ECT Lesson Plan: What is Data? - Code Breaking and Patterns

Lesson plan at a glance...

Core subject(s)	Science, Mathematics
Subject area(s)	Data Analysis
Suggested age	14 to 18 years old
Prerequisites	What is Data? - Introduction
Time	**Preparation:** 11 to 35 minutes **Instruction:** 50 to 60 minutes
Standards	**Core Subject:** CCSS Math **CS:** CSTA, UK, Australia

In this lesson plan…

Lesson Overview

Students are introduced to the concept of **data** by creating new data and looking for patterns in existing data. They begin to understand how prevalent data is in their lives, and the activities are an excellent way to introduce the members of a class to each other.

Materials and Equipment

- □ For the teacher:
  - *Required:* Presentation set-up
    - Internet-connected computer
      - Chrome browser (https://www.google.com/chrome/browser/desktop) recommended
    - Projector and projection screen or other flat projection surface
- □ For the student:
  - *Required:* Internet-connected computer (one (1) computer per student recommended)
    - Google Sheets (http://docs.google.com/spreadsheets) or other spreadsheet app
  - *Required:* Journal
    - Google Docs (http://docs.google.com) or a wiki OR
    - If not using a computer-based collaboration tool
      - Markers/whiteboard or paper and pen/pencil

Preparation Tasks

	Prepare display-ready copies of the sentences and numeric sequences for Activity 1	3 to 5 minutes
	Complete all steps in the Spreadsheet Preparation document	5 to 10 minutes
	Confirm that your computer is on and logged-in	1 to 5 minutes
	Confirm that your projector is turned on and is projecting properly	1 to 5 minutes
	Confirm that all students' computers are turned on, logged-in, and connected to the Internet	1 to 10 minutes

The Lesson

Warm-up Activity: Sending lots of information using very little data	20 minutes
Activity 1: Breaking the code - finding the pattern	20 minutes
Wrap-up Activity: Finding more sources of data	10 to 20 minutes

Warm-up Activity: Sending lots of information using very little data (20 minutes)

Activity Overview: In this activity, students will use **abstraction** to describe themselves as accurately as possible in a text message of limited length.

Notes to the Teacher:
A group of scientists decided that the Arecibo Message would contain 210 bytes of **data** (about 12 seconds of an MP3) and contain approximately 7 pieces of **information**. In the late 1980s text messages were limited should to only 160 **bits** of data (letters, numbers, symbols - http://latimesblogs.latimes.com/technology/2009/05/invented-text-messaging.html). Twitter later shortened the available message space to 140 so the user ID could be sent as well.

Activity:
After opening and completing the steps in the Spreadsheet Preparation document for this lesson, walk through the following steps with your students:

1. Give each student a number so they know which cell in **Column A** to use.
2. Prompt students to add the information to their cell they think is most important for others to know about them, while staying within the 160-character limit.
3. After everyone is finished, the class can look over the information and see how contextual it is.

Assessment:
After completing the activity, have the students answer the following questions:
Q1: Would someone who is from outside your school/age/city/state/country/planet know what you are talking about?

Q2: How difficult was it to send information when you only had a little bit of data?

Q3: What could you do to get more information into your text?

Q4: Do you feel like your "text message" conveyed enough information for people to get to know you?

Q5: Before email and social networking, people wrote letters to "Pen Pals," people all over the world. How well could you get to know someone well only through letters? How long would it take?

Activity 1: Breaking the code - finding the pattern (20 minutes)

Activity Overview: In this activity, students will attempt to decode text and numeric messages. They will use **data analysis**, including **pattern recognition**, to make sense of the provided data.

Notes to the Teacher:

The ability to see patterns is what makes science and math possible. Sometimes data does not initially look meaningful, and it is necessary to decompose it and try to discover any regularity or logic to it. Some data is meant to be understood by everyone like a newspaper, our DNA or a calendar. Other data is meant to be kept secret and encryption or coding is used to make it difficult to understand.

Activity:
Start by providing your students with the following three sentences. Two of the sentences are made up of random letters, the third translates to a real sentence by substituting one letter for another

a. YMNX NX YMJ WJFQ XJSYJSHJ — *Translation: This is the real sentence*
b. LMP KIXIK IQ IIP VBJQU — *Translation: GHK FDSDF DL DDK QWELP*
c. EJW VFF UTNZ ALYDI I KJV — *Translation: ZER QAA POIU VGTYD D FEQ*

Next, provide your students with the following numbers to determine if there is a pattern and what it is.

a. 1 3 6 10 15 21 *Answer: Triangular Numbers 1+2=**3** 3+3=**6** 6+4=**10***
b. 1 2 6 24 120 720 *Answer: 1!=**1** 2!=**2** 3!=**6** 4!=**24** 5!=**120** 6!=**720***
c. 2 3 7 11 17 21 *Answer: No pattern (that I am aware of)*
d. 3 3 6 9 15 24 *Answer: A Fibonacci-like sequence: 3+3=**6** 3+6=**9** 6+9=**15***

Teaching Tip:

- At the end of the activity, remind students that while data may not seem to have a pattern, it could just be very difficult to discover.

Notes to the Teacher:

- Mathematicians have been trying to find a pattern in the digits of pi (3.1415....) and in the primes (1,3,5,7,11,13...) for most of recorded history.
- Astronomers have for centuries attempted to make a calendar that was 100% accurate.
- Geneticists are looking for patterns in the genome to find causes for conditions and traits.
- Statisticians look at tremendous amounts of data to attempt to predict the outcome of sporting events, weather, the stock market, and more.

Assessment:
Informally assess students' progress in discovering the patterns in the data.

Wrap-up Activity: Finding more sources of data (5 to 10 minutes)

Activity Overview: In this activity, students will identify types and uses of data that they had not previously considered.

Activity:
Ask students to respond to the following prompts in their journal:

- List 3 new examples of data that they had not thought of before class.
- Describe how data might be used in a future career they are considering.

Ask students to share some of their responses with the class or with a neighbor.

Assessment:
Informally examine students' journal responses.

Learning Objectives and Standards

Learning Objectives	Standards
LO1: Students will be able to create data that conforms to the given constraints, including the information that they judge to be most important.	*Common Core* CCSS.MATH.PRACTICE.MP3: Construct viable arguments and critique the reasoning of others. *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.
LO2: Students will be able to discover patterns in provided data.	*Common Core* CCSS.MATH.PRACTICE.MP8: Look for and express regularity in repeated reasoning. *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.
LO3: Students will be able to give examples of where and how data is used.	*Common Core* CCSS.MATH.PRACTICE.MP3: Construct viable arguments and critique the reasoning of others. CCSS.MATH.PRACTICE.MP8: Look for and express regularity in repeated reasoning. *Computer Science* CSTA L2.CT.7 UK 3.6

Additional Information and Resources

Lesson Vocabulary

Term	Definition	For Additional Information
Data	Information that is not yet interpreted. Anything we can see, hear, smell, touch, taste is data. Data can be transmitted from one place to another and stored.	http://en.wikipedia.org/wiki/Data
Information	Data placed into a context that can be understood. Information allows us to make decisions. One could see a table of numbers and not care one bit, but once it is understood that these numbers are your medical lab results indicating your quality of health, it is possible to make decisions based on that information.	http://en.wikipedia.org/wiki/Information
Bit	A unit of memory, the smallest information possible (1 or 0, yes or no, etc). eight bits equal a byte, one-million bytes equal a megabyte, one-thousand megabytes equal a gigabyte, etc.	http://en.wikipedia.org/wiki/Bit

Computational Thinking Concepts

Concept	Definition
Abstraction	Identifying and extracting relevant information to define main idea(s)
Data Analysis	Making sense of data by finding patterns or developing insights

Pattern Recognition	Observing patterns and regularities in data

Additional Resource Links

- Opinion article by Wired Magazine:
  - The End of Theory (http://www.wired.com/science/discoveries/magazine/16-07/pb_theory)
- Hans Rosling video:
  - The Joy of Stats (http://www.youtube.com/watch?v=jbkSRLYSojo)
- Education video with data:
  - Did You Know? (http://www.youtube.com/watch?v=PHmwZ96_Gos)
- How a miscommunication about data cost NASA/US almost 330 million dollars:
  - Metric Mix-Up (http://wikipedia.org/wiki/Mars_Climate_Orbiter#Communications_loss)

Extension Activities for Student Enrichment

- Ask students to find and submit a link to a news article that uses 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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