Unit 1 - Problem Solving and Computing

The Problem Solving and Computing unit is a highly interactive and collaborative introduction to the field of computer science, as framed within the broader pursuit of solving problems. Through a series of puzzles, challenges, and real world scenarios, students are introduced to a problem solving process that they will return to repeatedly throughout the course. Students then learn how computers input, output, store, and process information to help humans solve problems within the context of apps. The unit concludes with students designing an app that helps solve a problem of their choosing.

Chapter 1: The Problem Solving Process

Big Questions

- What strategies and processes can I use to become a more effective problem solver?

Week 1

Lesson 1: Intro to Problem Solving

Unplugged

Question of the Day: What can help us to work together and solve problems as a team? The class works in groups to design aluminum foil boats that will support as many pennies as possible. At the end of the lesson, groups reflect on their experiences with the activity and make connections to the types of problem solving they will be doing for the rest of the course.

Lesson 2: The Problem Solving Process

Unplugged

Question of the Day: What are some common steps we can use to solve many different types of problems? This lesson introduces the formal problem solving process that the class will use over the course of the year: Define - Prepare - Try - Reflect. The class relates these steps to the problem from the previous lesson, then to a problem they are good at solving, then to a problem they want to improve at solving. At the end of the lesson, the class collects a list of generally useful strategies for each step of the process to put on posters that will be used throughout the unit and year.

Lesson 3: Exploring Problem Solving

Unplugged

Question of the Day: How can we apply the problem solving process to many different kinds of problems? In this lesson, the class applies the problem solving process to three different problems: a word search, a seating arrangement for a birthday party, and planning a trip. The problems grow increasingly complex and poorly defined to highlight how the problem solving process is particularly helpful when tackling these types of problems.

Chapter Commentary

This chapter guides students to develop and adopt a more formal structured problem solving process by reflecting on problems they have problems they have encountered, both in the classroom and everyday life. By working through a diverse set of problems, such as logic puzzles, engineering challenges, and planning a trip, students learn to identify different classes of problems, decompose large problems, and develop their personal problem solving skills.

Chapter 2: Computers and Problem Solving

Big Questions

- How do computers help people to solve problems?
- How do people and computers approach problems differently?
- What does a computer need from people in order to solve problems effectively?

Week 2

Lesson 4: What is a Computer?

Unplugged

Question of the Day: What is a computer? In this lesson, the class develops a preliminary definition of a computer. After brainstorming the possible definitions for a computer, the class works in groups to sort pictures into “is a computer” or “is not a computer” categories on poster paper, and explain their motivations for choosing some of the most difficult categorizations. The teacher then introduces a definition of the computer and allows groups to revise their posters according to the new definition.

Lesson 5: Input and Output

Question of the Day: How do computers use input and output to get and give the information that they need to solve problems? In this lesson, the class considers how computers get and give information to the user through inputs and outputs. After first considering what information they would need to solve a "thinking problem”, the class identifies the inputs and outputs to that process. Afterwards, they explore a series of apps and determine the inputs and outputs for each one.

Lesson 6: Processing

Unplugged

Question of the Day: What are the different ways computers can process information? This lesson introduces four types of processing that the class will use throughout the course. Through a series of apps, the class explores how processing is used to turn input into output. In the end, the class brainstorms more types of app processing that would be useful.

Lesson 7: Storage

Unplugged

Question of the Day: Why is storage an important part of the computing process? This lesson covers the last part of the chapter's model of computing: storage. The class interacts with several different apps, determining which information should be stored for later and why. The input-output-storage-processing model of computing is then presented in full, and the class reflects on how various apps use each of the components, and how the model impacts whether or not something should be considered a computer.

Week 3

Lesson 8: Project - Propose an App

Unplugged | Project

Question of the Day: How can the IOSP model help us to design an app that solves a problem? To conclude the study of the problem solving process and the input/output/store/process model of a computer, the class proposes apps designed to solve real world problems. This project is completed across multiple days and culminates in a poster presentation where students highlight the features of their apps. The project is designed to be completed in pairs, though it can be completed individually.

Chapter Commentary

This chapter presents computers as machines that solve information problems. Students begin by building a common definition for a computer that focuses on functionality instead of specific hardware. They then explore the ways that computers approach problems. For their final project, students propose an app that could be used to solve a problem of their choosing.

Chapter 3: The Problem Solving Process - Alternate Lessons

Week 4

Lesson 9: Intro to Problem Solving - Newspaper Table (Alternate Lesson 1)

Question of the Day: What can help us to work together and solve problems as a team? The class works in groups to design newspaper tables that will support as many books as possible. At the end of the lesson, groups reflect on their experiences with the activity and make connections to the types of problem solving they will be doing for the rest of the course.

Lesson 10: Intro to Problem Solving - Spaghetti Bridge (Alternate Lesson 1)

Unplugged

Question of the Day: What can help us to work together and solve problems as a team? The class works in groups to design spaghetti bridges that will support as many books as possible. At the end of the lesson, groups reflect on their experiences with the activity and make connections to the types of problem solving they will be doing for the rest of the course.

Lesson 11: Intro to Problem Solving - Paper Tower (Alternate Lesson 1)

Unplugged

Question of the Day: What can help us to work together and solve problems as a team? The class works in groups to design paper towers that will be as tall as possible. At the end of the lesson groups reflect on their experiences with the activity and make connections to the types of problem solving they will be doing for the rest of the course.

Lesson 12: Exploring Problem Solving - Animal Theme (Alternate Lesson 3)

Unplugged

Question of the Day: How can we apply the problem solving process to many different kinds of problems? In this lesson, the class applies the problem solving process to three different problems: a tangram puzzle, choosing a pet according to criteria, and planning a pet adoption event. The problems grow increasingly complex and poorly defined to highlight how the problem solving process is particularly helpful when tackling these types of problems.

Lesson 13: Exploring Problem Solving - Games Theme (Alternate Lesson 3)

Unplugged

Question of the Day: How can we apply the problem solving process to many different kinds of problems? In this lesson, the class applies the problem solving process to three different problems: a maze, a logic puzzle, and planning field day activity. The problems grow increasingly complex and poorly defined to highlight how the problem solving process is particularly helpful when tackling these types of problems.

Chapter Commentary

This chapter provides alternate lessons for this unit.

Lesson 1: Intro to Problem Solving

Overview

Question of the Day: What can help us to work together and solve problems as a team?

In this lesson, students work in groups to design aluminum foil boats that will support as many pennies as possible. Groups have two rounds to work on their boats, with the goal of trying to hold more pennies than they did in round 1. The structure of the activity foreshadows different steps of the problem solving process that students will be introduced to in more detail in the following lesson. At the end of the lesson students reflect on their experiences with the activity and make connections to the types of problem solving they will be doing for the rest of the course.

Alternate versions of this lesson are also available.

- **Newspaper Table**
- **Spaghetti Bridge**
- **Paper Tower**

Purpose

This lesson is a fun introduction to the open-ended, collaborative, and creative problem solving students will be using over the rest of this unit and course. The aluminum boats problem could easily be substituted out for any number of other problems that require students to define their goals, devise a plan, try a solution, evaluate their results, and then iteratively improve from there. The fact that the problem chosen is "non-computational" is intentional. Computer science is fundamentally a problem-solving discipline and staying away from traditional computer science problems at this point helps to frame this class as one about problem-solving more generally with computer science being a new "tool" to help attack certain types of problems.

Assessment Opportunities

1. **Communicate and collaborate with classmates in order to solve a problem**

   In the wrap up discussion question about collaboration, check for advantages to collaboration in problem solving and can list appropriate strategies for overcoming challenges. This practice will be reinforced throughout the unit and course.

2. **Iteratively improve a solution to a problem**

   In the Activity Guide, check for strengths and weaknesses in students' original design and connection to appropriate changes for the next iteration of the project.

View on Code Studio

Objectives

Students will be able to:

- Communicate and collaborate with classmates in order to solve a problem
- Iteratively improve a solution to a problem
- Identify different strategies used to solve a problem

Preparation

For each group

□2 sheets of aluminum foil, 5x5 inches in length each
□1 container that can hold 3-5 inches of water
□Several paper towels or rags that can be placed under the container
□15 pennies
□One copy of the activity guide

For the teacher

□1 container that can hold 3-5 inches of water
□50 pennies
□Extra paper towels or rags

Links

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

For the Teachers

- **Aluminum Boats** - Exemplar
- **Intro to Problem Solving - Aluminum Boats** - Slides
- **Code.org How-to Video Playlist**

For the Students

- **Aluminum Boats** - Activity Guide
  Make a Copy ▾

3. **Identify different strategies used to solve a problem**

   In the Activity Guide, check for strategies for overcoming the challenges in the activity. You also may want to check the "strengths" of their designs that students list as part of developing their plan on the second page of the guide.

Agenda

Tech Setup

- **Before class**
- **At the beginning of class**

CSD Pre-Course Survey

- **Important! Have your students take the CSD Pre-Course Survey!**

Warm Up (5 min)

- **Set the Stage**

Activity (30 min)

- **Building an Aluminum Boat**
- **Goal and Rules**
- **Develop a Plan**
- **Test Your Boat**
- **Evaluate and Improve**
- **Develop a Plan**
- **Test Your Boat**
- **Reflect**

Wrap Up (5 mins)

- **Discuss the Challenge**

Teaching Guide

Tech Setup

Throughout the year, in order for you to be able to see student work, and for students to be able to access online tools and resources, all students need to be in the same section on Code Studio. To see assessments and answer keys that Code.org provides, you also need to be a "verified teacher".

Before class

Ensure you are registered on Code Studio as a "verified" teacher account

Anyone can create a teacher account on Code Studio, which means that we need an extra layer of authorization to allow CS Discoveries teachers to see assessments, answer keys, and any other collateral that students should not be able to trivially get access to. If you attended a Code.org TeacherCon during the summer, you should already have this access.

To check whether you have access:

1. Navigate to the **Unit 1 course overview page**
2. Do you see the CS Discoveries Pre-course Survey as the first "stage" of the course?
3. If not, please fill out **this form**. Note that it can take a day or so to become a verified teacher account, so please do this step early!

If you are *not* a verified teacher account, you can still create a section for your class, but you will not be able to administer the pre-course survey on the first day.

Create a class section on Code Studio.

To create a section:

1. Navigate to the **Teacher Home Page**
2. Click 'New section' under 'Classroom Sections'
3. Choose 'Email Logins'
4. In the space provided, give your section a name (e.g. CSD Period 1), the grade of your students, Course: 'Computer Science Discoveries', Current Unit: 'Unit 1: Problem Solving', and click 'Save'
5. Once the section is created, click the name of the section
6. On the new page, you will see a unique Join URL that you will distribute to your students in class.

For a video walkthrough of these steps and more on navigating your Code.org account, go to the **Code.org How-to Video Playlist**

At the beginning of class

1. Have students create a Code Studio account at **https://studio.code.org** if they don't already have one
2. Share the section Join URL with students and tell them to navigate to it to join your section
   - You can confirm that a student successfully joined your section by having the section progress page on the Teacher Home Page open and hitting refresh as students join. Students should see a small green bar at the top of their page that says 'You've successfully joined ...'
3. From **studio.code.org** have students locate the Computer Science Discoveries tile and click 'View course', then go to Unit 1.

Once students are looking at the Unit 1 overview page, they will be ready to take the CSD Pre-Course survey

CSD Pre-Course Survey

Important! Have your students take the CSD Pre-Course Survey!

Students can find a link to the survey in Code Studio as the first item on the Unit 1 overview page. To ensure that students only take the survey at the appropriate time, it is "locked" and unviewable by them until you "unlock" the survey. The **How to Administer a Locked Assessment** document provides details on how to do that when you are ready. Note that the instructions for administering an assessment and a survey are the same.

How much time does it take?

The survey does take some time - it is roughly 30 questions. You might consider administering it on an admin day at school, or as an early homework.

Because it is a pre-course survey it is important that students take it as early in the course as possible, before they have had much (or any) exposure to the class so that we may accurately gauge changes in attitudes and beliefs caused by the course.

Thank you!

-- The Code.org Team

Why do the pre-course survey?

- A major goal of CS Discoveries is to broaden participation in computer science.
- It is *crucial* therefore to have insight into students' attitudes and beliefs about computer science *before* the course so that we can measure the amount of change that occurred *after* the course is over.
- Please note that this survey is **anonymous for students**
- Completing it also helps us understand important improvements we can make to the curriculum to improve the teacher and student experience.

Please help by having your students contribute to this vital dataset. Their voices make the difference!

Warm Up (5 min)

Set the Stage

Prompt: What makes someone a good problem solver? Be ready to share three ideas with your group.

Discuss: Allow students to share answers at their table groups or with a partner, then have those who are comfortable share with the whole class.

Remarks

> Those are all great ideas! In computer science, we have to solve problems all of the time, so we'll be looking back at all of these problem solving skills today and for the rest of the course. Most of the problem solving that people do in computer science happens in teams. Today, we're going to work in teams to solve a fun problem that doesn't need computers. While you work on that problem, here's a question that you can think about.

Display: Show students the Question of the Day

Question of the Day: What can help us to work together and solve problems as a team?

Teaching Tip

Journaling: Journaling is a key practice in CS Discoveries. Students can journal on loose leaf paper, in notebooks, or digitally. See the CSD Guide to Journaling for more information.

Slides: Slides for this unit are available in the "Teacher Resources" section of the lesson plan. If you'd like to edit your own copy of a slide deck you may without requesting access. Simply log in with a Google account, click "File" and "Make a copy" from the menu.

Discussion Goal

The goal of this warm up is to start students thinking about problem solving in preparation for the day's activity. Highlight answers that reinforce key practices in the class, such as collaboration, persistence, and creativity. This is also a chance to reinforce a positive culture that encourages students to share out and support each other in brainstorming ideas.

Activity (30 min)

Building an Aluminum Boat

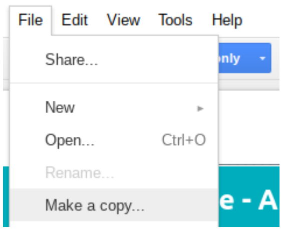
Group: Put students in groups of 2 or 3.

Remarks

Today we're going to be building aluminum boats. You'll have an opportunity to build at least two boats and use your experience with each one to improve your designs. Before we get started, decide as a group what kind of design you'd like to make with your first boat. Record your ideas and any possible weaknesses of this design on your activity guide.

Distribute: One copy of the activity guide to each group.

Teaching Tip



Getting Copies of Google Docs: Activity Guides in this curriculum are available as Google Docs, Word Docs, and PDFs. If you'd like to edit or make your own copy of a Google Doc you may without requesting access. Simply log in with a Google account, click "File" and "Make a copy" from the menu. You may then share your own copy with your students.

Goal and Rules

As a class, read through the Goal and Rules sections of the activity guide and answer questions.

Develop a Plan

Give students a couple minutes to discuss in groups the approach they will be taking with this first boat. Once groups have recorded their ideas and some possible weaknesses they can come to you to get their aluminum foil and begin building their boats.

Teaching Tip

This activity can get your room wet! Ideally, each group should have its own bucket/container with water to conduct its own tests. If needed, you can have several groups share one container, but be mindful to set guidelines for sharing that container. Place towel/rag under each container. You may also want to consider teaching this activity in the hallway or some other space if your room is very restrictive, or add in additional rules as necessary.

Teaching Tip

Hold onto the foil until students submit a plan for their boat. The goal isn't to slow them down too much, but just give them a moment to reflect briefly on the possible approaches they could take. This is one way this activity foreshadows the Planning step of the problem solving process students will see in subsequent lessons.

Test Your Boat

Once groups are ready, have them test their boats by dropping individual pennies into the boat. Remind them of the rules, specifically that they can't touch or adjust the boats once they're in the water. Have them record the total number of pennies held on their activity guides.

Evaluate and Improve

Remarks

> This first attempt at building our boats was just to get familiar with the challenge. We're all going to build a second boat and see if we can improve the number of pennies our boats held. Before we get started though, let's see what we can learn from this trial run.

Share: Have students share the results of their first run with neighboring groups. Ask groups to focus particularly on what the eventual failure of their boat was (e.g. it wasn't deep enough, it was unstable, etc.) and brainstorm ways to get around those problems.

Teaching Tip

While some students will view this portion as a competition, emphasize that each group is looking to improve its own design, not competing against others. You are appealing for each student to challenge themselves first, not others.

Develop a Plan

Prompt: Now that you've had a chance to learn from the first round of boat making, let's run the same activity again. First, your group will develop a new plan. Just as before, record it on your activity guide, and once you're ready I'll come around and give you a new piece of foil.

Support: As you circulate from group to group, ask questions about the group’s focus in redesign. EX: “What aspect of your boat needed the most improvement?” “What ideas from other groups did you want to incorporate to yours?” “Did you feel the need to completely restructure your boat, or make minor modifications?”

Once groups have prepared their new plans give them a new piece of foil and have them each build a new boat.

> ### Test Your Boat
>
> Groups can test their designs just as before and record the results on their activity guides.
>
> ### Reflect
>
> **Transition**: Ask class to return to their own seats to reflect on the activity.

Wrap Up (5 mins)

Discuss the Challenge

Question of the Day: What can help us to work together and solve problems as a team?

Prompt: You worked in teams for this activity. How did working in a team make this activity easier, how did it make the activity more challenging? What helped your group overcome these challenges?

✓ **Discuss**: Allow students time to share thoughts with the class.

✓ Assessment Opportunity

Students may recognize that collaboration allowed them to think through their ideas more thoroughly or that they were able to split up the work that they needed to do. As students list challenges, ensure that they are coming up with ways to overcome those challenges. If you have noticed any issues in group dynamics during the activity, you may want to use this time to bring up these as potential problems in a non-confrontational way and help students to generate strategies for working together more effectively in future activities. These can serve as classroom norms for group work moving forward.

Remarks

> All of your thoughts around these questions were great. We're going to be doing a lot of teamwork in this class. You may be used to thinking about computer science as being all about computers, but first and foremost computer science is about solving problems, and usually that happens in teams. A lot of other parts of this activity like improving designs, and building things is also going to be a big part of this class. I hope you're excited for the year. Tomorrow we'll start digging deeper into problem solving itself.

Standards Alignment

CSTA K-12 Computer Science Standards (2017)

- ▶ **AP** - Algorithms & Programming

Lesson 2: The Problem Solving Process

Overview

Question of the Day: What are some common steps we can use to solve many different types of problems?

This lesson introduces the formal problem solving process that students will use over the course of the year, Define - Prepare - Try - Reflect. The lesson begins by asking students to brainstorm all the different types of problems that they encounter in everyday life. Students are then shown the four steps of the problem solving process and work together to relate these abstract steps to their actual experiences solving problems. First students relate these steps to the problem activities from the previous lesson, then a problem they are good at solving, then a problem they want to improve at solving. At the end of the lesson the class collects a list of generally useful strategies for each step of the process to put on posters that will be used throughout the unit and year.

Purpose

This lesson aims to anchor the formal problem solving process students will use throughout the course in some real-life experiences they already have solving problems. Future units in CS Discoveries will present problems in contexts that may or may not be familiar. A structured problem solving process will be an important tool for helping students move forward in the face of novel and complex challenges.

Assessment Opportunities

1. **Given a problem, identify individual actions that would fall within each step of the problem solving process**

   On page 2 of the activity guide, check that students have written down reasonable actions for each of the four steps in the problem they are trying to solve.

2. **Identify useful strategies within each step of the problem solving process**

   In the wrap up, check that students are coming up with effective strategies for each step of the process.

Agenda

Warm Up (5 min)

  Problems Brainstorm

Activity (30 min)

  The Problem Solving Process
  What it Looks Like

View on Code Studio

Objectives

Students will be able to:

- Given a problem, identify individual actions that would fall within each step of the problem solving process
- Identify useful strategies within each step of the problem solving process

Preparation

For each student

□Print a copy of Activity Guide

For the class

□Poster paper
□Markers/colored pencils

Links

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

For the Teachers

- **Problem Solving Process** - Exemplar
- **The Problem Solving Process** - Slides
- **Problem Solving Process** - Graphic

For the Students

- **Problem Solving Process** - Video (**download**)
- **The Problem Solving Process** - Activity Guide Make a Copy ▾

- A Problem You Are Good at Solving
- A Problem You and a Classmate Want to Get Better at Solving
- Create Posters of the Steps

Wrap Up (15 min)

Extended Learning

- Article Discussion

Teaching Guide

Warm Up (5 min)

Problems Brainstorm

Prompt: We use the term "problem" to refer to lots of different situations. I could say I have a problem for homework, a problem with my brother, and a problem with my car, and all three mean very different things. On a sheet of paper I want you to brainstorm as many different kinds of problems as you can and be ready to share with the class.

Discuss: Students should silently record their ideas in writing for a couple minutes. Afterwards invite them to share what they wrote with a neighbor and then finally bring the whole class together to develop a classwide list. Record all the different kinds of problems students think of on the board or somewhere else that they'll be clearly visible.

Remarks

> Clearly we encounter problems in lots of different areas of our lives. Depending on the context, this word can have many different meanings. Today, we're going to look at some steps we can use to solve all sorts of problems.

Question of the Day: What are some common steps we can use to solve many different types of problems?

Discussion Goal

Goal: This conversation aims to demonstrate that problems and problem solving are a part of everyday life. Use this brainstorm to list as many different kinds of problems on the board as you can. This will be useful when you later ask students to select one type of problem that you believe they're particularly good at solving.

Teaching Tip

Make Categories: You may want to group problems into larger categories during this conversation and invite students to help you do so. For example, if two suggestions are "finding my keys" and "finding my homework" suggest a larger category of "finding lost things".

Real World Problems: Try to guide students away from too many homework or subject-area type problems (e.g. math problems, word problems, science problems, etc.) by saying you're more interested in real-life problems like solving disagreements, making big decisions, fixing or finding things, getting from one place to another, etc.

Activity (30 min)

Remarks

> We solve problems all the time, but we don't often think about how we're solving problems. Having a strategy or process to approach lots of different kinds of problems can make you a more thoughtful, creative, and successful problem solver.

Distribute: Hand out copies of the activity guides.

The Problem Solving Process

Video: Watch the Problem Solving Process Video on Code Studio

Code Studio levels

- Video: Problem Solving Process
- **Teacher Overview**
- **Student Overview**

Discussion Goals

View on Code Studio

The first discussion question is part of the core activity in the rest of the lesson. Students should take time working in their groups to think of specific things that they did that follow each step of the process. The goal of this discussion is to make the abstract steps more concrete and accessible to students by relating them to a shared activity.

The second question gives students a chance to expand their understanding of the process to a different problem, seeing how the different steps may look in different domains. The goal of this discussion is to make sure students have a general enough understanding of the process that they can apply it to a wider variety of problems, since the process will be used throughout the course in various domains.

Questions to consider

View on Code Studio

- How did you follow the problem solving process in the last lesson?
- How could you use this process on a problem in your everyday life?

Introduce and as a class review the descriptions of the four steps in the process by reading them aloud. Answer or discuss any questions students have about the process but otherwise move on to completing the first section of the activity guide.

What it Looks Like

Have students complete the first section of the activity guide by filling in the steps of the previous day's activity they think fall within each step of the problem solving process.

Discuss: Once students have completed the first section of the activity guide ask them to share with neighbors and then with the class as a whole.

Discussion Goal

Goal: For this first conversation in particular you're making sure students understand the meaning of the four different steps. While some steps might sometimes be categorized in two ways, use this chance to talk about that ambiguity. Your goal is to use the shared context of the aluminum boats problem to understand this process. Here's a possible set of steps students may come up with.

Define: Understanding the problem when it was assigned, examining available resources, finding problems with their original design before deciding how to fix them, looking at problems with other groups' boats

Prepare: Discussing with team members how to proceed, brainstorming approaches, anticipating possible flaws.

Try: Actually building the boats, running the test

Reflect: Examining the results of their test, comparing their results to their predictions, discussing with group members the reasons the boat sunk eventually.

A Problem You Are Good at Solving

Ask students to select one type of problem that they think they're really good at solving. Use the list of problems already on the board to help students think of their type of problem. Again give them a couple of minutes to quietly record the steps of their process before sharing with a neighbor.

Discuss: Have students share what they wrote with a neighbor and then once again lead a discussion of the conversations they had. Ask students to talk about the individual steps they're using to solve their chosen problem but also point out instances where the same types of strategies are appearing multiple times.

Discussion Goal

Goal: All three of these discussions aim to reinforce the meaning of the 4 steps in the problem solving process. In this discussion you might lean more heavily on other students to ensure that the strategies and steps being offered by students seem to fit the definitions of the 4 steps provided on the activity guide.

A Problem You and a Classmate Want to Get Better at Solving

Place students in pairs and ask them to complete the final section of the activity guide. They will need to choose a type of problem that both members of the group want to get better at solving and then write the steps they would use within the problem solving process to solve that problem.

Discuss: Lead one final share out in which students present how they would use the problem solving process to approach a less familiar problem.

Create Posters of the Steps

Distribute: Give each group a piece of poster paper.

Prompt: At your tables, choose one of the problems that you worked on today, and create a poster that shows how the problem solving process can be used to help solve it.

Circulate: As students work on their posters, ask them questions about their different problems, and how the steps to solve it relate to the general steps of the problem solving process.

Share: Allow students to share their posters with the rest of the class.

Teaching Tip

You may also choose to do this activity digitally. Check out the **forum** to see how other teachers have modified this activity for their classrooms, or to share your own modifications.

Wrap Up (15 min)

Question of the Day: What are some common steps we can use to solve many different types of problems?

Prompt: You saw a lot of different types of problems today, but they all used our Problem Solving Process. For each step of the process, think of one general tip that could be useful no matter what problem someone is trying to solve.

Assessment Opportunity

Check that students are coming up with effective strategies for each step of the process. These should be general strategies, not specific to the particular problems that they chose to solve.

Remarks

> I began by saying a formal problem solving process could help us solve all kinds of problems. Today we began to understand what this process looks like in a variety of real life situations. Tomorrow we're going to start putting this process into action to see how it actually works.

Extended Learning

Article Discussion

Read through the article, **You Are Solving the Wrong Problem**

1. What was interesting about this article?
2. What current events do you think we need to look at through this problem solving process? Why?

Standards Alignment

CSTA K-12 Computer Science Standards (2017)

▸ **AP** - Algorithms & Programming

Lesson 3: Exploring Problem Solving

Overview

Question of the Day: How can we apply the problem solving process to many different kinds of problems?

In this lesson students apply the problem solving process to three different problems in order to better understand the value of each step. They will solve a word search, arrange seating for a birthday party, and redesign a classroom. The problems grow increasingly complex and poorly defined to highlight how the problem solving process is particularly helpful when tackling these types of problems. The lesson concludes with students reflecting on their experience with the problem solving process. They will justify the inclusion of each step and will brainstorm questions or strategies that can help them better define open-ended problems, as this is often the most critical step.

This lesson will likely take two class periods or more to complete. The first two problems may fit into a single class period but the third will need to be moved to a second day.

Purpose

This lesson provides students with more practice with the problem solving process in a variety of contexts. It highlights the fact that the problem solving process is particularly helpful when approaching poorly defined problems. The final brainstorm of the lesson provides students with some strategies and questions they can ask to better define problems for themselves, since this is often the most critical step. The problems seen in this lesson also help to drive a discussion in the following lesson about the types of problems that computers are well-suited to solve.

Assessment Opportunities

1. **Apply the problem solving process to approach a variety of problems**

   On page 5 of the Activity Guide, check the chart to make sure that students are putting in reasonable steps for each of the problems.

2. **Assess how well-defined a problem is and use strategies to define the problem more precisely**

   For the last question on page 5 of the Activity Guide, make sure that students have at least one question or strategy that would be an effective way to better define a problem.

Agenda

Warm Up (5 min)

View on Code Studio

Objectives

Students will be able to:

- Apply the problem solving process to approach a variety of problems
- Assess how well-defined a problem is and use strategies to define the problem more precisely

Preparation

□ Print the activity guide for each student
□ Scratch paper for the Birthday Party problem
□ Poster to record strategies for defining problems in wrap up discussion

Links

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

For the Teachers

- **Exploring Problem Solving** - Slides
- **Solving Problems** - Exemplar

For the Students

- **Solving Problems** - Activity Guide
  Make a Copy ▾

Activity (75 min)

- **Solving Problems**
- **Understanding the Problem Solving Process**

Wrap Up (5 min)

Teaching Guide

Warm Up (5 min)

Journal Prompt: Think of the silliest problem the problem solving process could help with. Be prepared to say how each step of the process could apply.

Allow students to share out individually.

Remarks

> With such a wide variety of problems and strategies, it's important to be able to think about how best to use the problem solving process. Today we're going to look at some different types of problems, talk about what makes them different, and reflect on how the problem solving process helped us solve them.

Discussion Goal

This discussion serves as a review of the problem solving process and highlights how many different types of problems there could be. Encourage students to be creative and have some fun with the different "problems" they might solve.

Question of the Day: How can we apply the problem solving process to many different kinds of problems?

Activity (75 min)

Group: For all three activities students should be working together in groups, even if they record their results individually. Groups of 2-4 will likely work best.

Distribute: Hand out the activity guide, one copy for each student. For now they can be face down so that the word search isn't visible.

Solving Problems

Word Search

Once students are in pairs ask them to flip over their activity guides and begin the first challenge. They'll be finding the 8 words in a 20 by 20 grid of letters.

Circulate: Walk around the room observing how students are addressing the problem. Make sure that groups are not sharing locations of words. Encourage them to think about how making a plan might help them address this task.

Teaching Tip

Integrating the Problem Solving Process: This word search can actually take several minutes, especially if students are approaching without some kind of strategy. Remind them that one step is to Prepare before they just jump in and start hunting.

Key: A key showing possible solutions can be found online following the link provided above.

Once all groups have finished, bring the class back together. Have students flip to the last page of the activity guide where there is a table to record their experiences with the problem. They will record what parts of solving this problem fall within each step of the problem solving process.

Discuss: Briefly discuss with students what parts of the activity they felt fell into each step of the problem solving process. Some possible points to make after students share are below.

- **Define**: This problem was already very well defined. Not all problems will be, though.
- **Prepare**: Developing a plan with a team (such as divvying up the words, splitting the grid into separate sections that each member searches in, or just being methodical about looking for words) makes this problem much easier to solve than random searching.
- **Try**: Patience and persistence is important to see your plan through
- **Reflect**: If your early plans are not working you can regroup and choose a new plan

Birthday Guests

Move the class on to the birthday guests problem. Groups may still work together on their solutions but shouldn't share with other groups.

Circulate: As before, circulate around the room noting the types of strategies that groups are using. Remind them to use the steps of the problem solving process to help them if they're getting stuck.

Once groups have finished solving the problem ask them to move to the last page of the activity guide to record how they used the problem solving process to solve this problem.

Discuss: Briefly discuss with students what parts of the activity they felt fell into each step of the problem solving process. Some possible points to make after students share are below.

- **Define**: The problem seems to be a problem of seating individuals. If you instead think of it as a problem of seating groups of people who would like to be together there are many fewer possible solutions to consider.
- **Prepare**: Ask students to share what types of strategies they considered before just starting to assign people to seats.
- **Try**: As before, patience and persistence is important to see your plan through
- **Reflect**: If early strategies are not working groups may have regrouped and tried a more structured approach

💡 Teaching Tip

Integrating the Problem Solving Process: This problem is particularly challenging if you don't Define the problem well. If you take it at face value, your job is to randomly guess and check where to put individual people until you find a solution. It is much easier if you define the problem as place groups of friends instead. Make groups of 2 or 3 you know need to be together and then figure out which groups can't be at the same table.

This isn't the only approach to the problem, and you shouldn't rush to introduce it as such. Rather, encourage students to discuss with one another what they know needs to be true at the end and whether different approaches might help.

Draw Pictures: Students will likely do better if they draw pictures. You may wish for students to use a journal or scratch paper as a place to brainstorm ideas.

Extending the Problem: If one group finishes far before others you could give them a blank sheet of paper and ask them to solve the problem again but with a new condition of your choosing (e.g. pick two people sitting at the same table in their solution and ask whether they can solve the problem now that those two people are also in a fight.)

📝 💡 *Redesign Your Classroom*

Move the class on to the Redesign Your Classroom problem. Each member of the group will individually be developing a plan for a layout that follows criteria they'll develop as a team. Give students time to choose the goals they'll use to plan their layout. For example there may be certain things they'd like to move, new items want to include, people they want help them, etc.

Circulate: Once groups have goals, they will move through the activity by developing a plan to redesign the classroom. Give them a time limit on this part of this process, e.g. 15 minutes, to make sure they focus on the key elements on their plan rather than perfecting it. They should record key information about their plan in their activity guides.

Bring groups back together and have them share their initial plans. On the activity guides they can record the feedback their classmates give them on their plans.

Once groups have discussed what they like or don't like about their classmates' proposed plans, they can re-examine them and make improvements. Are there other things they'd like to do? Do they have new goals? Give them several minutes to make improvements to their plans before deciding on a final version.

Bring the class back together and have them record the different steps of the problem solving process that they used in their activity guides.

💡 Teaching Tip

Integrating the Problem Solving Process: This problem is intentionally very open-ended and in fact has students develop the criteria they'll use to measure success. This problem does the best job of highlighting all 4 steps of the process and walks students more intentionally through the Define, Prepare, Try, and Reflect stages.

Give Resource Ideas: Students may just brainstorm ideas and layouts by themselves, but also let them know about other resources such as search engines and image searchers to help give them inspiration if they are stuck. Let them look at other classrooms online for help.

When to Stop: This problem could easily take a 50 minute class period. Let students know ahead of time that there are time limits on what they're doing and encourage them to think how they would improve their route using the problem solving process if they had more time to iterate.

Discuss: Briefly discuss with students what parts of the activity they felt fell into each step of the problem solving process. Some possible points to make after students share are below.

- **Define**: This problem was not well-defined. They needed to decide for themselves what a "good" room looked like, and this definition could have even shifted throughout the process.
- **Prepare**: Narrowing down a list of possible layout is helpful. You may also choose to make the point that this entire activity is an example of preparation. Some layouts just don't make sense or others work better, so you need to do the kind of planning they're doing here.
- **Try**: As before, patience and persistence is important to see your plan through
- **Reflect**: In this problem reflection came primarily through feedback from peers. Some layouts might not end up being that interesting to other group members. Some are fun but require too much moving or too many new things. Feedback is an important part of the reflect step, especially in group work.

Understanding the Problem Solving Process

Prompt: You just solved a number of very different problems. With your tables review the notes you took on each of the problems. Be ready to report out on the following questions

- For each step in the problem solving process, what is its purpose? Why is it included?
- Are there any kinds of problems that the problem solving process is particularly helpful at solving?

Discuss: After tables have discussed their responses for several minutes invite the whole class to share their rationale for including each step in the process. Once each step has been discussed, move on to the second question. This question may have many responses and you should allow students to share their thoughts and experiences. If it doesn't arise naturally as you leave the conversation offer some or all of the ideas mentioned in the discussion goals.

Discussion Goal

Goal: Students have practiced using the problem solving process on a number of different problems. Help them synthesize the notes they have been keeping to better understand the role of each step and the value of the problem solving process in general. A sample set of conclusions is below but you should allow students to share your own insights before offering your own.

Define: without defining a problem you might solve the wrong problem, not know where to start, or not know when you're finished

Prepare: Even well-defined problems usually have many possible approaches. Make each try more likely to succeed by first examining your options and anticipating challenges

Try: Without trying you'll never get anywhere. It's important to be persistent and patient so long as your plan still may work

Reflect: You'll likely not solve the problem the first time or there will be a better way to solve it. Learn from your past attempts and get ready to start the process again.

The Problem Solving Process: While you may notice you're using it even for small and trivial problems, this process is incredibly useful for large, complex, poorly-defined, or open-ended problems. It helps you make progress when the way forward may not always be clear.

Wrap Up (5 min)

Question of the Day: How can we apply the problem solving process to many different kinds of problems?

Journal Prompt: The problem solving process is particularly helpful when we encounter poorly-defined problems. We saw today that without a well-defined problem the rest of the problem solving process is difficult to follow. What are some questions or strategies we can use to help us better understand and define problems before we try to solve them?

Discuss: Have groups share quickly before taking suggestions from the class as a whole.

Remarks

> Excellent work everyone. We now understand a great deal about the problem solving process. This is going to be an incredibly useful tool that we'll use repeatedly throughout the year as we dig deeper into understanding the world of computer science.

Discussion Goal

There are many different strategies to help define problems, including the questions on the previous lesson's activity guide. Some potentially useful questions include:

- Who in particular the problem affects. What specifically do they need? In what kind of situations?
- Why the problem exists? (And why does that problem exist?) Keep asking to get to the heart of the problem.
- How could I be able to tell the problem had been solved? What could I observe or measure?

Standards Alignment

CSTA K-12 Computer Science Standards (2017)

▶ **AP** - Algorithms & Programming

Lesson 4: What is a Computer?

Overview

Question of the Day: What is a computer?

In this lesson students develop a preliminary definition of a computer. To begin the lesson, the class will brainstorm possible definitions for a computer and place the results of this brainstorm on the board. Next, students will work in groups to sort pictures into “is a computer” or “is not a computer” on poster paper. Groups will place their posters around the room and briefly explain their motivations for choosing some of their most difficult categorizations. The teacher will then introduce a definition of the computer and allow students to revise their posters according to the new definition.

Purpose

This lesson builds on the problem solving theme of the earlier lessons and focuses on the specifics of how computing is used in problem solving. In this lesson, students will consider different types of computers and that these computers use information as part of the problem solving process. Upcoming lessons will dive much deeper into what an information problem looks like and how computers solve these problems.

Assessment Opportunities

1. **Identify a computer as a machine that works with information.**

   In the last discussion of the main activity, check students' reasoning about whether a device is a computer. Make sure that they are mentioning that it uses information or solves information (or thinking) problems.

2. **Reason about whether particular objects are or are not computers.**

   In the last discussion of the main activity, check students' reasoning about whether a device is a computer. Make sure that they are mentioning that it uses information or solves information (or thinking) problems.

3. **Choose problems that can be solved with computing and justify those choices.**

   In the wrap up activity, check that students have chosen information problems and have explained how a computer gets and uses the information needed to solve the problem.

Agenda

Warm Up (5 mins)

View on Code Studio

Objectives

Students will be able to:

- Identify a computer as a machine that works with information
- Reason about whether particular objects are or are not computers.
- Choose problems that can be solved with computing and justify those choices.

Preparation

For each group

□Print out copies of the activity guide. Note there are two sets of pictures, but each group only needs a single set.
□Scissors (if you will not have time to cut the pictures prior to class)
□Poster paper
□Markers or colored pencils
□Glue or tape to attach pictures

Links

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

For the Teachers

- **What is a Computer?** - Exemplar
- **What is a Computer** - Slides

For the Students

- **What is a Computer** - Video (**download**)
- **What is a Computer (Version B)** - Activity Guide Make a Copy ▾
- **What is a Computer (Version A)** - Activity Guide Make a Copy ▾

Vocabulary

- **Computer** - A machine that works with information.

- **Computers then and now**

Activity (40 mins)

- **Computer or Not?**
- **Present Your Categorizations**

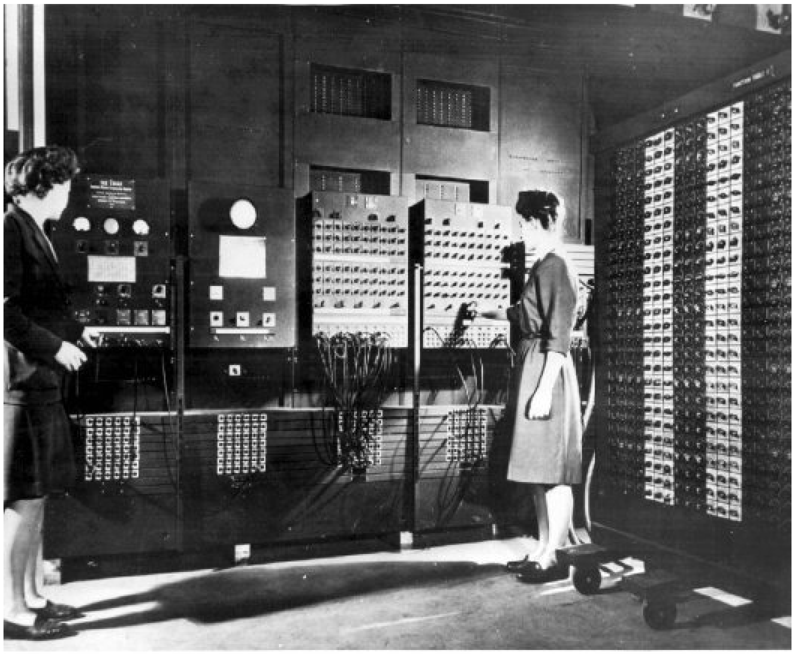
Wrap Up (5 mins)

- **Journal**

Teaching Guide

Warm Up (5 mins)

Computers then and now



Journal Prompt: This picture shows one of the world's first computers, and two of the world's first computer programmers. What are three ways this computer is different from computers that we use today? What are two ways that it is the same? What is one thing you think is true of ALL computers?

Discuss: Once students have reflected in their journals, they can share out their ideas "popcorn" style, with each student who shares an idea calling on a new classmate to share next. Run this conversation as a brainstorm, recording ideas on the board. Note and call out similarities in characteristics. Students may come up with counter examples for some of the common characteristics. Remind them that you are brainstorming and that it's important to consider all of the possible ideas, and that they will have more time to think about this question in the lesson.

Discussion Goal

Goal: This warm up starts students thinking about what the defining characteristics of a computer are. Students do not need to have a definition of a computer, but they should start to think about the different types of computers in their lives and what they have in common.

Note: The programmers pictured are Elizabeth Jean Jennings Bartik and Frances Bilas Spence. The computer pictured is the ENIAC.

Remarks

> Computers come in all different forms, and they've changed a lot over the years. Today we're going to think about what makes something a computer.

Question of the Day: What is a computer?

Activity (40 mins)

Computer or Not?

Group: Place students in groups of 3 or 4

Distribute: Activity Guide as well as scissors, markers / colored pencils, poster paper, and glue / tape for making posters. (Note that there are two possible versions of the activity guide. Choose the best for your class, or give different groups different versions.)

Teaching Tip

Modifications from the Forum: Many teachers have shared ideas for extending modifying lessons on the forum **(link)**. Head there to check out ways teachers have reduced printables, integrated technology, or otherwise adapted this activity to fit the needs of their class. If you do something new, share your ideas too!

Give students the following directions:

- Draw a line down the middle of your poster, label one side "Computer" and the other "Not a Computer"
- Discuss as a group which of the objects in your set (from the activity guide) belong in each category
- Once your group is in agreement tape your objects to the appropriate side
- Develop a list of characteristics your groups used to determine whether an object is a computer

Circulate: Circle the room as students work to categorize the different images on the activity guide. Encourage groups to talk openly about their ideas and explain why they do or don't think an object should be categorized as a computer. For groups that can’t decide on a categorization, ask members to defend their points of view, and try to reach a consensus. Assure groups that it is okay if one or two people disagree, and that everyone's point of view should be respected.

Teaching Tip

Tape First: Students will have an opportunity to update their categorizations later in the lesson. For now they should just tape their objects to their poster or even just place them on the correct side.

At the end of the time bring the class back together and ask them to place their posters at the front of the room.

Present Your Categorizations

Share: Have each group briefly present their posters, focusing their discussion on the following points

1. What rules or definition did you use to categorize your objects?
2. Which item was most difficult for you to categorize? How did you eventually make the decision of where to place it?

Teaching Tip

Comparing Categorizations: There are two different sets of objects in the activity guide. The first page of each set is identical while the second pages are different. This will mean all students will see some objects that they categorized already and some that are new. Use this to help drive conversation.

Invite the audience to respectfully question any categorizations if they disagree with the presenting group's decisions.

Remarks

> As you can see, it's not always clear whether something is a computer, and even experts sometimes have different points of view. Let's have a look, however, at a definition that we'll use throughout this course.

Display: Show the "What is a Computer?" video. This video is also available to students on the Code.org website, including an alternative link for schools where YouTube is blocked. The video presents a computer as a machine that helps with certain kinds of thinking work by manipulating information. You may want to present the definition as "a machine that works with information".

Assessment Opportunity

Rather than looking at how particular items are categorized, check students' reasoning about whether a device is a computer. Make sure that they are mentioning that it manipulates information or solves information (or thinking) problems, and prompt them with the scaffolding questions if they are unable to give a sufficient definition.

It may be impossible to tell from the picture alone whether or not an item is a computer. Reassure the class that even experts often disagree about what exactly is or is not a computer.

Key Vocabulary:

computer: - a machine that works with information

Allow students to revise their posters using the definition they have just learned. They can use the following questions to guide them.

- What types of problems is this device used to solve?
- Does the device use information to solve problems?
- Where does it get the information?
- How does it use the information to solve problems?

Discuss: Did any groups change their minds about whether something was a computer? What about the definition convinced you?

Wrap Up (5 mins)

Question of the Day: What is a computer?

Key Vocabulary:

- **computer:** - a machine that works with information

Journal

Prompt: Today you've had a chance to look at a definition of a computer that focuses on how the computer solves problems. We've also seen many different types of computers. In your journal, think of a problem that a computer can help you to solve.

- What is the information problem?
- What information does the computer need to solve that problem?
- What type of thinking work does the computer need to do to solve the problem?

Teaching Tip

Identifying Information Problems: Students are still developing an understanding of what information is or what an information problem that a computer could help solve looks like. Have students share their ideas if you like but frame the conversation as a first investigation of this question since they'll return to it repeatedly for the rest of the unit.

Assessment Opportunity

Check that the students have chosen information problems and have described how information can be used to solve the problem. The answers do not need to be specific enough to program into a computer, but should give enough of a general description to justify that it is an information (or computational) problem.

Standards Alignment

CSTA K-12 Computer Science Standards (2017)

▶ **CS** - Computing Systems

Lesson 5: Input and Output

Overview

Question of the Day: How do computers use input and output to get and give the information that they need to solve problems?

In this lesson students consider how computers get and give information to the user through inputs and outputs. Students first consider what information the would need to solve a "thinking problem", then use that information to produce a recommendation. They then identify the inputs and outputs to that process. Afterwards, students consider an app that engages in the same process and determine how that app inputs and outputs information. Last, they consider other types of inputs and outputs that computers can use to help solve problems.

Purpose

In the previous lesson students were introduced to the input, output, store, and process model of a computer. Since this model of a computer is still fairly abstract, this lesson grounds it in the ways a computer actually input and output information.

Assessment Opportunities

1. **Select the inputs and outputs used to perform common computing tasks**

   ✓ In the wrap up discussion, make sure that students come up with multiple examples of tasks that involve input and output, and that they are coming up with multiple types of inputs and outputs specific to the task at hand. You might also collect individual answers to this question as an exit ticket.

2. **Explain the role that input and output take when computers are used to solve information problems.**

   ✓ On the activity guide, check that "student app" has appropriate inputs and outputs listed, with a reasonable explanation for why each is necessary. Student answers will vary, but you can use the exemplar linked on the first level of the Code Studio progression as a guide.

Agenda

Warm Up (10 mins)

  Recommending a Pet

Activity (25 mins)

  Inputs and Outputs

Sample Apps

Pet Chooser

Story Creator

View on Code Studio

Objectives

Students will be able to:

- Select the inputs and outputs used to perform common computing tasks
- Explain the role that input and output take when computers are used to solve information problems.

Preparation

□ Prepare copies of the activity guide

Links

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

For the Teachers

- **Input and Output** - Exemplar
- **Input and Output** - Slides

For the Students

- **Input and Output** - Activity Guide
  Make a Copy ▾

Vocabulary

- **Input** - the information computers get from users, devices, or other computers
- **Output** - the information computers give to users, devices, or other computers

Student Apps

Other Sources of Input

Improved Pet App

Wrap Up (5 mins)

- What Inputs and Outputs Do I Use?

Teaching Guide

Warm Up (10 mins)

Recommending a Pet

Journal

Prompt: Imagine that you are going to recommend a pet to someone. What are three questions you would ask them to help make that recommendation?

Give students time to write down their three questions.

Remarks

> In the last lesson we learned that a computer is a machine that "works with information". Right now, we're going to work with information to make a pet recommendation to a classmate.

Group: Put students into pairs.

Prompt: Take turns asking your questions and making a recommendation to your partner.

Discuss: After students have had time to each make a recommendation, allow some students to share out the answers that their partner gave them and the recommendation that they made. Make a list on the board with the "answers" next to the "recommendations".

Discussion Goal

Goal: In today's lesson students will be talking about the concepts of "input" and "output" in computing. For this discussion, it's not so important the exact answers and recommendations, but that students can see that this information falls into two different categories.

Remarks

> In order to solve this problem, you had to **get** information from your partner in the form of answers to you questions. You also had to **give** information to your partner in the form of a recommendation. Computers do the same thing. The information that they get from users is called **input**, and the information that they give to users is called **output**. Lets take a look at an app that also makes pet recommendations.

Key Vocabulary:

- **Input** - the information computers get from users, devices, or other computers
- **Output** - the information computer give to users, devices, or other computers

Question of the Day: How do computers use input and output to get and give the information that they need to solve problems?

Activity (25 mins)

Inputs and Outputs

Distribute: Copies of the activity guide to each pair (or ask them to answer the questions in their journals).

Vocabulary: The two vocabulary words of the day are found on the top of the activity guide.

Sample Apps

Transition: Send pairs to Code Studio.

Pet Chooser

Look at the pet chooser app together. Note that it does something very similar to what the students just did in pairs. As a group, answer the first two questions about the app's input. Make sure students understand that the app gets the input from the user's behavior, in this case, pressing a button. Depending on the group, you may want to model the question around output or have students work on it in pairs.

Teaching Tip

Students do not need the exact input for every possible question asked. It's sufficient to say that the input is information about whether the user has allergies, wants to play with the pet, etc., and that the app gets this information from the user pressing a button.

Story Creator

Next, allow pairs to look at the story creation app on their own, answering similar questions about its input and output. This app allows students to put specific information into a form, then generate a personalized story based on the information provided.

Assessment Opportunity

Ensure that students are identifying appropriate inputs and outputs. Student answers may vary slightly, but they should be similar to those in the exemplar provided in the "Teachers Only" box of the first level in Code Studio.

Student Apps

In pairs or larger groups, students come up with their own app ideas, and decide the types of input and output that would be needed for those apps.

Share: Allow students to present their app ideas and the inputs and outputs that they would need.

Other Sources of Input

Prompt: So far, all of the input that we have seen comes directly from the user. Is there any other way that apps can get the information that they need?

Discuss: Allow students to brainstorm silently, then talk in pairs or small groups before soliciting answers from the entire group.

Discussion Goal

As students come up with their ideas, ensure that the Internet and sensor data (such as GPS, microphone, and camera), come up. You may need to prompt students by asking them whether there is anything that a smartphone knows without the user having to tell it. Although students may not be familiar with every possible sensor on a phone, by the end of the discussion, they should understand that the phone has sensors that it can use to get data without the user's direct input.

Improved Pet App

Students should look at the new pet app that is similar to the one they saw before, but with the additional feature that it gives the user directions to a nearby pet shop where they can get the pet.

Students should identify the different inputs to the improved app, including which inputs are from the user, which from the Internet, and which from the phone sensors.

Wrap Up (5 mins)

Question of the Day: How do computers use input and output to get and give the information that they need to solve problems?

What Inputs and Outputs Do I Use?

Key Vocabulary:

- **Input** - the information computers get from users, devices, or other computers
- **Output** - the information computers give to users, devices, or other computers

Prompt: Brainstorm an everyday activity you or people you know do with an app or computer.

1. What is the input used for that activity?
2. What is the output?

Circulate: Have students brainstorm individually and record their ideas on their activity guides or journals.

✓ **Discuss:** As a class discuss the examples students brainstormed.

✓ Assessment Opportunity

Use this wrap up activity to assess how well students have understood the role of input and output in some common activities on a computer. For example:

- Typing on a Keyboard (Input) Makes Letters Appear on a Screen (Output)
- Moving a Mouse or Touch Screen (Input) Changes What Appears on the Screen (Output)
- Pressing play on a touchscreen (Input) Makes a Song Play through the Speakers (Output)

If you need, give students this or other examples to prompt more examples

Standards Alignment

CSTA K-12 Computer Science Standards (2017)

▶ **CS** - Computing Systems

Lesson 6: Processing

Overview

Question of the Day: What are the different ways computers can process information?

This lesson introduces students to four common types of processing: if/then (conditionals), finding a match (searching), counting, and comparing. Students are first introduced to the types of processing through several sample apps. They then investigate more apps to determine what sorts of processing each uses. They then think of their own app and decide what types of processing it would need to work. Finally, they brainstorm other types of processing that may be useful but were not included in the main lesson.

Purpose

This lesson introduces the concept of processing within computational problem solving. The definition of processing presented in this lesson is intentionally approachable. Students should understand that processing is whatever a computer does to turn inputs to outputs, and that there are many different ways for computers to do this work. The goal of this lesson is not for students to write specific algorithms for the example apps.

Agenda

Warm Up (10 min)

Analyzing an App (Birthday App)

Activity (30 mins)

Types of Processing
Apps and Processing
More Processing
Student Apps

Wrap Up (10 min)

What Inputs and Outputs Do I Use?

View on Code Studio

Objectives

Students will be able to:

- Define processing as the work done (possibly by a computer) to turn an input into an output
- Identify several common types of processing used in computing.
- Determine which types of processing are appropriate for a particular computing problem.

Preparation

Links

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

For the Teachers

- **Processing** - Exemplar
- **Apps with Processing** - Slides

For the Students

- **Apps with Processing** - Activity Guide
  Make a Copy ▾

Vocabulary

- **Processing** - The thinking work computers do to turn input into output.

Teaching Guide

Warm Up (10 min)

Analyzing an App (Birthday App)

Journal Prompt: Go on Code Studio to try out the birthday app. It has three possible outputs. Try to find each one.

1. What is the input to the app?
2. What is the output?
3. How do you think the app decides which output to give back to the user?

Circulate: The first part of this reflection serves as a review of input and output. As students reflect on the prompt, check their answers to ensure that they understand how input and output are used in the app.

Ask students to share out how they thought the app made the decision.

Content Corner

Students may identify the user's birthdate as one input and possibly the current date as another input. The message of whether or not it is the birthday is the output. The decision of which message to output is based on whether the current date matches the date that the user inputs.

Discussion Goal

Students may have trouble articulating exactly how the app makes its decision. Encourage discussion and highlight the "matching" and "if/then" facets of the decision make process. (e.g. "The app **compares** the birthdate to today's date." / **If** the birthdate is the same as today's date, **then** display "Happy Birthday!")

Remarks

> In the past few lessons, we learned that computers are machines that help us with thinking work by turning input into output. For example, the thinking work this app did was to compare the birthdate to today's date, and to use that information to decide what to display on the screen. These types of thinking work computers do are called "processing." We are going to look at some different types of processing today.

Key Vocabulary:

- **Processing** - the thinking work computers do to turn input into output

Question of the Day: What are the different ways computers can process information?

Activity (30 mins)

Types of Processing

Remarks

> We've already seen two different types of processing in the Birthday App: comparing and if/then. We're going to look at a couple other apps and see what kinds of processing they might use.

Display: Demonstrate the "National Park " app at the front of the room, or allow students to explore the app on their own.

Prompt: How does this app use if/then and comparing to turn the input into output?

Discussion Goal

Allow students to share out their answers, and reinforce that comparing can mean deciding whether any two things are the same, not just numbers.

Display: Demonstrate the "How Many Countries..." app at the front of the room, or allow students to explore the app on their own.

Prompt: This app uses some different types of processing to make decisions. What kinds of processing might it use?

Discussion Goal

Allow students to share out their answers, but make sure that the "counting" and the "find a match" are highlighted in the discussion.

Remarks

> There are lots of different types of processing that computers can use. Today, we are going to focus on four basic types: If/then, comparing, finding a match, and counting.

Display: Display the four types of processing and their definitions at the front of the room, and review the information with the students.

Group: Put students in groups of 2-3. Each group will need access to one computer for this activity.

Distribute: Give each group one copy of the activity guide.

Apps and Processing

As a class, complete the first three rows of the activity guide, which reference the three apps that students have already seen.

✓ **Circulate:** Allow students to complete the rest of the chart in their groups. As they fill out the charts, ask them to elaborate on how the app works and what makes that particular type of processing useful.

✓ Assessment Opportunity

Because almost all apps use more than one form of processing, students may identify unexpected aspects of the apps. The most important part is their explanation. They should be reasoning about how the input is used to generate the output of the app.

My Famous Birthday

This app asks users to input their birthday, then tells them the day of the week that they are born and a famous author born on that same day. The type of processing is included in the "teacher only" notes in the level.

Stamp Notebook

This app allows users to click on an icon and "stamp" that icon on the display screen. Clicking an icon more than once changes the color of the stamp.

More Processing

The next chart asks students to find two types of processing for every app. The explanations for processing are included in the teacher notes in Code Studio. This section asks students to evaluate more complex apps, which may be difficult for younger students. Feel free to skip this more challenging section and move directly to the "student app" section.

The Fastest Finger

This app displays which key is being pressed the fastest, the 's' key or the 'k' key.

Guess the Number

This app asks users to guess a number between one and one hundred, and displays whether the guess is too high, too low, or correct.

Where Should I Live?

This app gives the user advice on where to live based on the answers to a few questions.

Student Apps

Students come up with their own app ideas, using their previous app from the Inputs and Outputs lesson, or coming up with a new one. They then think of the types of processing that would be needed for those apps.

Share: Allow students to present their app ideas and the processing that they would need.

Wrap Up (10 min)

What Inputs and Outputs Do I Use?

Prompt: We saw four different types of processing today, but there are many more.

1. What’s another type of processing that you think would be useful?
2. What kind of app might use it?

Circulate: Have students brainstorm individually and record their ideas on their activity guides or journals.

✓ **Discuss:** As a class, discuss the examples students brainstormed.

✓ Assessment Opportunity

Students' answers will vary, but make sure that they are reasonably using processing to change an input into an output.

Standards Alignment

CSTA K-12 Computer Science Standards (2017)

- ▶ **AP** - Algorithms & Programming
- ▶ **CS** - Computing Systems

Lesson 7: Storage

Overview

Question of the Day: Why is storage an important part of the computing process?

This lesson introduces the final component of the unit's model of computing: storage. After trying out an "outfit picker" app, students discuss what information should be stored in the app versus input every time the app is run. They then look at a series of apps and use their decisions about what shoulg be stored to create guidelines for deciding what information to store. They then review the four components of this chapter's model of computing: input, output, storage, and processing. Afterwards, they have one last opportunity to revise their decisions about which items should be classified as a "computer" from earlier in the chapter. The lesson ends with a reflection on their own app ideas and how storage could be used.

Purpose

In Chapter 1 of this unit, students learned the problem solving process. In Chapter 2, students learned how computers solve problems. At this point, students know that computers are information processing machines that can do four things with information: input, output, store, and process. In this final lesson before the unit project, students look at types of input that may be needed to solve a particular problem and describe the processing and storage that a computer would do to produce the desired output. This should prepare them to eventually design their own app to address a problem and explain how that app would work.

Assessment Opportunities

1. **Determine whether some input should be stored or not.**

   ✓ In the activity guide, check student answers and reasoning for what information should be stored.

2. **Identify guidelines regarding which kinds of input should and should not be stored.**

   ✓ Check the guidelines that each group writes together.

3. **Use the IOSP model to identify some of the input, output, storage, and processing used in a given computer.**

   The two journal prompts after the IOSP video ask students to identify the different parts of IOSP in an app they commonly use and in a smartphone.

Agenda

View on Code Studio

Objectives

Students will be able to:

- Determine which information in a computing problem should be stored for later use.
- Identify guidelines regarding what information should and should not be stored as part of the computing process.
- Use the input-output-storage-processing model to describe a computing process.

Preparation

☐ Print a copy of the activity guide for each student

Links

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

For the Teachers

- **Storage** - Slides
- **Storage** - Exemplar

For the Students

- **Storage** - Activity Guide Make a Copy ▾

Vocabulary

- **storage** - saving information to use in the future

Warm Up (5 min)

- Analyzing an App (Outfit Picker)

Activity (20 min)

- Apps with Storage
- Outfit Picker
- Friend Finder
- Choose a Kid's Movie
- Guidelines

Introducing the IOSP Model (20 min)

Wrap Up (5 min)

- Journal

Teaching Guide

Warm Up (5 min)

Analyzing an App (Outfit Picker)

Journal Prompt: Go on Code Studio to look at the outfit picker app. What is one input, one output, and one kind of processing it might use? Let’s say you used this app every day. What information would you want this app to remember?

Circulate: The first part of this reflection serves as a review of input, output, and processing. As students reflect on the prompt, check their answers to ensure that they understand how input, output, and processing are used in the app.

Ask students to share out what information they thought should be stored and why.

Remarks

> This example app asks for some information that won't change very often, such as your favorite color. Instead of being required to enter this data every time, it would be helpful if the app could remember our answers by storing it. All computers can save information for later and read saved information through **storage**.

Content Corner

Students may identify the weather, favorite color, or season as the input, and the pictures of outfits as the output. Although the exact processing of the app may not be clear, students may point out that there are several likely if/then scenarios ("If the weather is rainy, then include an umbrella.") or matching between the user's input and features of the outfits.

Discussion Goal

While it's not important that students agree on the answers, this discussion introduces them to the idea of storing information for later and prompts them to think about what information should and should not be stored in an app.

Key Vocabulary: Storage - saving information to use in the future

Question of the Day: Why is storage an important part of the computing process?

Activity (20 min)

Apps with Storage

Remarks

> We're going to look at a few apps that use a few kinds of information. We want to identify which information could be stored so that we don't have to enter it every time.

Group: Put students in groups of 2-3. Each group will need access to one computer for this activity.

Distribute: Give each group one copy of the activity guide.

As a class, complete the first section of the activity guide, which references the outfit picker app used in the warm up.

Send students to Code Studio to see the sample apps.

Circulate: Allow students to complete the rest of the activity guide in their groups. As they fill out the charts, ask them to elaborate on why they thought each input should be stored or not.

Assessment Opportunity

There is some flexibility about what should and shouldn't be stored, since that is a choice that the app designer could make. The most important part is their explanation. They should be reasoning about whether that information will change frequently.

Outfit Picker

The first app asks users to input their favorite color, the current season, and the weather, then outputs a picture of an outfit based on the user input.

Friend Finder

The first app asks users to input which friends should be on their friends list, then outputs a map that displays the locations of the friends on the list.

Choose a Kid's Movie

The third app asks users to input several preferences around movies, then outputs a movie recommendation based on the user's preferences.

Guidelines

As groups move on to the final activity, you may need to briefly explain what a guideline is and what the question is asking for. Make sure that all groups have time to come up with guidelines, even if they have to skip parts of the earlier chart.

✓ **Circulate:** If groups get stuck writing their guidelines, ask them about which inputs they said should be stored in the other apps. Ask them to see if they can find any similarities between which inputs were stored and were not stored. Remind them that they can also write guidelines about which inputs were not stored.

✓ Assessment Opportunity

Student answers may vary, but in general, they should realize that whether information should or should not be stored relates to how frequently it changes, if changes at all.

Once most of the groups are done writing their guidelines, bring the class back together and ask if any group would like to share one of their guidelines.

Introducing the IOSP Model (20 min)

Remarks

> Now we can understand a computer as a machine that does four things: input, output, storage, and processing

Show them the video introducing the IOSP model.

Prompt for discussion with two discussion questions.

1. Think of something you do on the computer. What sort of input, output, storage, and processing are happening?
2. What kinds of input, output, storage, and processing are used in a modern smartphone?

Teaching Tip

If you are using journaling, prompt the students to write their answers down in their journals

Finally, look at the poster from the "What is a Computer?" lesson and check to see if any of the machines should be reclassified as computers or not computers based on this new IOSP model.

Wrap Up (5 min)

Journal

Prompt: Think of an app you would like to make. What information would it store?

Share: Time permitting, allow students to share out their ideas.

Discussion Goal

As student share their ideas, ensure that they are using the key vocabulary of the lesson:

storage - saving information to use in the future

Standards Alignment

CSTA K-12 Computer Science Standards (2017)

- ▶ **AP** - Algorithms & Programming
- ▶ **IC** - Impacts of Computing

Lesson 8: Project - Propose an App

Overview

Question of the Day: How can the IOSP model help us to design an app that solves a problem?

To conclude their study of the problem solving process and the input/output/store/process model of a computer, students will propose an app designed to solve a real world problem. This project will be completed across multiple days and will result in students creating a poster highlighting the features of their app that they will present to their classmates. A project guide provides step by step instructions for students and helps them organize their thoughts. The project is designed to be completed in pairs though it can be completed individually.

Purpose

This project combines the two major themes of Unit 1, problem solving, and the input-output-store-process model of a computer. This project ties both themes to a broader goal of identifying real world problems and finding ways to use technology to help solve them. Students collaborate in the creation of their app and also take part in a structured peer review process that they will see many more times throughout the course. This project should be a fun and creative experience as well, and gives students a chance to tie the field of computer science to their own interests and ambitions.

Assessment Opportunities

Use the project rubric attached to this lesson to assess student mastery of learning goals of this unit. You may also choose to assign the post-project test through code studio.

Agenda

Warm Up (10 min)

- **Introduce the Project**

Activity (150 min)

- **Project Guide**
- **Presenting Apps**

Wrap Up

- **Reflection**

Extended Learning

- **Shark Tank**

Post-Project Test

View on Code Studio

Objectives

Students will be able to:

- Identify and define a problem that could be solved using computing
- Design an app that inputs, outputs, stores, and processes information in order to solve a problem
- Provide and incorporate targeted peer feedback to improve a computing artifact

Preparation

□ Print a copy of **Apps and Problem Solving - Project Guide** for each pair of students

□ Poster paper, pens, markers and other supplies for making posters

Links

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

For the Teachers

- **Apps and Problem Solving** - Slides
- **Project - Propose an App** - Project Guide Exemplar
- **Apps and Problem Solving** - Sample Marked Rubrics

For the Students

- **Apps and Problem Solving** - Project Guide
  Make a Copy ▾
- **Apps and Problem Solving** - Rubric
  Make a Copy ▾
- **Apps and Problem Solving** - Peer Review
  Make a Copy ▾
- **Computer Science Practices** - Reflection
  Make a Copy ▾

Teaching Guide

Warm Up (10 min)

Introduce the Project

Prompt: Of the apps we've seen in this unit, what was your favorite? What problem did it solve?

Share: Allows students to share out their favorite apps.

Remarks

> This whole unit we’ve been learning about the problem solving process and how computers process information to help solve problems by taking inputs and processing them to create useful outputs. Today we're going to start a project where you and a partner will design an app to solve a problem of your choosing.

Question of the Day: How can the IOSP model help us to design an app that solves a problem?

Activity (150 min)

Project Guide

Distribute: Give one project guide and one rubric to each student. As a class, review the information provided on the first sheet of the project guide which explains the project, lists the steps, and shows what students will need to produce. Then provide a brief overview of each of the more detailed steps.

Step 1: Choose a Partner: Place students in pairs or groups of three.

Teaching Tip

Creating Groups: Ideally this project is done in pairs. If need be, groups of 3 will work. You should decide beforehand whether you will assign or allow students to pick their partners.

Step 2: Brainstorm Problems: Prompt groups to spend several minutes silently brainstorming problems and recording them on their project guides. Circulate the room and remind them that at this point they shouldn't be thinking about an app they want to build or even whether it's possible to solve this problem with an app. Make sure they're beginning with the problem rather than the solution.

Teaching Tip

Helping the Brainstorm: Listen carefully to student conversations. Identify students who are stuck, and the reason why they are stuck. Are they thinking too big? Help those students to think about problems as annoyances or inconveniences, or an opportunity to improve your quality of life to a small or big degree.

Step 3: Choose Your Problem: The project guide provides several criteria students can use to assess which of their problems they'd like to address. Ask students to look forward to Step 4 if they need more guidance on how they'll need to define or scope their problems. Give students a few minutes to discuss with their group and choose the problem they'd like to address with their app.

Step 4: Define Your Problem: For this step students will need to appropriately scope their problem by defining who their audience is, what specifically is the problem, and how they will know they have fixed it.

Teaching Tip

How Much to Help: At this point students have had a lot of practice defining problems. They also have a peer review process shortly after this step. Encourage them to be as detailed as possible but avoid giving specific advice for how to define their problem.

Step 5: Your App: Once students have scoped their problem, ask them to discuss an app that could be used to help solve their problem. To begin they'll just need to provide a high level description of the app that describes how a user would use it and what it does.

Step 6: Input, Output, Store, Process: In this step students design the way their app will actually work to process data.

> First students will draw and then describe the outputs of their apps. On the left side they can make a rough sketch of what their app would look like. This does not need to be a final draft and is just there to help them brainstorm ideas and communicate to another group how their app would look. On the right side they have space to label each individual piece of information on the screen.
>
> Using the outputs that students selected as a guide, students should pick the inputs they'll need to create them. Only 6 spaces are provided though students could opt to choose more. This is somewhat intentional to help students scope the functionality of their app.
>
> Students will describe the way their app processes data using as a model the way they would process it themselves. The goal here is primarily just to ensure students have selected inputs that could be processed to produce the outputs. For example, if they're finding a list of friends with birthdays this month then both a computer and human would need to know a list of friends' birthdays and the current month.
>
> Lastly students are asked to decide what information, if any, it makes sense to store long term.
>
> **Distribute: Apps and Problem Solving - Peer Review**, one copy to each pair of students
>
> **Step 7: Peer Review**: Each group should trade their project guides with another. They should fill out the first line of the peer review which asks what specific part of their project they'd like feedback on. Afterwards there are a number of directed questions as well as a chance to provide more open-ended feedback on the idea.
>
> Students should be given their project guides back as well as their peer feedback. On the back there are questions where they can indicate what changes or improvements to their projects they intend to make on their apps based on the feedback.
>
> **Step 8: Finalize App and Make Poster**: Students should incorporate the ideas of their peers in finalizing their app idea. They should then make a poster presenting their app following the guidance provided on the activity guide.

Teaching Tip

What Kind of App?: This project is supposed to result in a simple app, along the lines of those seen in the previous lesson. Even large problems or parts of large problems can be addressed by collecting and processing information appropriately.

Presenting Apps

Share: Decide if and how students will share their posters with one another. If students will be doing more formal presentations then use the guidelines provided in Step 9 of the project guide to structure the presentations.

Collect: At the end of the presentation collect the completed project guides, peer feedback forms, and posters from each group.

Wrap Up

Reflection

Question of the Day: How can the IOSP model help us to design an app that solves a problem?

Reflect: Students reflect on the following question in their journals:

- What are you most proud of in your project?

🖥 Send students to Code Studio to complete their reflection on their attitudes toward computer science. Although their answers are anonymous, the aggregated data will be available to you once at least five students have completed the survey.

🖥 Code Studio levels

- Levels
- **✔ ☰ 2**

Student Instructions

View on Code Studio

This level is an assessment or survey with multiple questions. To view this level click the "View on Code Studio" link.

Extended Learning

Shark Tank

Run a mock “Shark Tank” as the backdrop for this unit project. Some things to consider:

- Is the culture of your class one where this competition can remain at a healthy level?
- Invite faculty / staff, local residents, or other professionals to hear the Phase 2 presentations and decide on a first, second, third place idea.
- Invite local business people / other professionals to share during Day 1 or Day 2 so students can see how computer science relates to jobs in their community.

Post-Project Test

The post-project test is found at the bottom of the Problem Solving and Computing unit overview page on Code Studio (**studio.code.org/s/csd1-2019**).

This test is locked and hidden from student view by default. In order for students to see and take this test, you'll need to unlock it by clicking the "Lock Settings" button and following the instructions that appear.

Standards Alignment

CSTA K-12 Computer Science Standards (2017)

- ▶ **AP** - Algorithms & Programming
- ▶ **CS** - Computing Systems

Lesson 9: Intro to Problem Solving - Newspaper Table (Alternate Lesson 1)

Overview

Question of the Day: What can help us to work together and solve problems as a team?

In this lesson, students work in groups to design newspaper tables that will hold as many books as possible. Groups have two rounds to work on their tables, with the goal of trying to hold more books than they did in the first round. The structure of the activity foreshadows different steps of the problem solving process that students will be introduced to in more detail in the following lesson. At the end of the lesson students reflect on their experiences with the activity and make connections to the types of problem solving they will be doing for the rest of the course.

This is an alternate activity to Intro to Problem Solving - Aluminum Boats

Purpose

This lesson is a fun introduction to the open-ended, collaborative, and creative problem solving students will be using over the rest of this unit and course. The newspaper table problem could easily be substituted out for any number of other problems that require students to define their goals, devise a plan, try a solution, evaluate their results, and then iteratively improve from there. The fact that the problem chosen is "non-computational" is intentional. Computer science is fundamentally a problem-solving discipline and staying away from traditional computer science problems at this point helps to frame this class as one about problem-solving more generally with computer science being a new "tool" to help attack certain types of problems.

Assessment Opportunities

1. **Communicate and collaborate with classmates in order to solve a problem**

   In the wrap up discussion question about collaboration, check for advantages to collaboration in problem solving and can list appropriate strategies for overcoming challenges. This practice will be reinforced throughout the unit and course.

2. **Iteratively improve a solution to a problem**

   In the Activity Guide, check for strengths and weaknesses in students' original design and connection to appropriate changes for the next iteration of the project.

3. **Identify different strategies used to solve a problem**

View on Code Studio

Objectives

Students will be able to:

- Communicate and collaborate with classmates in order to solve a problem
- Iteratively improve a solution to a problem
- Identify different strategies used to solve a problem

Preparation

For each group

□2 full newspapers for each group of students
□1 roll of tape for each group of students
□One copy of the activity guide

For the teacher

□10-20 books of similar weight.

Links

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

For the Teachers

- **Intro to Problem Solving - Newspaper Table (Alternate Lesson 1)** - Exemplar
- **Intro to Problem Solving - Newspaper Tables** - Slides
- **Code.org How-to Video Playlist**

For the Students

- **Build a Newspaper Table** - Activity Guide
  Make a Copy ▾

In the Activity Guide, check for strategies for overcoming the challenges in the activity. You also may want to check the "strengths" of their designs that students list as part of developing their plan on the second page of the guide.

Agenda

Tech Setup

- **Before class**
- **At the beginning of class**

CSD Pre-Course Survey

- **Important! Have your students take the CSD Pre-Course Survey!**

Warm Up (5 min)

- **Set the Stage**

Activity (30 min)

- **Building a Newspaper Table**
- **Goal and Rules**
- **Develop a Plan**
- **Test Your Table**
- **Evaluate and Improve**
- **Develop a Plan**
- **Test Your Table**
- **Reflect**

Wrap Up (5 mins)

- **Discuss the Challenge**

Teaching Guide

Tech Setup

Throughout the year, in order for you to be able to see student work, and for students to be able to access online tools and resources, all students need to be in the same section on Code Studio. To see assessments and answer keys that Code.org provides, you also need to be a "verified teacher".

Before class

Ensure you are registered on Code Studio as a "verified" teacher account

Anyone can create a teacher account on Code Studio, which means that we need an extra layer of authorization to allow CS Discoveries teachers to see assessments, answer keys, and any other collateral that students should not be able to trivially get access to. If you attended a Code.org TeacherCon during the summer, you should already have this access.

To check whether you have access:

1. Navigate to the **Unit 1 course overview page**
2. Do you see the CS Discoveries Pre-course Survey as the first "stage" of the course?
3. If not, please fill out **this form**. Note that it can take a day or so to become a verified teacher account, so please do this step early!

If you are *not* a verified teacher account, you can still create a section for your class, but you will not be able to administer the pre-course survey on the first day.

Create a class section on Code Studio.

To create a section:

1. Navigate to the **Teacher Home Page**
2. Click 'New section' under 'Classroom Sections'
3. Choose 'Email Logins'
4. In the space provided, give your section a name (e.g. CSD Period 1), the grade of your students, Course: 'Computer Science Discoveries', Current Unit: 'Unit 1: Problem Solving', and click 'Save'
5. Once the section is created, click the name of the section
6. On the new page, you will see a unique Join URL that you will distribute to your students in class.

For a video walkthrough of these steps and more on navigating your Code.org account, go to the **Code.org How-to Video Playlist**

At the beginning of class

1. Have students create a Code Studio account at **https://studio.code.org** if they don't already have one
2. Share the section Join URL with students and tell them to navigate to it to join your section
   - You can confirm that a student successfully joined your section by having the section progress page on the Teacher Home Page open and hitting refresh as students join. Students should see a small green bar at the top of their page that says 'You've successfully joined ...'
3. From **studio.code.org** have students locate the Computer Science Discoveries tile and click 'View course', then go to Unit 1.

Once students are looking at the Unit 1 overview page, they will be ready to take the CSD Pre-Course survey

CSD Pre-Course Survey

Important! Have your students take the CSD Pre-Course Survey!

Students can find a link to the survey in Code Studio as the first item on the Unit 1 overview page. To ensure that students only take the survey at the appropriate time, it is "locked" and unviewable by them until you "unlock" the survey. The **How to Administer a Locked Assessment** document provides details on how to do that when you are ready. Note that the instructions for administering an assessment and a survey are the same.

How much time does it take?

The survey does take some time - it is roughly 30 questions. You might consider administering it on an admin day at school, or as an early homework.

Because it is a pre-course survey it is important that students take it as early in the course as possible, before they have had much (or any) exposure to the class so that we may accurately gauge changes in attitudes and beliefs caused by the course.

Thank you!

-- The Code.org Team

Why do the pre-course survey?

- A major goal of CS Discoveries is to broaden participation in computer science.
- It is *crucial* therefore to have insight into students' attitudes and beliefs about computer science *before* the course so that we can measure the amount of change that occurred *after* the course is over.
- Please note that this survey is **anonymous for students**
- Completing it also helps us understand important improvements we can make to the curriculum to improve the teacher and student experience.

Please help by having your students contribute to this vital dataset. Their voices make the difference!

Warm Up (5 min)

Set the Stage

Prompt: What makes someone a good problem solver? Be ready to share three ideas with your group.

Discuss: Allow students to share answers at their table groups or with a partner, then have those who are comfortable share with the whole class.

Remarks

> Those are all great ideas! In computer science, we have to solve problems all of the time, so we'll be looking back at all of these problem solving skills today and for the rest of the course. Most of the problem solving that people do in computer science happens in teams. Today, we're going to work in teams to solve a fun problem that doesn't need computers. While you work on that problem, here's a question that you can think about.

Display: Show students the Question of the Day

Question of the Day: What can help us to work together and solve problems as a team?

Teaching Tip

Journaling: Journaling is a key practice in CS Discoveries. Students can journal on loose leaf paper, in notebooks, or digitally. See the CSD Guide to Journaling for more information.

Slides: Slides for this unit are available in the "Teacher Resources" section of the lesson plan. If you'd like to edit your own copy of a slide deck you may without requesting access. Simply log in with a Google account, click "File" and "Make a copy" from the menu.

Discussion Goal

The goal of this warm up is to start students thinking about problem solving in preparation for the day's activity. Highlight answers that reinforce key practices in the class, such as collaboration, persistence, and creativity. This is also a chance to reinforce a positive culture that encourages students to share out and support each other in brainstorming ideas.

Activity (30 min)

Building a Newspaper Table

Group: Put students in groups of 2 or 3.

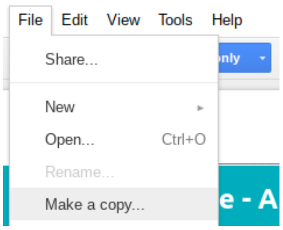
Remarks

> Today we're going to be building tables out of newspaper and tape. Each table should hold books at least one foot off the ground. You'll have an opportunity to build at least two tables and use your experience with each one to improve your designs. Before we get started, decide as a group what kind of design you'd like to make with your first table. Record your ideas and any possible weaknesses of this design on your activity guide.

Distribute: One copy of the activity guide to each group.

Teaching Tip

Getting Copies of Google Docs: Activity Guides in this curriculum are available as Google Docs, Word Docs, and PDFs. If you'd like to edit or make your own copy of a Google Doc you may without requesting access. Simply log in with a Google account, click "File" and "Make a copy" from the menu. You may then share your own copy with your students.



Goal and Rules

As a class, read through the Goal and Rules sections of the activity guide and answer questions.

Teaching Tip

This activity can take some space. You may also want to consider running this activity in the hallway or some other space if your room is very restrictive, or add in additional rules as necessary.

Develop a Plan

Give students a couple minutes to discuss in groups the approach they will be taking with this first table. Once groups have recorded their ideas and some possible weaknesses they can come to you to get their newspaper and tape and begin building their tables.

Teaching Tip

Hold onto the supplies until students submit a plan for their table. The goal isn't to slow them down too much, but just give them a moment to reflect briefly on the possible approaches they could take. This is one way this activity foreshadows the Planning step of the problem solving process students will see in subsequent lessons.

Test Your Table

Once groups are ready, have them test their tables by placing individual books onto the top. Remind them of the rules, specifically that they can't touch or adjust the tables once they've begun to add books, and that the books need to be at least one foot (or 30 cm) off the ground. Have them record the total number of books held on their activity guides.

Evaluate and Improve

Remarks

> This first attempt at building our tables was just to get familiar with the challenge. We're all going to build a second table and see if we can improve the number of books our tables hold. Before we get started though, let's see what we can learn from this trial run.

Share: Have students share the results of their first run with neighboring groups. Ask groups to focus particularly on what the eventual failure of their table was (e.g. it wasn't wide enough, it was unstable, etc.) and brainstorm ways to get around those problems.

Teaching Tip

While some students will view this portion as a competition, emphasize that each group is looking to improve its own design, not competing against others. You are appealing for each student to challenge themselves first, not others.

Develop a Plan

Remarks

> Now that you've had a chance to learn from the first round of table making, let's run the same activity again. First, your group will develop a new plan. Just as before, record it on your activity guide, and once you're ready I'll come around and give you a new newspaper.

Support: As you circulate from group to group, ask questions about the group’s focus in redesign. EX: “What aspect of your table needed the most improvement?” “What ideas from other groups did you want to incorporate to yours?” “Did you feel the need to completely restructure your table, or make minor modifications?”

Once groups have prepared their new plans give them a new newspaper and have them each build a new table.

Test Your Table

Groups can test their designs just as before and record the results on their activity guides.

Reflect

Transition: Ask class to return to their own seats to reflect on the activity.

Wrap Up (5 mins)

Discuss the Challenge

Question of the Day: What can help us to work together and solve problems as a team?

Prompt: You worked in teams for this activity. How did working in a team make this activity easier, how did it make the activity more challenging? What helped your group overcome these challenges?

Discuss: Allow students time to share thoughts with the class.

Remarks

> All of your thoughts around these questions were great. We're going to be doing a lot of teamwork in this class. You may be used to thinking about computer science as being all about computers, but first and foremost computer science is about solving problems, and usually that happens in teams. A lot of other parts of this activity like improving designs, and building things is also going to be a big part of this class. I hope you're excited for the year. Tomorrow we'll start digging deeper into problem solving itself.

Assessment Opportunity

Students may recognize that collaboration allowed them to think through their ideas more thoroughly or that they were able to split up the work that they needed to do. As students list challenges, ensure that they are coming up with ways to overcome those challenges. If you have noticed any issues in group dynamics during the activity, you may want to use this time to bring up these as potential problems in a non-confrontational way and help students to generate strategies for working together more effectively in future activities. These can serve as classroom norms for group work moving forward.

Standards Alignment

CSTA K-12 Computer Science Standards (2017)

▶ **AP** - Algorithms & Programming

Lesson 10: Intro to Problem Solving - Spaghetti Bridge (Alternate Lesson 1)

Overview

Question of the Day: What can help us to work together and solve problems as a team?

In this lesson, students work in groups to design spaghetti bridges that will support as many books as possible. Groups have two rounds to work on their bridges, with the goal of trying to hold more books than they did in Round 1. The structure of the activity foreshadows different steps of the problem solving process that students will be introduced to in more detail in the following lesson. At the end of the lesson students reflect on their experiences with the activity and make connections to the types of problem solving they will be doing for the rest of the course.

This is an alternate activity to Intro to Problem Solving - Aluminum Boats

Purpose

This lesson is a fun introduction to the open-ended, collaborative, and creative problem solving students will be using over the rest of this unit and course. The spaghetti bridge problem could easily be substituted out for any number of other problems that require students to define their goals, devise a plan, try a solution, evaluate their results, and then iteratively improve from there. The fact that the problem chosen is "non-computational" is intentional. Computer science is fundamentally a problem-solving discipline and staying away from traditional computer science problems at this point helps to frame this class as one about problem-solving more generally with computer science being a new "tool" to help attack certain types of problems.

Assessment Opportunities

1. **Communicate and collaborate with classmates in order to solve a problem**

   In the wrap up discussion question about collaboration, check for advantages to collaboration in problem solving and can list appropriate strategies for overcoming challenges. This practice will be reinforced throughout the unit and course.

2. **Iteratively improve a solution to a problem**

   In the Activity Guide, check for strengths and weaknesses in students' original design and connection to appropriate changes for the next iteration of the project.

3. **Identify different strategies used to solve a problem**

View on Code Studio

Objectives

Students will be able to:

- Communicate and collaborate with classmates in order to solve a problem
- Iteratively improve a solution to a problem
- Identify different strategies used to solve a problem

Preparation

For each group

□1 pound of dry spaghetti noodles (about 1 box)
□1 glue gun
□One copy of the activity guide

For the teacher

□10-20 books of similar size and weight

Links

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

For the Teachers

- **Intro to Problem Solving - Spaghetti Bridge** - Exemplar
- **Intro to Problem Solving - Spaghetti Bridges** - Slides
- **Code.org How-to Video Playlist**

For the Students

- **Spaghetti Bridge - Activity Guide**
  Make a Copy ▾

In the Activity Guide, check for strategies for overcoming the challenges in the activity. You also may want to check the "strengths" of their designs that students list as part of developing their plan on the second page of the guide.

Agenda

Tech Setup

- **Before class**
- **At the beginning of class**

CSD Pre-Course Survey

- **Important! Have your students take the CSD Pre-Course Survey!**

Warm Up (5 min)

- **Set the Stage**

Activity (30 min)

- **Building a Spaghetti Bridge**
- **Goal and Rules**
- **Develop a Plan**
- **Test Your Bridge**
- **Evaluate and Improve**
- **Develop a Plan**
- **Test Your Table**
- **Reflect**

Wrap Up (5 min)

- **Discuss the Challenge**

Teaching Guide

Tech Setup

Throughout the year, in order for you to be able to see student work, and for students to be able to access online tools and resources, all students need to be in the same section on Code Studio. To see assessments and answer keys that Code.org provides, you also need to be a "verified teacher".

Before class

Ensure you are registered on Code Studio as a "verified" teacher account

Anyone can create a teacher account on Code Studio, which means that we need an extra layer of authorization to allow CS Discoveries teachers to see assessments, answer keys, and any other collateral that students should not be able to trivially get access to. If you attended a Code.org TeacherCon during the summer, you should already have this access.

To check whether you have access:

1. Navigate to the **Unit 1 course overview page**
2. Do you see the CS Discoveries Pre-course Survey as the first "stage" of the course?
3. If not, please fill out **this form**. Note that it can take a day or so to become a verified teacher account, so please do this step early!

If you are *not* a verified teacher account, you can still create a section for your class, but you will not be able to administer the pre-course survey on the first day.

Create a class section on Code Studio.

To create a section:

1. Navigate to the **Teacher Home Page**
2. Click 'New section' under 'Classroom Sections'
3. Choose 'Email Logins'
4. In the space provided, give your section a name (e.g. CSD Period 1), the grade of your students, Course: 'Computer Science Discoveries', Current Unit: 'Unit 1: Problem Solving', and click 'Save'
5. Once the section is created, click the name of the section
6. On the new page, you will see a unique Join URL that you will distribute to your students in class.

For a video walkthrough of these steps and more on navigating your Code.org account, go to the **Code.org How-to Video Playlist**

At the beginning of class

1. Have students create a Code Studio account at **https://studio.code.org** if they don't already have one
2. Share the section Join URL with students and tell them to navigate to it to join your section
   - You can confirm that a student successfully joined your section by having the section progress page on the Teacher Home Page open and hitting refresh as students join. Students should see a small green bar at the top of their page that says 'You've successfully joined ...'
3. From **studio.code.org** have students locate the Computer Science Discoveries tile and click 'View course', then go to Unit 1.

Once students are looking at the Unit 1 overview page, they will be ready to take the CSD Pre-Course survey

CSD Pre-Course Survey

Important! Have your students take the CSD Pre-Course Survey!

Students can find a link to the survey in Code Studio as the first item on the Unit 1 overview page. To ensure that students only take the survey at the appropriate time, it is "locked" and unviewable by them until you "unlock" the survey. The **How to Administer a Locked Assessment** document provides details on how to do that when you are ready. Note that the instructions for administering an assessment and a survey are the same.

How much time does it take?

The survey does take some time - it is roughly 30 questions. You might consider administering it on an admin day at school, or as an early homework.

Because it is a pre-course survey it is important that students take it as early in the course as possible, before they have had much (or any) exposure to the class so that we may accurately gauge changes in attitudes and beliefs caused by the course.

Thank you!

-- The Code.org Team

Why do the pre-course survey?

- A major goal of CS Discoveries is to broaden participation in computer science.
- It is *crucial* therefore to have insight into students' attitudes and beliefs about computer science *before* the course so that we can measure the amount of change that occurred *after* the course is over.
- Please note that this survey is **anonymous for students**
- Completing it also helps us understand important improvements we can make to the curriculum to improve the teacher and student experience.

Please help by having your students contribute to this vital dataset. Their voices make the difference!

Warm Up (5 min)

Set the Stage

Prompt: What makes someone a good problem solver? Be ready to share three ideas with your group.

Discuss: Allow students to share answers at their table groups or with a partner, then have those who are comfortable share with the whole class.

Remarks

> Those are all great ideas! In computer science, we have to solve problems all of the time, so we'll be looking back at all of these problem solving skills today and for the rest of the course. Most of the problem solving that people do in computer science happens in teams. Today, we're going to work in teams to solve a fun problem that doesn't need computers. While you work on that problem, here's a question that you can think about.

Display: Show students the Question of the Day

Question of the Day: What can help us to work together and solve problems as a team?

Teaching Tip

Journaling: Journaling is a key practice in CS Discoveries. Students can journal on loose leaf paper, in notebooks, or digitally. See the CSD Guide to Journaling for more information.

Slides: Slides for this unit are available in the "Teacher Resources" section of the lesson plan. If you'd like to edit your own copy of a slide deck you may without requesting access. Simply log in with a Google account, click "File" and "Make a copy" from the menu.

Discussion Goal

The goal of this warm up is to start students thinking about problem solving in preparation for the day's activity. Highlight answers that reinforce key practices in the class, such as collaboration, persistence, and creativity. This is also a chance to reinforce a positive culture that encourages students to share out and support each other in brainstorming ideas.

Activity (30 min)

Building a Spaghetti Bridge

Group: Put students in groups of 2 or 3.

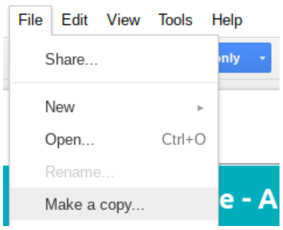
Remarks

Today we're going to be building spaghetti bridges. Each bridge will need to cross a 1-foot (or 30cm) gap and hold as many books as possible. You'll have an opportunity to build at least two bridges and use your experience with each one to improve your designs. Before we get started, decide as a group what kind of design you'd like to make with your first bridge. Record your ideas and any possible weaknesses of this design on your activity guide.

Distribute: One copy of the activity guide to each group.

Teaching Tip

Getting Copies of Google Docs: Activity Guides in this curriculum are available as Google Docs, Word Docs, and PDFs. If you'd like to edit or make your own copy of a Google Doc you may without requesting access. Simply log in with a Google account, click "File" and "Make a copy" from the menu. You may then share your own copy with your students.



Goal and Rules

As a class, read through the Goal and Rules sections of the activity guide and answer questions.

Teaching Tip

This activity can take some space and can get a little messy. You may also want to consider teaching this activity in the hallway or some other space if your room is very restrictive, or add in additional rules as necessary.

Develop a Plan

Give students a couple minutes to discuss in groups the approach they will be taking with this first bridge. Once groups have recorded their ideas and some possible weaknesses they can come to you to get their spaghetti and begin building their bridges. Give about 1/2 pound of spaghetti to each group.

Teaching Tip

Hold onto the supplies until students submit a plan for their bridge. The goal isn't to slow them down too much, but just give them a moment to reflect briefly on the possible approaches they could take. This is one way this activity foreshadows the Planning step of the problem solving process students will see in subsequent lessons.

Test Your Bridge

Once groups are ready, have them test their bridges by placing individual books onto the bridge. Remind them of the rules, specifically that they can't touch or adjust the bridges once they've placed a book on it. Have them record the total number of books held on their activity guides.

Evaluate and Improve

Remarks

> This first attempt at building our bridge was a great chance to learn more about the problem. We're all going to build a second bridge and see if we can improve the number of books our bridges held. Before we get started though, let's see what we can learn from this trial run.

Share: Have students share the results of their first run with neighboring groups. Ask groups to focus particularly on what the eventual failure of their bridge was (e.g. it wasn't long enough, it was unstable, etc.) and brainstorm ways to get around those problems.

Teaching Tip

While some students will view this portion as a competition, emphasize that each group is looking to improve its own design, not competing against others. You are appealing for each student to challenge themselves first, not others.

If running this activity over two days, you may choose to break here.

Develop a Plan

Remarks

> Now that you've had a chance to learn from the first round of bridge making, let's run the same activity again. First, your group will develop a new plan. Just as before, record it on your activity guide, and once you're ready I'll come around and give you new spaghetti.

Support: As you circulate from group to group, ask questions about the group's focus in redesign. EX: "What aspect of your bridge needed the most improvement?" "What ideas from other groups did you want to incorporate to yours?" "Did you feel the need to completely restructure your bridge, or make minor modifications?"

Once groups have prepared their new plans give them more spaghetti and have them each build a new bridge.

Test Your Table

Groups can test their designs just as before and record the results on their activity guides.

Reflect

Transition: Ask class to return to their own seats to reflect on the activity.

Wrap Up (5 min)

Discuss the Challenge

Question of the Day: What can help us to work together and solve problems as a team?

Prompt: You worked in teams for this activity. How did working in a team make this activity easier, how did it make the activity more challenging? What helped your group overcome these challenges?

✓ **Discuss**: Allow students time to share thoughts with the class.

Remarks

> All of your thoughts around these questions were great. We're going to be doing a lot of teamwork in this class. You may be used to thinking about computer science as being all about computers, but first and foremost computer science is about solving problems, and usually that happens in teams. A lot of other parts of this activity like improving designs, and building things is also going to be a big part of this class. I hope you're excited for the year. Tomorrow we'll start digging deeper into problem solving itself.

✓ Assessment Opportunity

Students may recognize that collaboration allowed them to think through their ideas more thoroughly or that they were able to split up the work that they needed to do. As students list challenges, ensure that they are coming up with ways to overcome those challenges. If you have noticed any issues in group dynamics during the activity, you may want to use this time to bring up these as potential problems in a non-confrontational way and help students to generate strategies for working together more effectively in future activities. These can serve as classroom norms for group work moving forward.

Standards Alignment

CSTA K-12 Computer Science Standards (2017)

▸ **AP** - Algorithms & Programming

Lesson 11: Intro to Problem Solving - Paper Tower (Alternate Lesson 1)

Overview

Question of the Day: What can help us to work together and solve problems as a team?

In this lesson, students work in groups to design paper towers that can stand as high as possible. Groups have two rounds to work on their towers, with the goal of trying to go higher than they did in Round 1. The structure of the activity foreshadows different steps of the problem solving process that students will be introduced to in more detail in the following lesson. At the end of the lesson students reflect on their experiences with the activity and make connections to the types of problem solving they will be doing for the rest of the course.

This is an alternate activity to Intro to Problem Solving - Aluminum Boats

Purpose

This lesson is a fun introduction to the open-ended, collaborative, and creative problem solving students will be using over the rest of this unit and course. The paper towers problem could easily be substituted out for any number of other problems that require students to define their goals, devise a plan, try a solution, evaluate their results, and then iteratively improve from there. The fact that the problem chosen is "non-computational" is intentional. Computer science is fundamentally a problem-solving discipline and staying away from traditional computer science problems at this point helps to frame this class as one about problem-solving more generally with computer science being a new "tool" to help attack certain types of problems.

Assessment Opportunities

1. **Communicate and collaborate with classmates in order to solve a problem**

   In the wrap up discussion question about collaboration, check for advantages to collaboration in problem solving and can list appropriate strategies for overcoming challenges. This practice will be reinforced throughout the unit and course.

2. **Iteratively improve a solution to a problem**

   In the Activity Guide, check for strengths and weaknesses in students' original design and connection to appropriate changes for the next iteration of the project.

3. **Identify different strategies used to solve a problem**

View on Code Studio

Objectives

Students will be able to:

- Communicate and collaborate with classmates in order to solve a problem
- Iteratively improve a solution to a problem
- Identify different strategies used to solve a problem

Preparation

For each group

□20 sheets of paper, 8.5 x 11 inches
□Space to build their tower
□One copy of the activity guide

For the teacher

□Extra paper
□Timer
□Ruler

Links

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

For the Teachers

- **Intro to Problem Solving - Paper Tower** - Exemplar
- **Intro to Problem Solving - Paper Towers** - Slides
- **Code.org How-to Video Playlist**

For the Students

- **Paper Tower** - Activity Guide
  Make a Copy ▾

In the Activity Guide, check for strategies for overcoming the challenges in the activity. You also may want to check the "strengths" of their designs that students list as part of developing their plan on the second page of the guide.

Agenda

Tech Setup

- **Before class**
- **At the beginning of class**

CSD Pre-Course Survey

- **Important! Have your students take the CSD Pre-Course Survey!**

Warm Up (5 min)

- **Set the Stage**

Activity (30 min)

- **Building a Paper Tower**
- **Goal and Rules**
- **Develop a Plan**
- **Test Your Table**
- **Evaluate and Improve**
- **Develop a Plan**
- **Test Your Table**
- **Reflect**

Wrap Up (5 min)

- **Discuss the Challenge**

Teaching Guide

Tech Setup

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Create a class section on Code Studio.

To create a section:

1. Navigate to the **Teacher Home Page**
2. Click 'New section' under 'Classroom Sections'
3. Choose 'Email Logins'
4. In the space provided, give your section a name (e.g. CSD Period 1), the grade of your students, Course: 'Computer Science Discoveries', Current Unit: 'Unit 1: Problem Solving', and click 'Save'
5. Once the section is created, click the name of the section
6. On the new page, you will see a unique Join URL that you will distribute to your students in class.

For a video walkthrough of these steps and more on navigating your Code.org account, go to the **Code.org How-to Video Playlist**

At the beginning of class

1. Have students create a Code Studio account at **https://studio.code.org** if they don't already have one
2. Share the section Join URL with students and tell them to navigate to it to join your section
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3. From **studio.code.org** have students locate the Computer Science Discoveries tile and click 'View course', then go to Unit 1.

Once students are looking at the Unit 1 overview page, they will be ready to take the CSD Pre-Course survey

CSD Pre-Course Survey

Important! Have your students take the CSD Pre-Course Survey!

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How much time does it take?

The survey does take some time - it is roughly 30 questions. You might consider administering it on an admin day at school, or as an early homework.

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Thank you!

-- The Code.org Team

Why do the pre-course survey?

- A major goal of CS Discoveries is to broaden participation in computer science.
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Please help by having your students contribute to this vital dataset. Their voices make the difference!

Warm Up (5 min)

Set the Stage

Prompt: What makes someone a good problem solver? Be ready to share three ideas with your group.

Discuss: Allow students to share answers at their table groups or with a partner, then have those who are comfortable share with the whole class.

Remarks

> Those are all great ideas! In computer science, we have to solve problems all of the time, so we'll be looking back at all of these problem solving skills today and for the rest of the course. Most of the problem solving that people do in computer science happens in teams. Today, we're going to work in teams to solve a fun problem that doesn't need computers. While you work on that problem, here's a question that you can think about.

Display: Show students the Question of the Day

Question of the Day: What can help us to work together and solve problems as a team?

Teaching Tip

Journaling: Journaling is a key practice in CS Discoveries. Students can journal on loose leaf paper, in notebooks, or digitally. See the CSD Guide to Journaling for more information.

Slides: Slides for this unit are available in the "Teacher Resources" section of the lesson plan. If you'd like to edit your own copy of a slide deck you may without requesting access. Simply log in with a Google account, click "File" and "Make a copy" from the menu.

Discussion Goal

The goal of this warm up is to start students thinking about problem solving in preparation for the day's activity. Highlight answers that reinforce key practices in the class, such as collaboration, persistence, and creativity. This is also a chance to reinforce a positive culture that encourages students to share out and support each other in brainstorming ideas.

Activity (30 min)

Building a Paper Tower

Group: Put students in groups of 2 or 3.

Remarks

> Today we're going to be building paper towers. You'll have an opportunity to build at least two towers and use your experience with each one to improve your designs. Before we get started, decide as a group what kind of design you'd like to make with your first tower. Record your ideas and any possible weaknesses of this design on your activity guide.

Distribute: One copy of the activity guide to each group.

Teaching Tip

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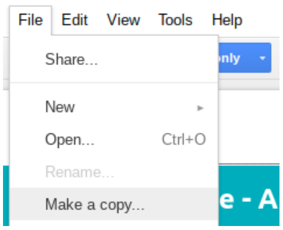

Goal and Rules

As a class, read through the Goal and Rules sections of the activity guide and answer questions.

Develop a Plan

Give students a couple minutes to discuss in groups the approach they will be taking with this first tower. Once groups have recorded their ideas and some possible weaknesses they can come to you to get their paper and begin building their towers.

Teaching Tip

This activity needs some space! Ideally, each group should have its own space to conduct its tests. You may also want to consider teaching this activity in the hallway or some other large area if your room is very restrictive.

Test Your Table

Once groups are ready, have them test their towers by recording its height and see if it can stand on its own. Remind them of the rules, specifically that they can't touch or adjust the towers once they let go of it.

Teaching Tip

Hold onto the paper until students submit a plan for their tower. The goal isn't to slow them down too much, but just give them a moment to reflect briefly on the possible approaches they could take. This is one way this activity foreshadows the Planning step of the problem solving process students will see in subsequent lessons.

Evaluate and Improve

Remarks

> This first attempt at building our towers was just to get familiar with the challenge. We're all going to build a second tower and see if we can improve the height of our tower without having it fall. Before we get started though, let's see what we can learn from this trial run.

Share: Have students share the results of their first run with neighboring groups. Ask groups to focus particularly on what the eventual failure of their tower was (e.g. tall but doesn't stand on its own, stands but is really short, etc.) and brainstorm ways to get around those problems.

Teaching Tip

While some students will view this portion as a competition, emphasize that each group is looking to improve its own design, not competing against others. You are appealing for each student to challenge themselves first, not others.

Develop a Plan

Remarks

> Now that you've had a chance to learn from the first round of tower making, let's run the same activity again. First, your group will develop a new plan. Just as before, record it on your activity guide, and once you're ready I'll come around and give you more paper.

Support: As you circulate from group to group, ask questions about the group’s focus in redesign. EX: “What aspect of your tower needed the most improvement?” “What ideas from other groups did you want to incorporate to yours?” “Did you feel the need to completely rebuild your tower, or make minor modifications?”

Once groups have prepared their new plans give them new pieces of paper and have them each build a new tower.

Test Your Table

> Groups can test their designs just as before and record the results on their activity guides.
>
> ### Reflect
>
> **Transition**: Ask class to return to their own seats to reflect on the activity.

Wrap Up (5 min)

Discuss the Challenge

Question of the Day: What can help us to work together and solve problems as a team?

Prompt: You worked in teams for this activity. How did working in a team make this activity easier, how did it make the activity more challenging? What helped your group overcome these challenges?

✓ **Discuss**: Allow students time to share thoughts with the class.

✓ Assessment Opportunity

Students may recognize that collaboration allowed them to think through their ideas more thoroughly or that they were able to split up the work that they needed to do. As students list challenges, ensure that they are coming up with ways to overcome those challenges. If you have noticed any issues in group dynamics during the activity, you may want to use this time to bring up these as potential problems in a non-confrontational way and help students to generate strategies for working together more effectively in future activities. These can serve as classroom norms for group work moving forward.

Remarks

> All of your thoughts around these questions were great. We're going to be doing a lot of teamwork in this class. You may be used to thinking about computer science as being all about computers, but first and foremost computer science is about solving problems, and usually that happens in teams. A lot of other parts of this activity like improving designs, and building things is also going to be a big part of this class. I hope you're excited for the year. Tomorrow we'll start digging deeper into problem solving itself.

Standards Alignment

CSTA K-12 Computer Science Standards (2017)

- ▶ **AP** - Algorithms & Programming

Lesson 12: Exploring Problem Solving - Animal Theme (Alternate Lesson 3)

Overview

Question of the Day: How can we apply the problem solving process to many different kinds of problems?

In this lesson students apply the problem solving process to three different problems in order to better understand the value of each step. They will solve tangrams, choose a pet for several people, and plan a pet adoption event. The problems grow increasingly complex and poorly defined to highlight how the problem solving process is particularly helpful when tackling these types of problems. The lesson concludes with students reflecting on their experience with the problem solving process. They will justify the inclusion of each step and will brainstorm questions or strategies that can help them better define open-ended problems, as this is often the most critical step.

This lesson will likely take two class periods or more to complete. The first two problems may fit into a single class period but the third will need to be moved to a second day.

Purpose

This lesson provides students with more practice with the problem solving process in a variety of contexts. It highlights the fact that the problem solving process is particularly helpful when approaching poorly defined problems. The final brainstorm of the lesson provides students with some strategies and questions they can ask to better define problems for themselves, since this is often the most critical step. The problems seen in this lesson also help to drive a discussion in the following lesson about the types of problems that computers are well-suited to solve.

Assessment Opportunities

1. **Apply the problem solving process to approach a variety of problems**

   On page 5 of the Activity Guide, check the chart to make sure that students are putting in reasonable steps for each of the problems.

2. **Assess how well-defined a problem is and use strategies to define the problem more precisely**

   For the last question on page 5 of the Activity Guide, make sure that students have at least one question or strategy that would be an effective way to better define a problem.

Agenda

View on Code Studio

Objectives

Students will be able to:

- Apply the problem solving process to approach a variety of problems
- Assess how well-defined a problem is and use strategies to define the problem more precisely

Preparation

☐Print the activity guide for each student
☐Prepare tangrams for students, or print out one tangram sheet and get scissors for each group.
☐Poster to record strategies for defining problems in wrap up discussion

Links

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

For the Teachers

- **Exploring Problem Solving - Animal Theme** - Exemplar
- **Exploring Problem Solving - Animals Theme** - Slides

For the Students

- **Solving Problems** - Tangrams
  Make a Copy ▾
- **Solving Problems** - Activity Guide
  Make a Copy ▾

Warm Up (5 min)

Activity (75 min)

- Solving Problems
- Understanding the Problem Solving Process

Wrap Up

Teaching Guide

Warm Up (5 min)

Journal Prompt: Think of the silliest problem the problem solving process could help with. Be prepared to say how each step of the process could apply.

Allow students to share out individually.

Remarks

> With such a wide variety of problems and strategies, it's important to be able to think about how best to use the problem solving process. Today we're going to look at some different types of problems, talk about what makes them different, and reflect on how the problem solving process helped us solve them.

Discussion Goal

This discussion serves as a review of the problem solving process and highlights how many different types of problems there could be. Encourage students to be creative and have some fun with the different "problems" they might solve.

Question of the Day: How can we apply the problem solving process to many different kinds of problems?

Activity (75 min)

Group: For all three activities students should be working together in groups, even if they record their results individually. Groups of 2-4 will likely work best.

Distribute: Hand out the activity guide, one copy for each student. For now they can be face down so that the tangrams aren't visible.

Solving Problems

Tangrams

Once students are in groups, hand them the sheets with the tan pieces. ask them to flip over their activity guides and begin the first challenge. They'll be creating the images using their tan pieces that they can cut out.

Circulate: Walk around the room observing how students are addressing the problem. Make sure that groups are not sharing answers. Encourage them to think about how making a plan might help them address this task.

Once all groups have finished, bring the class back together. Have students flip to the last page of the activity guide where there is a table to record their experiences with the problem. They will record what parts of solving this problem fall within each step of the problem solving process.

Discuss: Briefly discuss with students what parts of the activity they felt fell into each step of the problem solving process. Some possible points to make after students share are below.

- **Define**: This problem was already very well defined. Not all problems will be, though.
- **Prepare**: Developing a plan with a team (such as divvying up the images or just working together on each image) makes this problem much easier to solve than randomly placing pieces places.
- **Try**: Patience and persistence is important to see your plan through
- **Reflect**: If your early plans are not working you can regroup and choose a new plan

Teaching Tip

Integrating the Problem Solving Process: The tangrams can actually take several minutes, especially if students are approaching without some kind of strategy. Remind them that one step is to Prepare before they just jump in and start hunting.

Make It a Race: Making this problem a race is a good way to drive motivation and also ensure that groups don't share the solutions once they've found them.

Key: A key showing possible solutions can be found online following the link provided above.

Choose a Pet

Move the class on to the choose a pet problem. Groups may still work together on their solutions but shouldn't share with other groups.

Circulate: As before, circulate around the room noting the types of strategies that groups are using. Remind them to use the steps of the problem solving process to help them if they're getting stuck.

Once groups have finished solving the problem ask them to move to the last page of the activity guide to record how they used the problem solving process to solve this problem.

Discuss: Briefly discuss with students what parts of the activity they felt fell into each step of the problem solving process. Some possible points to make after students share are below.

- **Define**: The problem seems to be a problem of choosing a pet for each person according to requirements. If you first break that problem down into choosing a pet from a list of possible pets, it is much easier.
- **Prepare**: Ask students to share what types of strategies they considered before just starting to assign people to seats.
- **Try**: As before, patience and persistence is important to see your plan through
- **Reflect**: If early strategies are not working groups may have regrouped and tried a more structured approach

Teaching Tip

Integrating the Problem Solving Process: This problem is particularly challenging if you don't define the problem well. If you take it at face value, your job is to randomly guess and check where to place individual puts until you find a solution. It is much easier if you first list the possible pets for each person, then choose pets for the most selective people first.

This isn't the only approach to the problem, and you shouldn't rush to introduce it as such. Rather, encourage students to discuss with one another what they know needs to be true at the end and whether different approaches might help.

Extending the Problem: If one group finishes far before others you could give them a blank sheet of paper and ask them to solve the problem again but with a new condition of your choosing (e.g. pick one person in their solution and ask whether they can solve the problem with an added requirement.)

Plan a Pet Adoption Event

Move the class on to the Plan a Pet Adoption Event problem. Each member of the group will individually be developing a plan for a layout that follows criteria they'll develop as a team. Give students time to choose the goals they'll use to plan their plan. For example there may be certain things they'd like to move, places people will have to go, people they want to help them, etc.

Circulate: Once groups have goals, they will move through the activity by developing a plan to create the adoption event. Give them a time limit on this part of this process, e.g. 15 minutes, to make sure they focus on the key elements on their plan rather than perfecting it. They should record key information about their plan in their activity guides.

Bring groups back together and have them share their initial plans. On the activity guides they can record the feedback their classmates give them on their plans.

Once groups have discussed what they like or don't like about their classmates' proposed plans, they can re-examine them and make improvements. Are there other things they'd like to do? Do they have new goals? Give them several minutes to make improvements to their plans before deciding on a final version.

Bring the class back together and have them record the different steps of the problem solving process that they used in their activity guides.

Discuss: Briefly discuss with students what parts of the activity they felt fell into each step of the problem solving process. Some possible points to make after students share are below.

Teaching Tip

Integrating the Problem Solving Process: This problem is intentionally very open-ended and in fact has students develop the criteria they'll use to measure success. This problem does the best job of highlighting all 4 steps of the process and walks students more intentionally through the Define, Prepare, Try, and Reflect stages.

Give Resource Ideas: Students may just brainstorm ideas by themselves, but also let them know about other resources such as search engines and image searchers to help give them inspiration if they are stuck. Let them look at other event pages and flyers online for help.

When to Stop: This problem could easily take a 50 minute class period. Let students know ahead of time that there are time limits on what they're doing and encourage them to think how they would improve their plan using the problem solving process if they had more time to iterate.

> - **Define**: This problem was not well-defined. They needed to decide for themselves what a "good" adoption event looked like, and this definition could have even shifted throughout the process.
> - **Prepare**: Narrowing down a list of possible layouts is helpful. You may also choose to make the point that this entire activity is an example of preparation. Some layouts just don't make sense or others work better, so you need to do the kind of planning they're doing here.
> - **Try**: As before, patience and persistence is important to see your plan through
> - **Reflect**: In this problem reflection came primarily through feedback from peers. Some layouts might not end up seeming as practical to other group members. Some are fun but require too much moving or too many new things. Feedback is an important part of the reflect step, especially in group work.

Understanding the Problem Solving Process

Prompt: You just solved a number of very different problems. With your table groups, review the notes you took on each of the problems. Be ready to report out on the following questions

- For each step in the problem solving process, what is its purpose? Why is it included?
- Are there any kinds of problems that the problem solving process is particularly helpful at solving?

Discuss: After tables have discussed their responses for several minutes invite the whole class to share their rationale for including each step in the process. Once each step has been discussed, move on to the second question. This question may have many responses and you should allow students to share their thoughts and experiences. If it doesn't arise naturally as you leave the conversation offer some or all of the ideas mentioned in the discussion goals.

Discussion Goal

Goal: Students have practiced using the problem solving process on a number of different problems. Help them synthesize the notes they have been keeping to better understand the role of each step and the value of the problem solving process in general. A sample set of conclusions is below but you should allow students to share your own insights before offering your own.

Define: without defining a problem you might solve the wrong problem, not know where to start, or not know when you're finished

Prepare: Even well-defined problems usually have many possible approaches. Make each try more likely to succeed by first examining your options and anticipating challenges

Try: Without trying you'll never get anywhere. It's important to be persistent and patient so long as your plan still may work

Reflect: You'll likely not solve the problem the first time or there will be a better way to solve it. Learn from your past attempts and get ready to start the process again.

The Problem Solving Process: While you may notice you're using it even for small and trivial problems, this process is incredibly useful for large, complex, poorly-defined, or open-ended problems. It helps you make progress when the way forward may not always be clear.

Wrap Up

Question of the Day: How can we apply the problem solving process to many different kinds of problems?

Journal Prompt: The problem solving process is particularly helpful when we encounter poorly-defined problems. We saw today that without a well-defined problem the rest of the problem solving process is difficult to follow. What are some questions or strategies we can use to help us better understand and define problems before we try to solve them?

Discuss: Have groups share quickly before taking suggestions from the class as a whole.

Discussion Goal

There are many different strategies to help define problems, including the questions on the previous lesson's activity guide. Some potentially useful questions include:

- Who in particular the problem affects. What specifically do they need? In what kind of situations?
- Why does the problem exist? (And why does that problem exist?) Keep asking to get to the heart of the problem.
- How could I be able to tell the problem had been solved? What could I observe or measure?

Remarks

> Excellent work everyone. We now understand a great deal about the problem solving process. This is going to be an incredibly useful tool that we'll use repeatedly throughout the year as we dig deeper into understanding the world of computer science.

Standards Alignment

CSTA K-12 Computer Science Standards (2017)

- ▶ **AP** - Algorithms & Programming

Lesson 13: Exploring Problem Solving - Games Theme (Alternate Lesson 3)

Overview

Question of the Day: How can we apply the problem solving process to many different kinds of problems?

In this lesson students apply the problem solving process to three different problems in order to better understand the value of each step. They will solve a maze, organizing a team to race as fast as possible, and design a game. The problems grow increasingly complex and poorly defined to highlight how the problem solving process is particularly helpful when tackling these types of problems. The lesson concludes with students reflecting on their experience with the problem solving process. They will justify the inclusion of each step and will brainstorm questions or strategies that can help them better define open-ended problems, as this is often the most critical step.

This lesson will likely take two class periods or more to complete. The first two problems may fit into a single class period but the third will need to be moved to a second day.

Purpose

This lesson provides students with more practice with the problem solving process in a variety of contexts. It highlights the fact that the problem solving process is particularly helpful when approaching poorly defined problems. The final brainstorm of the lesson provides students with some strategies and questions they can ask to better define problems for themselves, since this is often the most critical step. The problems seen in this lesson also help to drive a discussion in the following lesson about the types of problems that computers are well-suited to solve.

Assessment Opportunities

1. **Apply the problem solving process to approach a variety of problems**

   On page 5 of the Activity Guide, check the chart to make sure that students are putting in reasonable steps for each of the problems.

2. **Assess how well-defined a problem is and use strategies to define the problem more precisely**

   For the last question on page 5 of the Activity Guide, make sure that students have at least one question or strategy that would be an effective way to better define a problem.

Agenda

View on Code Studio

Objectives

Students will be able to:

- Apply the problem solving process to approach a variety of problems
- Assess how well-defined a problem is and use strategies to define the problem more precisely

Preparation

□Print the activity guide for each student
□Scratch paper for the Partner Race Relay problem
□Poster to record strategies for defining problems in wrap up discussion

Links

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

For the Teachers

- **Exploring Problem Solving - Games Theme** - Exemplar
- **Exploring Problem Solving - Games Theme** - Slides

For the Students

- **Solving Problems** - Activity Guide
  Make a Copy ▾

Warm Up (5 min)

Activity (75 min)

- Solving Problems
- Understanding the Problem Solving Process

Wrap Up (20 min)

Teaching Guide

Warm Up (5 min)

Journal Prompt: Think of the silliest problem the problem solving process could help with. Be prepared to say how each step of the process could apply.

Allow students to share out individually.

Remarks

> With such a wide variety of problems and strategies, it's important to be able to think about how best to use the problem solving process. Today we're going to look at some different types of problems, talk about what makes them different, and reflect on how the problem solving process helped us solve them.

Discussion Goal

This discussion serves as a review of the problem solving process and highlights how many different types of problems there could be. Encourage students to be creative and have some fun with the different "problems" they might solve.

Question of the Day: How can we apply the problem solving process to many different kinds of problems?

Activity (75 min)

Group: For all three activities students should be working together in groups, even if they record their results individually. Groups of 2-4 will likely work best.

Distribute: Hand out the activity guide, one copy for each student. For now they can be face down so that the maze isn't visible.

Solving Problems

Maze

Once students are in pairs ask them to flip over their activity guides and begin the first challenge. They'll be finding a solution to a multi-step maze.

Circulate: Walk around the room observing how students are addressing the problem. Make sure that groups are not sharing solutions. Encourage them to think about how making a plan might help them address this task.

Once all groups have finished, bring the class back together. Have students flip to the last page of the activity guide where there is a table to record their experiences with the problem. They will record what parts of solving this problem fall within each step of the problem solving process.

Teaching Tip

Integrating the Problem Solving Process: This word search can actually take several minutes, especially if students are approaching without some kind of strategy. Remind them that one step is to Prepare before they just jump in and start hunting.

Make It a Race: Making this problem a race is a good way to drive motivation and also ensure that groups don't share the locations of words once they've found them.

Key: A key showing possible solutions can be found online following the link provided above.

Discuss: Briefly discuss with students what parts of the activity they felt fell into each step of the problem solving process. Some possible points to make after students share are below.

- **Define**: This problem was already very well defined. Not all problems will be, though.
- **Prepare**: Developing a plan with a team (such as divvying up the maze, or just being methodical about looking for a path) makes this problem much easier to solve than random trying.
- **Try**: Patience and persistence is important to see your plan through
- **Reflect**: If your early plans are not working you can regroup and choose a new plan

Partner Race Relay

Move the class on to the partner race relay problem. Groups may still work together on their solutions but shouldn't share with other groups.

Circulate: As before, circulate around the room noting the types of strategies that groups are using. Remind them to use the steps of the problem solving process to help them if they're getting stuck.

Once groups have finished solving the problem ask them to move to the last page of the activity guide to record how they used the problem solving process to solve this problem.

Discuss: Briefly discuss with students what parts of the activity they felt fell into each step of the problem solving process. Some possible points to make after students share are below.

- **Define**: The problem seems to be a problem of getting a team to move quickly. If you instead think of it as a problem of having fast people run more trips or pairing slow people so they don't slow down fast people, the problem can be solved more quickly.
- **Prepare**: Ask students to share what types of strategies they considered before just starting to try out solutions.
- **Try**: As before, patience and persistence is important to see your plan through
- **Reflect**: If early strategies are not working groups may have regrouped and tried a more structured approach

Teaching Tip

Integrating the Problem Solving Process: This problem is particularly challenging if you don't Define the problem well. If you take it at face value, your job is to randomly guess and check partnering the players until you find a fast solution. It is much easier if you come up with general strategies first (send fast people back, pair slow people together).

This isn't the only approach to the problem, and you shouldn't rush to introduce it as such. Rather, encourage students to discuss with one another what they know needs to be true at the end and whether different approaches might help.

Draw Pictures: Students will likely do better if they try out different solutions. You may wish for students to use a journal or scratch paper as a place to brainstorm ideas.

Extending the Problem: If one group finishes far before others you could give them a blank sheet of paper and ask them to solve the problem again but with a shorter time. The minimum time for the solution is 42 minutes, and if students have already reached that time, challenge them to explain how they know that their time is the fastest.

Make a Game

Move the class on to the Make a Game problem. Each member of the group will individually be developing a plan for a layout that follows criteria they'll develop as a team. Give students time to choose the goals they'll use to plan their game. For example there may be certain space restrictions, number of students included, etc.

Once groups have goals, they will move through the activity by developing a plan to make their game. Give them a time limit on this part of this process, e.g. 15 minutes, to make sure they focus on the key elements on their plan rather than perfecting it. They should record key information about their plan in their activity guides.

Bring groups back together and have them share their initial plans. On the activity guides they can record the feedback their classmates give them on their plans.

Once groups have discussed what they like or don't like about their classmates' proposed plans, they can re-examine them and make improvements. Are there other things they'd like to do? Do they have new goals? Give them several minutes to make improvements to their plans before deciding on a final version.

Bring the class back together and have them record the different steps of the problem solving process that they used in their activity guides.

Teaching Tip

Integrating the Problem Solving Process: This problem is intentionally very open-ended and in fact has students develop the criteria they'll use to measure success. This problem does the best job of highlighting all 4 steps of the process and walks students more intentionally through the Define, Prepare, Try, and Reflect stages.

Give Resource Ideas: Students may just brainstorm ideas by themselves, but also let them know about other resources such as search engines and image searchers to help give them inspiration if they are stuck. Let them look at other games online for help.

When to Stop: This problem could easily take a 50 minute class period. Let students know ahead of time that there are time limits on what they're doing and encourage them to think how they would improve their route using the problem solving process if they had more time to iterate.

> **Discuss:** Briefly discuss with students what parts of the activity they felt fell into each step of the problem solving process. Some possible points to make after students share are below.
>
> - **Define**: This problem was not well-defined. They needed to decide for themselves what a "good" game looked like, and this definition could have even shifted throughout the process.
> - **Prepare**: Narrowing down a list of possible layout is helpful. You may also choose to make the point that this entire activity is an example of preparation. Some games just don't make sense or others work better, so you need to do the kind of planning they're doing here.
> - **Try**: As before, patience and persistence is important to see your plan through
> - **Reflect**: In this problem reflection came primarily through feedback from peers. Some games might not end up being that interesting to other group members. Some are fun but require too much work or too many materials. Feedback is an important part of the reflect step, especially in group work.

Understanding the Problem Solving Process

Prompt: You just solved a number of very different problems. With your tables review the notes you took on each of the problems. Be ready to report out on the following questions

- For each step in the problem solving process, what is its purpose? Why is it included?
- Are there any kinds of problems that the problem solving process is particularly helpful at solving?

Discuss: After tables have discussed their responses for several minutes invite the whole class to share their rationale for including each step in the process. Once each step has been discussed, move on to the second question. This question may have many responses and you should allow students to share their thoughts and experiences. If it doesn't arise naturally as you leave the conversation offer some or all of the ideas mentioned in the discussion goals.

Discussion Goal

Goal: Students have practiced using the problem solving process on a number of different problems. Help them synthesize the notes they have been keeping to better understand the role of each step and the value of the problem solving process in general. A sample set of conclusions is below but you should allow students to share your own insights before offering your own.

Define: without defining a problem you might solve the wrong problem, not know where to start, or not know when you're finished

Prepare: Even well-defined problems usually have many possible approaches. Make each try more likely to succeed by first examining your options and anticipating challenges

Try: Without trying you'll never get anywhere. It's important to be persistent and patient so long as your plan still may work

Reflect: You'll likely not solve the problem the first time or there will be a better way to solve it. Learn from your past attempts and get ready to start the process again.

The Problem Solving Process: While you may notice you're using it even for small and trivial problems, this process is incredibly useful for large, complex, poorly-defined, or open-ended problems. It helps you make progress when the way forward may not always be clear.

Wrap Up (20 min)

Question of the Day: How can we apply the problem solving process to many different kinds of problems?

Journal Prompt: The problem solving process is particularly helpful when we encounter poorly-defined problems. We saw today that without a well-defined problem the rest of the problem solving process is difficult to follow. What are some questions or strategies we can use to help us better understand and define problems before we try to solve them?

Discuss: Have groups share quickly before taking suggestions from the class as a whole.

Remarks

> Excellent work everyone. We now understand a great deal about the problem solving process. This is going to be an incredibly useful tool that we'll use repeatedly throughout the year as we dig deeper into understanding the world of computer science.

Discussion Goal

There are many different strategies to help define problems, including the questions on the previous lesson's activity guide. Some potentially useful questions include:

- Who in particular the problem affects. What specifically do they need? In what kind of situations?
- Why the problem exists? (And why does that problem exist?) Keep asking to get to the heart of the problem.
- How could I be able to tell the problem had been solved? What could I observe or measure?

Standards Alignment

CSTA K-12 Computer Science Standards (2017)

- ▶ **AP** - Algorithms & Programming