New 'Basic Skills' Computational Thinking Unplugged

Instructional Time: 95 minutes

Build our students economic mobility and economic skills.

Introduction

Computational thinking skills are noted to be the "New Basic Skills" that should be added to students' toolboxes to prepare them to be active citizens who can navigate the ever-changing real-world challenges. Schools are preparing students for a workforce with jobs that may not even be invented yet. The 4 key computational thinking skills that will be focused on in this lesson are decomposition, algorithms, abstraction, and pattern recognitions.

According to Seymour Papert, an early pioneer of computational thinking, the focus of computational thinking should not be on the machine but on the mind. Ultimately, the goal of computational thinking is the ability to problem solve and forge new ideas that will continue to better our world.

This is a sample STEM Connections lesson. Please find more information at https://explore.avid.org/experience-avid/stem-connections

Essential Question

What are the Key Computational Thinking Skills and how can they help us to be future ready?

Lesson Objectives

Students will:

- Explore and practice the 4 key computational thinking skills.
- Connect the computational skills to their future-ready toolbox.

Materials and Resources

Resources below are available in additional formats such as Microsoft and PDF with a subscription to AVID STEM Connections. Links provided below are in a Google format. (If another format is needed, please contact cskeen@avid.org)

Hands-on:

- *Computational Thinking* Presentation
- *CT Skills Stations* Student Resource
- *Computational Thinking Handout* Student Resource
- *Additional Tangrams* Student Resource (optional)
- *History of Tangrams* Video (optional)
- *Navajo Code Talkers* Video (optional)

Design Thinking:

This lesson explores the indicated stages in the design thinking process:

- ☒ Empathize
- ☒ Define
- ☒ Ideate
- ☒ Prototype
- ☐ Test

Standards and Goals:

Common Core State Standards:

- CCSS.ELA-Literacy.RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

International Society for Technology in Education Standards:

- ISTE – 1.5 Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Next Generation Science Standards:

- NGSS – Practice of Using mathematics and computational thinking.

- *Sudoku Invented* Website (optional)
- Scissors
- Brass paper fasteners
- Game pieces of two different colors

Minds-on:

- Productive struggle
- Problem solving
- Growth mindset
- Curiosity and open-mindedness
- Planning and organizational skills
- Effective communication and collaboration

Teacher Preparation

- Print double-sided the *Computational Thinking Handout.*
- Review *CT Skills Stations* directions in detail.
- Prepare stations materials using *CT Skills Station*s: You may want to create 2–3 sets of the stations, depending on the class size.
    - **Decomposition Station:**
        - Pg. 1 — 1 copy to remain at the station
        - Pg. 2 — printed in color (1 per 2 students)
        - Scissors (per person in the group)
    - **Algorithm Station:**
        - Pg. 3 — 1 copy to remain at the station
        - Pg. 4 — 1 copy per group
        - Scissors (per person in the group)
        - Brass paper fasteners (1 per group)
    - **Abstraction Station:**
        - Pg. 5 — 1 copy to remain at the station
        - Pg. 6 — 1 per student
        - Pg. 7 – 1 copy to remain at the station
    - **Patterns Station:**
        - Pg. 8 — 1 copy to remain at the station
        - Pg. 9 — 2–3 boards per group (The game boards can be laminated for future use)
        - 2 – 3 sets of game pieces of 2 different colors (colored counters or other math manipulatives work well)

Essential Question: *What are the Key Computational Thinking Skills and how can they help us to be future ready?*

ENGAGE (15 minutes)

What is Computational Thinking:

Display *Essential Question* (Slide 2) and read aloud to students.

Distribute *Computational Thinking Handout* to each student.

Display *What is Computational Thinking?* (Slide 3) and explain to students that they will be collecting their initial ideas about computational thinking by viewing a series of images. Show each image on slides 4–9 for about 15 seconds and ask students to record a word or two to describe each image in the "Computational Thinking Word Bank" portion of the *Computational Thinking Handout.*

Share with students that they are creating a word bank for developing a definition for computational thinking. After all the images have been shown, students should share their word banks with an elbow partner and add any new words to describe the images.

Encourage students to use the sentence frame to create initial computational thinking ideas. If time permits, share out a few student examples.

- When I hear the term "computational thinking" it makes me think of _____.
- These pictures make me think about _____.

Show students the definition of computational thinking skills (Slide 11) and read it aloud for students.

Allow 1–2 minutes for students to add to their definition or delete information that is not needed on their handout.

Share *Vocabulary* Slides 22–27 with the computational thinking skills defined and allow students 1–2 minutes to add the information to their notes.

Ask students how close they were with their initial definition and what were some concepts they missed or added.

Resources:

Computational Thinking Presentation
Computational Thinking Handout Student Resource

Teacher Tip:

You could stop after the Engage section and use it as a class opener.

EXPLORE (40 minutes)

4 Key CT Skills Stations:

Set up the four computational skills stations around the room. Below are some suggestions for setting up the stations if class time is short.

- Station 1: Cut the shapes out for each group before class starts.
- Station 2: Create the cipher disks before class starts.
- Station 3: Cut out the sudoku cards before class starts. If you think many students haven't previously completed a sudoku puzzle, use only the "mild" cards.
- Station 4: Show the video of how to play the game rather than having students try to figure it out on their own.

Explain to students that they will be working in groups of 3–4 and immersing themselves in the 4 key computational skills activities that allow them to explore the skills.

Display *Computational Thinking Station Overview* (Slide 12) and spend a couple of minutes giving a brief explanation of each station. Explain that they will challenge themselves as they work as a team to figure out the problems to be solved at the stations, they may experience productive struggle.

Share how you would like the student teams to rotate through the stations.

Describe how the *Computational Thinking Handout* will be used to help them deepen their understanding of their newly learned skills. Review the worksheet with students so they understand what the expectations are for capturing their learning.

Allow between 8–10 minutes per station. Students should work as a group.

- At Station 1, students should create the duck, fox and dolphin. Also, they may want to try to create extra animals from the shapes that are given on *Additional Tangrams*.
- For station 2, have students create another message for others to decode.
- For station 3, students will choose either a spicy, medium, or mild Sudoku card to complete. They can check the answer key to see if they are correct. There is a video on the station worksheet to help give some guidance on how to do Sudoku, you can choose to have students look at it on their own or you can show the video.
- Station 4, students will play the Kono game, it might be good to have them play in 2 groups, so 2 students play each other and 2 other students in the group play each other using the 2nd board at

Resources:

Computational Thinking Presentation
Computational Thinking Handout Student Resource
Additional Tangrams

Teacher Tip:

Stations should be completed in one class period. Students don't have to successfully complete everything at each station to understand the skills being utilized, the focus of the skills is more important than completion of the activities.

Students might end Stations 1 and 2 early and can try additional puzzles.

the station. There is a video on the station worksheet to help give some guidance on how to play Kono, you can choose to have students look at it on their own or you can show the video.

Teacher Tip:

This is a great stopping point in the lesson.

EXPLAIN (15 minutes)

Computational Thinking Around the World:

Display *Computational Thinking Around the World* (Slide 13) and explain that as you think about the computational thinking skills used in each station activity, we are also going to learn a little about where these games came from.

Display slides 14–17 as you briefly explore the different cultures that provided a background for each of the activities. Share with students where each game originated.

- Decomposition: Tangrams originated in China. There is a Tangram Legend if you would like to share with your students.
- Algorithm: Cipher disks were created for military intelligence to send secret messages. In WWII, the Navajo Indian code talkers helped encrypt messages. This was the most successful code used.
- Abstraction: Sudoku's name came from its popularity in Japan, but the original number puzzles were first found in France in 1895.
- Patterns: Five Field Kono originated in Korea.

As each activity is displayed**, direct** students to think about how they were utilizing the specific computational thinking skill. What were they doing in the Tangrams station that made them utilize decomposition skills? Did they utilize any other CT skills while they were working on the Tangrams? Remind students of definitions as necessary. (Slide is animated)

- Decomposition: breaking down the images into shapes
- Algorithm: used steps and sequencing to create and break the code
- Abstraction: find the details (numbers) within each section of the puzzle
- Patterns: finding similarities and trends on the game board

Resources:

Computational Thinking Presentation
Computational Thinking Handout Student Resource

Optional videos:
History of Tangrams
Navajo Code Talkers
Sudoku Invented

Teacher Tip:

Share the activity resources as time allows or provide students the links to explore on their own. The resources added in this section about each activity's culture of origin is just one resource about the topic; there are many others which may have different perspectives.

Teacher Tip:

The stations in this activity can make it seem that each computational thinking skill works in silo but in reality, more than one skill is utilized at a time. Asking students to reflect on other skills used in each station, helps to make this connection.

Have students discuss the computational thinking skills in a whole group or with a partner as time allows.

Advance to *Reflection* (Slide 18) and have students return to their original definitions for computational thinking in their *Computational Thinking Handout.*

ELABORATE (20 minutes)

Computational Thinking Around the World:

Display *Personal Connection* (Slide 19) and have students think of their own culture, traditions, or childhood.

Ask "What unplugged games or activities did you play as a child, or do you currently play that represent one or more of the computational skills?" Allow time for students to share out their thoughts.

Move students into groups of 3–4 students.

Display *Create a Station* (Slide 20) and explain that they will work as a group to create a station game based in computational thinking that can be used in an elementary classroom. They will create an analog or digital prototype of the station.

Direct groups to choose one computational thinking skill to focus on but to try and include as many of the skills as possible in their station. Many activities will involve multiple skills.

- a prototype is just a mockup, it doesn't have to be perfect
- station should be appropriate for elementary students
- station should be unplugged (not using technology)
- analog or digital (ex. Paper or a digital tool such as Google Slides or Canva)
- justification of what computational thinking skills are utilized in the game and how those skills are being utilized

Resources:

Computational Thinking Presentation
Computational Thinking Handout Student Resource
Paper, markers, or digital tool such as Google Slides or Canva

Teacher Tip:

The focus here is on unplugged activities or activities that do not utilize the computer, but many students may have more experiences with video games, it is fine to acknowledge those experiences and how they utilize CT skills.

Teacher Tip:

A prototype is a simple experimental model of a proposed solution, a mock-up, a rough idea of the design. It doesn't have to work or be exact. It can be created out or materials such as cardboard, cardstock, etc. or it can be drawn. Prototypes can also be created digitally with a tool such as Canva or Google Draw.

EVALUATE (5 minutes)

Computational Thinking Skills Takeaways?

Display *3,2,1 Summary* (Slide 21) and ask students to use three sticky notes to summarize their learning or have them add to their notes.

- Write 3 things you learned about computational thinking.
- Write 2 things you would like to share about computational thinking.
- Write 1 question you still have about computational thinking.

Resources:

Computational Thinking Presentation
Computational Thinking Handout Student Resource
Sticky notes

VOCABULARY

- **Computational Thinking:** A future-ready skill that promotes the problem-solving process of decomposition, algorithms, abstraction, and patterns
- **Decomposition:** Break things down into smaller, manageable parts
- **Algorithm:** Use steps and sequencing to solve problems
- **Abstraction:** Look at relevant and important details only
- **Patterns:** Find similarities and trends

Vocabulary slides are included in the Presentation that accompanies this lesson.

CAREER CONNECTIONS

- **Computational Engineers:** work on teams and computers using advanced math skills to understand, predict, and solve complex real-world issues, especially in the sciences.
- **Intelligence Officers:** (ex. Military, NSA, FBI, or CIA) analyze information to allow their organizations to understand, reduce, and counterbalance threats. The work ranges from counterterrorism to organized crime, and beyond.
- **Real Estate Analysts:** research and assess the different conditions in the commercial and/or residential real estate industry, such as data on local, regional, national and/or international sales, acquisitions, trends, and occupancy.

Career Connections slides are included in the Presentation that accompanies this lesson.

See the Occupational Handbook of the Bureau of Labor Statistics for specific career information: https://www.bls.gov/ooh/

- **Physicians:** strive to make sure patients maintain good health, aware of how to prevent illness, and restore health by studying, diagnosing, and treating injuries and diseases.

EXTENSIONS AND MODIFICATIONS

Lesson Extension:

- Connect with an elementary teacher and have students create their stations to share with an elementary classroom.
- **Reading:** Ask students to write a mystery story using the 4 key computational thinking skills.
- **Math:** Have students create a problem or scenario and then switch with a classmate to try to solve the problem or give solutions to the scenario, making sure to identify which computational thinking skill they are utilizing.

Lesson Modification:

- Jigsaw: Students could engage in a jigsaw of the computational thinking skills stations. Each group (expert group) could complete one station and then teach the rest of the class how they utilized computational thinking skills to accomplish/complete the station's activities.

Resources:

Computational Thinking Presentation
Computational Thinking Handout
Student Resource