information such as the object color? What other senses could you incorporate besides sight?**

Q2: As a guesser:

c. **Were your questions helpful in guessing the object description? How could you improve your questions so that you guess the object in fewer steps?**
d. **Suppose you were visually impaired and couldn't understand visual information. How would you change your questions so that you can still guess the object?**

Q3: Do you think there was a good "question" or a good "simile" or a good "answer" in your games? If yes, discuss why you think so. Do your questions, similes, or answers follow a pattern (i.e. always asking about color first)?

Q4: A set of similar guessing, questioning, and answering steps might have repeated in your game. In that

case, the game had a loop consisting of those steps. Describe the repetition that occurred. Did you ever get "stuck in a cycle or loop" that was difficult to break out of? How did you break the loop?

Q5: Draw a flowchart of the steps outlined in Part 2. This is an algorithm that defines the sequence of steps to be conducted when playing the guessing game.

Assessment:
Assess student answers and their created flowcharts.

Learning Objectives and Standards

Learning Objectives	Standards
LO1: Students will be able to identify and generalize characteristics to create similes that describe the images.	*Common Core* CCSS.MATH.CONTENT.HSG.MG.A.1: Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). CCSS.MATH.CONTENT.3.G.A.1: Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories. CCSS.MATH.CONTENT.5.G.B.3: Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles. CCSS.MATH.CONTENT.5.G.B.4: Classify two-dimensional figures in a hierarchy based on properties. *Computer Science* CSTA L2.CT.15: Provide examples of interdisciplinary applications of computational thinking.
LO2: Students will be able to collect the data from the game play.	*Computer Science* CSTA L2.CT.15 *Common Core* CCSS.MATH.CONTENT.1.MD.C.4 Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.
LO3: Students will be able to strategize their game play based upon the data received.	*Computer Science* AUSTRALIA 10.4 (Collecting, managing and analyzing data): Analyse and visualise data to create information and address complex problems; and model processes, entities and their relationships using structured data CSTA L3B.CT.9: Analyze data and identify patterns through modeling and simulation.

	Common Core CCSS.MATH.PRACTICE.MP4: Model with mathematics.
LO4: Students will be able to analyze the game data to identify effective and ineffective elements.	*Computer Science* AUSTRALIA 10.4 (Collecting, managing and analyzing data) CSTA L3B.CT.9 *Common Core* CCSS.MATH.PRACTICE.MP3: Construct viable arguments and critique the reasoning of others.
LO5: Students will be able to identify patterns in the game data that resulted in efficient game play.	*Computer Science* AUSTRALIA 10.4 (Collecting, managing and analyzing data) CSTA L3B.CT.9 *Common Core* CCSS.MATH.PRACTICE.MP7: Look for and make use of structure.
LO6: Students will be able to generalize the game flow to describe an algorithm for solving the game.	*Computer Science* CSTA L2.CT.7: Represent data in a variety of ways including text, sounds, pictures and numbers. UK 3.6: Understand how instructions are stored and executed within a computer system; understand how data of various types (including text, sounds and pictures) can be represented and manipulated digitally, in the form of binary digits. *Common Core* CCSS.MATH.PRACTICE.MP8: Look for and express regularity in repeated reasoning. CCSS.MATH.PRACTICE.MP2: Reason abstractly and quantitatively.
LO7: Students will be able to create a flowchart from the generalized game flow.	*Computer Science* CSTA L2.CT.7 UK 3.6 *Common Core* CCSS.MATH.PRACTICE.MP5: Use appropriate tools strategically.

Additional Information and Resources

Lesson Vocabulary

Term	Definition	For Additional Information
Algorithm	A procedure or formula for solving a problem	http://en.wikipedia.org/wiki/Algorithm

Computational Thinking Concepts

Concept	Definition
Algorithm Design	Creating an ordered series of instructions for solving similar problems
Data Analysis	Making sense of data by finding patterns or developing insights
Data Collection	Gathering information
Data Representation	Depicting and organizing data in appropriate graphs, charts, words or images
Pattern Generalization	Creating models of observed patterns to test predicted outcomes
Pattern Recognition	Observing patterns and regularities in data

Administrative Details

Contact info For more info about Exploring Computational Thinking (ECT), visit the ECT website (g.co/exploringCT)

Credits Developed by the Exploring Computational Thinking team at Google and reviewed by K-12 educators from around the world.

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