

# Lesson 7: Recursion

45 minutes

## Overview

### What is recursion?

Students explore recursive methods through an unplugged activity and practice tracing code with recursive methods. Students then work through the tasks on their Project Planning Board to begin the development of their Creative Coding with The Theater Project.

## Standards

Full Course Alignment

### CSA Conceptual Framework

- **CON-2** - Programmers incorporate iteration and selection into code as a way of providing instructions for the computer to process each of the many possible input values

## Agenda

### Warm Up (5 minutes)

Fractal Art

### Activity (35 minutes)

Introduction to Recursion  
Tracing Recursive Methods  
Project Development

### Wrap Up (5 minutes)

Revisiting the Need to Knows  
Assessment: Check for Understanding  
AP Classroom Topic Questions

## Objectives

Students will be able to:

- Explain the purpose and functionality of a recursive method
- Identify the recursive call and base case in a recursive method
- Trace a recursive method

## Preparation

- Print copies of the Recursion Unplugged handout (one for each pair of students)
- Print copies of the Coloring Page handout
- Print and cut out the Method Cards
- Gather sets of ten disposable cups and markers or colored pencils
- Check the **Teacher's Lounge** for verified teachers on the CSA Forum to find additional strategies or resources shared by fellow teachers

## Links

**Heads Up!** Please make a copy of any documents you plan to share with students.

For the students

- **Coloring Page** - Handout
- **Recursion Unplugged** - Handout
- **U7L7 Extra Practice** - Handout

## Vocabulary

- **Base Case** - The instance where a recursive method will return a value rather than calling itself
- **Recursion** - When a method calls itself
- **Recursive Case** - The instance where a recursive method calls itself

## Teaching Guide

### Warm Up (5 minutes)

#### Fractal Art

##### *Remarks*

Fractal art is often created using a special type of algorithm that we will explore in today's lesson. Let's take a look at an example.

 **Do This:** Click through the animated slide to define and demonstrate fractal art.

 **Discuss:** Use the Hold That Thought strategy to discuss the prompt.

- *How is repetition used in fractal art?*

**Discussion Goal:** Students identify that fractal art is created by repeating patterns over and over again.

##### Teaching Tip


Encourage students to identify the conditions of the repetitive algorithm used to create the art. Ask students to identify the starting value and the condition for continuing the process.

### Activity (35 minutes)

#### Introduction to Recursion (10 minutes)

##### *Remarks*

We have used loops to repeat processes in our programs. There is an alternative way to implement repetition. Let's explore how this approach works.

 **Do This:** Review the lesson objectives.


**Group:** Place students into pairs.

 **Distribute:** Give each pair a copy of the Recursion Unplugged handout.

 **Do This:** Have pairs choose a challenge to complete.

 **Distribute:** Give students the materials for the challenge they chose.

- Wall Walking: one set of Wall Walking method cards
- Cup Stacking: ten disposable cups, one set of Cup Stacking method cards
- Coloring: one coloring sheet, one marker or colored pencil, one set of Coloring method cards

 **Do This:** Click through the animated slide to explain the instructions, then have students complete their activity.

 **Discuss:** Click through the animated slide to display the prompts.

- *What happened in your activity?*
- *How is this type of algorithm different from any other type of algorithm you've seen?*

**Discussion Goal:** Students describe the activity they completed. Students note that the code repeated until a certain point and then did something different before ending, which seems to be a combination of loops and `if-else` statements.

## Tracing Recursive Methods (10 minutes)

### Remarks


Before writing these types of solutions, we need to understand what they are and how to trace them.


 **Do This:** Click through the animated slide to define *recursion*, *base case*, and the *recursive case*.

**Group:** Place students in groups of four.

#### Teaching Tip


Groups should consist of two sets of pairs from the previous activity. The pairs should have completed different activities.


 **Do This:** Have students complete Part A of the Recursion Unplugged handout by identifying the recursive call and base case for their activity.


 **Do This:** Click through the animated slide to demonstrate expanding recursive code into individual lines of code.

### Remarks

As we saw in this example, the recursive call has its own set of local variables, including the formal parameters. The parameter values capture the progress of a recursive process, much like loop control variable values capture the progress of a loop.

 **Do This:** Have students complete Part B of the Recursion Unplugged handout by expanding the recursive sample code into individual lines of code.

 **Do This:** Explain the solution and the trace table. Have students copy the trace table onto Part C of the Recursion Unplugged handout.


 **Do This:** Have students choose one of the code segments on the Recursion Unplugged handout and complete a trace table to find the output of the code.

## Project Development (15 minutes)

### Remarks

Using the items on your Project Planning Board, begin developing your Creative Coding Project. Each time you complete a goal, commit your code and move the task to the next column. There should

time you complete a goal, commit your code and move the tasks to the next column. There should only be one item in the “In Progress” column at a time, meaning that each item should be entirely completed before moving on to the next item.


 **Do This:** Direct students to Level 1 on Code Studio to work on their Creative Coding with The Theater Project.

 1

## Creative Coding with The Theater Project

### Teaching Tip

Remind students to refer to their Project Planning Board to decide what tasks to work on during this time. You can also encourage students to request a code review from their peers as they work.


 **Do This:** Have students update their Project Planning Board and Project Backlog with any tasks they completed, changed, or added.


## Wrap Up (5 minutes)

### Revisiting the Need to Knows

#### *Remarks*

We just learned a lot of new information today, which may have even answered some of the Need to Know questions you wrote down about the Creative Coding Project. As we progress through the unit, it is helpful to stop and note what we have learned that is related to or useful for the project.

 **Do This:** Have students review the questions they wrote in the “Need to Know” column on page two of their Creative Coding with The Theater Project Planning Guide. Students add new questions to this column, check off any answered questions, and write answers to any questions in the “Learned” column.

 **Do This:** Have students share what they added to their chart with a partner.

### Teaching Tip

If time permits, you can also have students share as a class.

 **Do This:** Review the concepts covered in this lesson.

 **Display:** Key Vocabulary

---

## Assessment: Check for Understanding

*Check For Understanding Question(s) and solutions can be found in each lesson on Code Studio. These questions can be used for an exit ticket.*

 2

## Check for Understanding

## AP Classroom Topic Questions

To assign questions from the AP Classroom Question Bank that align with this lesson, create a custom quiz in AP Classroom by searching the Question Bank for the Essential Knowledge statements listed at the top of this lesson plan. You can find instructions and video demonstrations to do this on **AP Central**.



This curriculum is available under a  
Creative Commons License (CC BY-NC-SA 4.0).

If you are interested in licensing Code.org materials for commercial purposes **contact us**.