
CS Unplugged

No-Device Activities for Any Classroom

Grades K–5 · 20 Hands-On Activities

Binary Encoding	Algorithm Sequencing	Graph Theory
Sorting Networks	Encryption	Data Representation

20 hands-on CS activities with zero devices — binary encoding, algorithm sequencing cards, graph theory puzzles, sorting networks, encryption activities, and data representation art. Each includes a plain-language CS concept explanation.

What's Inside:

- ✓ 20 Complete Activity Packs (Instruction + Student Pages)
 - ✓ CS Concept Explainer for Each Activity
 - ✓ Extension Challenge Sets
 - ✓ Teacher Vocabulary Guide
 - ✓ 20 "CS in the Real World" Connection Cards
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Introduction

Welcome to **CS Unplugged: No-Device Activities for Any Classroom!** This resource is designed to help educators introduce fundamental computer science concepts to students in Grades K–5 without the need for computers, tablets, or any digital devices.

Computer science is much more than just coding on a screen. At its core, it is about problem-solving, logical thinking, and understanding how to process information. By taking the device away, we remove the intimidation factor and allow young learners to grasp the underlying concepts through movement, play, and hands-on creativity.

Inside this resource, you will find 20 carefully crafted activities divided into six core CS categories: **Binary Encoding, Algorithm Sequencing, Graph Theory, Sorting Networks, Encryption, and Data Representation**. Each activity is classroom-tested, requires zero devices, and uses everyday materials you likely already have on hand.

How to Use This Resource

- **Activity Packs:** Each of the 20 activities includes a 3-page pack: a Teacher Instruction page, a Student Activity page, and an Extensions & Connections page.
- **CS Concept Explainers:** Found on the Teacher Instruction page, these break down the core CS concept into plain, approachable language.
- **Vocabulary Guides:** Essential CS terms are defined for the teacher so you can confidently introduce them to your students.
- **Real-World Connections:** Found on the Extensions page, these cards help students see how the unplugged activity maps to actual technology they use every day.
- **Adaptability:** Grade ranges (K–2 or 3–5) are suggestions. Many activities can be scaled up or down depending on your students' needs.

Teacher Vocabulary Guide

Use this glossary to familiarize yourself with the core CS terms used throughout this resource. Definitions are written in plain language to help you explain them to young learners.

Algorithm	A step-by-step set of instructions to complete a task.
Binary	A number system using only two digits: 0 and 1. The language of computers.
Bit	A single binary digit (0 or 1), the smallest unit of data in computing.
Byte	A group of 8 bits.
Data Representation	How information is encoded, stored, or displayed in a specific format.
Decryption	The process of converting encoded or scrambled data back into its original, readable form.
Encryption	The process of converting readable data into a scrambled, secret format to protect it.
Graph (Network)	A structure made of nodes (points) and edges (lines connecting the points), used to model relationships.
Node / Vertex	A point or object in a graph (e.g., a city on a map).
Edge	A line connecting two nodes in a graph (e.g., a road connecting two cities).
Pixel	The smallest unit of a digital image. Short for 'picture element'.
Sequence	A specific order in which things are arranged or events occur.
Sorting	Arranging items in a specific order (e.g., smallest to largest, A to Z).
Sorting Network	A fixed arrangement of 'wires' and 'comparators' that sorts items as they pass through.
Substitution Cipher	An encryption method where each letter is replaced by another letter or symbol.
Path	A sequence of edges connecting a sequence of nodes in a graph.
Shortest Path	The path between two nodes that has the smallest total weight or fewest edges.
Debugging	Finding and fixing errors (bugs) in an algorithm or process.
Decomposition	Breaking down a complex problem into smaller, more manageable parts.
Pattern Recognition	Identifying similarities or trends within data or a sequence.

● Binary Encoding**■ CS Concept**

Computers don't understand letters or words—they only understand two states: ON and OFF, represented by 1 and 0. This is called binary. To store text, computers assign a unique pattern of 1s and 0s to each letter. In this activity, students use two bead colors to represent 1s and 0s, encoding the first letter of their name just like a computer does.

Key Vocabulary

Binary: A coding system using only two symbols: 0 and 1.

Bit: A single 0 or 1; the smallest piece of data a computer uses.

Encode: To convert information into a specific code or format.

Materials Needed

- Pony beads in two colors (e.g., black and white)
- Pipe cleaners or string
- Binary Alphabet Reference Sheet (provided)

Activity Steps

1. Show students the Binary Alphabet Reference Sheet. Explain that A is 01000001, B is 01000010, etc.
2. Ask students to find the first letter of their name on the chart.
3. Have students read the 8-bit binary code for their letter aloud as a class.
4. Assign one bead color to represent '0' and the other to represent '1'.
5. Students string beads onto their pipe cleaner in the exact order of their letter's binary code.
6. Students twist the ends together to form a bracelet. Have them trade with a partner to 'decode' each other's letters.

Teacher Tips

- For Kindergarten, use a simplified 5-bit code instead of the full 8-bit ASCII to make the bracelets smaller and more manageable.
- Use larger wooden beads for easier grasping for younger students.

Caesar Cipher Wheels — Extensions & Connections

■ Extension Challenges

Challenge 1: Create a 'treasure hunt' where clues are encrypted using the Caesar cipher. Students must decrypt one clue to find the next.

Challenge 2: What happens if you use a key of 13? (Hint: It's called ROT13. Encrypting it again decrypts it!)

■ CS in the Real World: Online Security and HTTPS

When you buy something online or log into a website, your data is encrypted so hackers can't steal your passwords or credit card numbers. The 'https' in a web address means the connection is secure. Modern computers use much more complex math than the Caesar cipher, but the core idea—using a key to scramble and unscramble data—is exactly the same!

■ Think Like a Computer Scientist

If a stranger finds your encrypted message but doesn't know the key, how might they try to crack it? (Hint: What letter is the most common in the English language?)

Activity 8

Pattern Predictions

Grades K–2

● Algorithm Sequencing

■ CS Concept

Computers are incredibly fast at finding and following patterns. Recognizing a repeating sequence allows a computer to predict what comes next without having to process all the data from scratch. In programming, repeating a set of instructions is called a 'loop'. In this activity, students identify repeating patterns and predict the next elements, laying the groundwork for understanding loops.

Key Vocabulary

Pattern: A repeated decorative design or a repeating sequence.

Loop: In programming, a sequence of instructions that is repeated until a condition is met.

Predict: To say or estimate what will happen next based on evidence.

Materials Needed

Today's Challenge

Imagine you are making a map and you don't want two countries that share a border to have the same color. In computer science, we call this graph coloring! Today, you have to color a web of circles so that no two connected circles share a color. Can you use the fewest colors possible?

What To Do

Step 1: Pick a starting node (circle) and color it in.

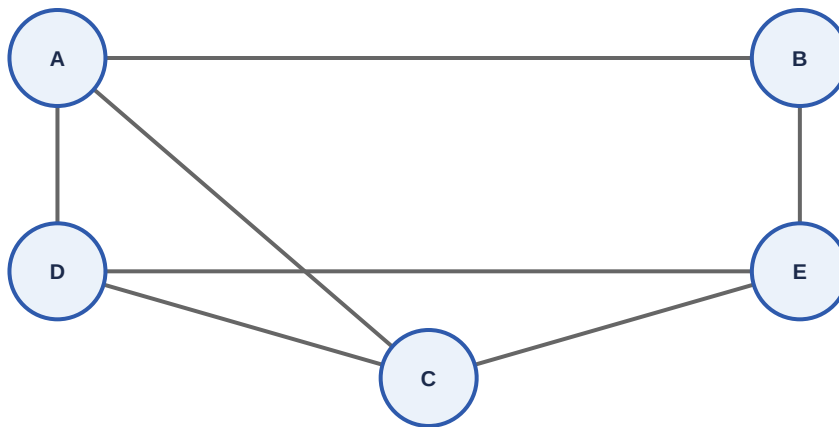
Step 2: Look at the nodes connected to it by lines. They **MUST** be different colors.

Step 3: Color the rest of the nodes, one by one, following the rule.

Step 4: Count how many colors you used. Try again using fewer colors!

Your Work Space

Color this Graph:



Graph Coloring Puzzles — Extensions & Connections

■ Extension Challenges

Challenge 1: Draw your own graph with 6 nodes and challenge a friend to find its chromatic number.

Challenge 2: Create a graph that ONLY needs 2 colors. What does it look like?

■ CS in the Real World: Scheduling and WiFi Channels

Schools use graph coloring to make schedules! If Math and Science share students, they can't be at the same time (they are connected). The schedule 'colors' them into different time slots. WiFi routers also use this so that neighboring routers don't broadcast on the same channel and interfere with each other.

■ Think Like a Computer Scientist

If a graph has no lines connecting any of the nodes, what is the chromatic number? (Hint: How many colors do you need?)

Activity 13

Secret Symbol Substitution

Grades 2–5

● Encryption

■ CS Concept

A substitution cipher replaces each letter of a message with another letter or symbol. Unlike the Caesar cipher which uses a simple shift, a random substitution cipher can use any arrangement of symbols. This type of encryption relies on keeping the translation key completely secret.

Key Vocabulary

Substitution Cipher: An encryption method where each letter is replaced by another symbol or letter.

Plaintext: Normal, readable text.

Ciphertext: Encrypted, scrambled text.

Key: The secret rule used to encrypt and decrypt the message.

Materials Needed

- Paper and pencils
- Symbol key worksheet (provided)

Today's Challenge

Spies don't just shift letters—sometimes they use completely different symbols! In a substitution cipher, you make up a new symbol for every letter. As long as your friend has the key, they can read your secret message. Make your own symbol alphabet today!

What To Do

Step 1: Create your secret key. Write a symbol next to each letter of the alphabet.

Step 2: Write a short secret message in plain text.

Step 3: Rewrite the message, but substitute every letter with your secret symbol.

Step 4: Give the message and the key to a friend to decode!

Your Work Space

My Symbol Key:

A		B		C		D	
:		:		:		:	
E		F		G		H	
:		:		:		:	

Write your encrypted message here:

Today's Challenge

Can you draw a shape without lifting your pencil and without tracing the same line twice? This is called an Euler Path, and it's a famous puzzle in computer science! Today, you will learn a secret math rule that tells you instantly if the puzzle is possible or impossible.

What To Do

Step 1: Look at your graph. Count how many lines are connected to each dot.

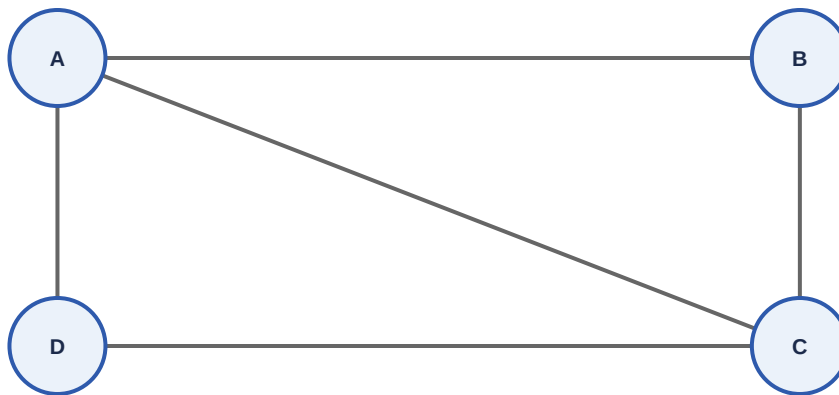
Step 2: Write that number next to each dot.

Step 3: Check the rule: Do more than two dots have an ODD number?

Step 4: If YES, it's impossible! If NO, try to trace the trail without lifting your pencil.

Your Work Space

Can you trace this network?



Today's Challenge

Have you ever used a GPS to find the fastest way to school? The GPS looks at a map with numbers on the roads (like miles or minutes) and adds them up to find the trip with the lowest total number. Today, you will be the GPS and find the shortest path through a weighted graph!

What To Do

Step 1: Find the Start and End nodes on your map.

Step 2: Trace one path connecting them. Add up all the numbers on the lines you used.

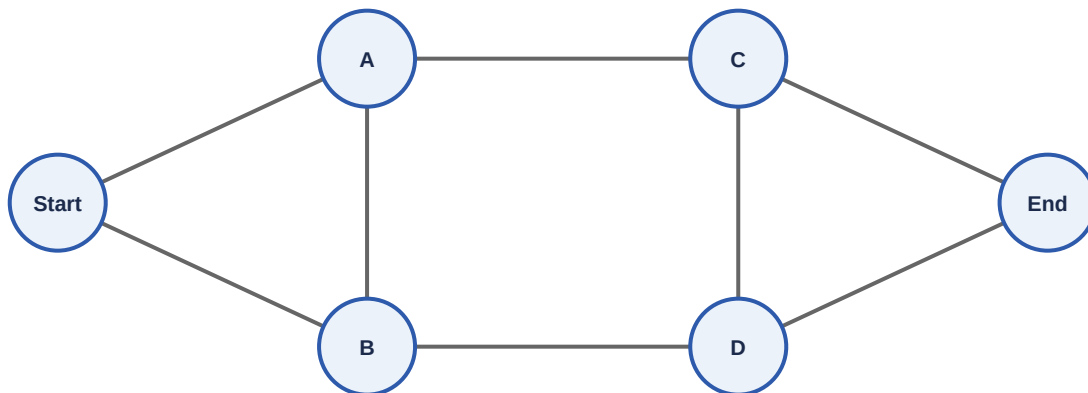
Step 3: Write the total next to the path.

Step 4: Find another path. Add those numbers up.

Step 5: Compare all your totals. The smallest number is the shortest path!

Your Work Space

Calculate the Paths:



Teacher: Write weights (like 3, 5, 8) on the edges above before copying!

Path 1 total: _____ Path 2 total: _____ Shortest: _____

Activity 15: Card Sorting Race

■ CS in the Real World: Multi-Core Processors

Modern computers and phones have 'multi-core' processors, meaning they have multiple brains working in parallel. Just like the sorting network lets you compare two pairs of cards at the same time, multi-core processors sort data, render graphics, and run apps much faster by splitting the work into parallel paths.

Activity 16: Maze Path Algorithms

■ CS in the Real World: Self-Driving Cars

Self-driving cars use pathfinding algorithms to navigate city streets safely. They constantly calculate the best sequence of moves—turn left, go straight for 200 feet, turn right—while avoiding obstacles like other cars and pedestrians, exactly like navigating a maze!

Activity 17: Network Trail

■ CS in the Real World: Snow Plows and Mail Carriers

("City planners use Euler paths to route snow plows and mail carriers! They want the trucks to drive down every street (edge) exactly once so they don't waste gas or time retracing their path. Graph theory saves cities millions of dollars every year.",)

Activity 18: Invisible Ink Encryption

■ CS in the Real World: Digital Watermarks

Photographers and artists hide invisible marks in their digital photos called watermarks. You can't see them, but a computer can read them to prove who the photo belongs to. It's exactly like your invisible crayon message—the data is hidden in plain sight to protect it from being stolen!

Activity 19: Sound Pattern Encoding

■ CS in the Real World: WiFi and Bluetooth

Your tablet doesn't make a sound when it connects to WiFi, but it is actually shouting data using radio waves! Radio waves are like invisible sounds that computers use to talk to each other through the air. Bluetooth headphones work the same way, translating data into sound patterns you can hear!

Activity 20: Shortest Path Challenge

■ CS in the Real World: GPS and Internet Routing

('When you search for directions on Google Maps, an algorithm checks thousands of road segments and their current traffic times (weights) to find your fastest route. The internet does the same thing! Data packets travel through cables around the world, and routers use shortest path algorithms to make sure your videos load instantly'.')



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