

ECT Lesson Plan: Describing an Everyday Object

Lesson plan at a glance...

Core subjects	Computer Science
Subject areas	Data Analysis
Suggested age	8 to 15 years old
Prerequisites	None
Time	Preparation: 3 to 5 minutes Instruction: 60 to 85 minutes
Standards	Core Subject: CCSS Math CS: CSTA , UK , Australia

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Lesson Overview

Language is one way to clearly and thoroughly describe the attributes and functions of ordinary everyday objects. In this lesson, students act like the inventor of an everyday object that does not yet exist. Students **abstract** the essential details, and describe what need would be fulfilled by the new object and how, specifically, it functions. They will then translate the description into a format appropriate for modeling the object in a computer by **representing the data** in an organized visual format. **Pattern recognition** will enable them to organize and generalize the description.

Materials and Equipment

- 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

If students are using computers, confirm that all students' computers are turned on, logged-in, and connected to the Internet	3 to 5 minutes
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The Lesson

Warm-up Activity: What information is important?	15 minutes
Activity 1: Reinventing an everyday object	30 minutes
Wrap-up Activity: Connecting learning to Computer Science	15 to 25 minutes

Warm-up Activity: What information is important? (15 minutes)

Activity Overview: In this activity, students use abstraction to think about the attributes of an object that are important to clearly describe and define it.

Activity:

Choose one of the following student activities to start the lesson. Each warm-up activity is designed to prepare your students for the type of thinking required for this lesson.

1. Journaling: Students respond to the following question in their journal or word processor:
Imagine that you just invented a new and useful object. What information do you think you would need to tell others if you wanted to advertise the object and make them understand why your invention is worth buying? Why would they need to know each of these details about your invention in order to fully envision it?
2. 4-Square Share: Form teams of two. Each team discusses this prompt and records their answers:
Imagine that you just invented a new and useful object. What information do you think you would need to tell others if you wanted to advertise the object and make them understand why your invention is worth buying? Why would they need to know each of these details about your invention in order to fully envision it?
Form teams of four by combining two teams. Instruct the groups of 4 to compare their responses and create a composite list of their best ideas.

Teaching Tips:

- Guide the students to think about objects generally, not a specific object. The purpose is for them to be able to list the object “attributes” and the “behaviors” of objects that would be useful to fully describe the object to someone who has never seen it before.
- After 10 minutes, collect the responses and write key themes on the board.

Activity 1: Reinventing an everyday object (30 minutes)

Activity Overview: In this activity, students choose an item and assume the role of inventors, using abstraction to describe the appearance, purpose, and functionality of an item through student-student interaction.

Activity:

After organizing students into groups of 2 or 3, guide the students through these steps:

1. **Choose a common, useful, functional everyday object from your personal belongings or the classroom. Your challenge is to imagine that this object has just been invented and no one has ever seen it before. Your task will be to describe (in writing) these characteristics and behaviors mentioned in Step 2.**

Example Objects:

zipper	clothespin	binder clip	can opener
scissors	tape measure	stapler	umbrella

2. **As you are describing this object include the following:**
 - a. **The mechanical functions/uses of the object**
“A colander is used to separate food or other objects from liquid.”

b. What needs the object fulfills

"Instead of trying to scoop solids from a liquid, a colander ..."

c. The physical attributes and characteristics of the object:

i. components or parts

"A colander has a bowl, handles and typically legs or other support."

ii. shape or materials

"A colander is made of metal or heat-resistant plastic."

iii. general dimensions

"A colander can range from a few inches to as much as a foot in across the top of the bowl and from top to bottom."

iv. connections between parts

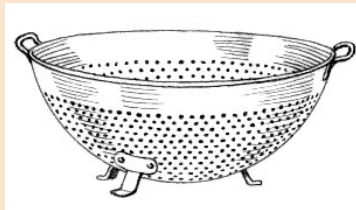
"A base or foot enables it to sit on a counter or in a sink and handles allow it to be easily moved or suspended over a cooking pot for steaming"

3. There are some specifications to describe all of the attributes and functions of the object:

- a. Use clear clear, non-technical language, to describe the object's function, the need it fulfills and its attributes.
- b. Your description must be specific enough so that someone who has never seen the object could visualize it, understand how it works, and appreciate the benefits it provides.
- c. Describe the object using at least 150 words and listing a minimum of 6 attributes. Keep in mind that attributes should involve all of your senses. (e.g. Is it smooth? Does it make a noise? Does it have an odor?)

Assessment

Assess student work by using the criteria listed in Steps 2 & 3 above, or the exemplar paragraph for a colander, below:



"A colander is a circular bowl-like object, typically about 12" in diameter and 9" in height, made of washable, smooth metal or heat-resistant plastic. It is used in food preparation to drain pasta after cooking or to hold food for washing or suspend food over boiling water for steaming. Sometimes specialty colanders are smaller. Colanders used in restaurants can be much larger. The holes in the bowl are large enough for water and other liquids to drain, but small enough to prevent food pieces from passing through. A base or foot enables it to sit on a counter or in a sink and handles allow it to be easily moved or suspended. Specialty colanders are used in food preservation to separate food such as applesauce from the apple skins by using a heavy paddle-like utensil to smash and push the desired food through the holes."

Wrap-up Activity: Connecting learning to Computer Science (15 to 25 minutes)

Activity Overview: In this activity, students will recognize patterns in their object descriptions to represent the data (attributes and functions) by modeling that object's inputs, outputs, functions, and attributes like a computer program.

Activity:

Lead the class in a demonstration and large group discussion to ensure that they understand the process of translating the attributes and functions of an object into a Computer Science analogy. Use the colander for demonstration

purposes. Pause periodically to allow the teams to repeat your demonstration steps using their object.

Q1. Consider your object as if you were a computer program. Let's draw a diagram that shows all of its functions as boxes, and for each function, its inputs (i.e. what is required to use the object in this way?) and outputs (i.e. what is produced when the object is used in this way?). Now draw the diagram for the colander. Ask, Are there inputs and outputs that repeat for different functions?

Q2. Are there functions that are similar and can be combined so that the object can be represented with a more concise program (i.e. fewer steps or boxes)?

Q3. Think about the physical attributes and characteristics of your object. Organize these so that each is declared as a variable with its proper type (e.g. 'color,' 'material type,' 'height,' 'weight'). Can some of these attributes and characteristics be arranged into a hierarchy of related attributes and characteristics (e.g. 'Material Type' can indicate weight or color, but weight and color do not indicate material type)?

Q4. Have you heard of abstraction? How does abstraction in Computer Science relate to the process of identifying the functions and characteristics as you have done in this exercise?

Assessment

Talk through these complex questions as a group, being sure to highlight the answers below. Students can submit their own answers as a formative assessment exit ticket, to which you can add comments to further push their thinking.

A1. Depends on the object. For the colander, yes: the input of 'food' can be used in the functions of 'washing' and 'cooking.' It is important to recognize that similar inputs can produce different outputs, and similar outputs can be produced by different inputs.

A2. Depends on the object. For the colander, yes: 'washing' and 'separating' could be combined into the more general function of 'filtering.'

A3. Depends on the object. For the colander, yes: 'Material Type' (e.g. metal) can indicate weight and/or color (e.g. possibly heavier than plastic or silver), but weight and color do not indicate material type. It is possible that some hierarchies are unique to the object students selected (i.e. a metal and a plastic colander would produce different hierarchies or related attributes and characteristics even though they are both colanders).

A4. Abstraction means 'identifying and extracting relevant information to define main idea(s).' Computer Science uses abstraction to analyze details in order to learn more about a concept as a whole. Analyzing, or abstracting, the details of an object's specific inputs, outputs, functions, and attributes tells more about the category of the object as a whole.

Notes to the Teacher:

If students are still struggling to connect an object's description to Computer Science, the visual representation of data, or the function of a computer program, emphasize that most people in the classroom had probably used all of the objects they described, but they had never thought about those objects in that much detail before. Thinking about the objects in detail can help us learn about larger categories of objects. Say, **"How many of you have seen a colander before today's lesson? How many of you knew that a colander could be used to make applesauce? Now that we have abstracted that detail, we've all learned that the category of colanders can be used in food preservation."**

Learning Objectives and Standards

Learning Objectives	Standards
<p>LO1: Students will be able to identify the attributes of an object that must be defined in order to fully define the object.</p>	<p><i>Computer Science</i> CSTA L2.CT.7: Represent data in a variety of ways including text, sounds, pictures and numbers.</p> <p>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.</p> <p><i>Common Core</i> CCSS MATH.CONTENT.5.G.B.4: Classify two-dimensional figures in a hierarchy based on properties.</p> <p>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).</p>
<p>LO2: Students will be able to analyze an object and use language to fully describe it.</p>	<p><i>Computer Science</i> AUSTRALIA 6.6 (Creating digital solutions by: designing): Design, modify and follow simple algorithms represented diagrammatically and in English involving sequences of steps, branching, and iteration (repetition)</p> <p>CSTA L2.CT.6: Describe and analyze a sequence of instructions being followed (e.g., describe a character's behavior in a video game as driven by rules and algorithms).</p> <p><i>Common Core</i> 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).*</p>
<p>LO3: Students will be able to generalize the characteristics of an object and translate into computer science terminology</p>	<p><i>Computer Science</i> CSTA L2.CT.13: Understand the notion of hierarchy and abstraction in computing including high level languages, translation, instruction set and logic circuits.</p> <p><i>Common Core</i> 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.</p> <p>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.</p> <p>CCSS MATH.CONTENT.5.G.B.4: Classify two-dimensional figures in a hierarchy based on properties.</p>

Additional Information and Resources

Lesson Vocabulary

Term	Definition	For Additional Information
Input/Output	Inputs are the signals or data received by the system and outputs are the signals or data sent from it	http://en.wikipedia.org/wiki/Input/output

Computational Thinking Concepts

Concept	Definition
Abstraction	Identifying and extracting relevant information to define main idea(s)
Data Representation	Depicting and organizing data in appropriate graphs, charts, words or images
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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