Unit 1 - Problem Solving

Unit 1 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. The unit concludes with students designing an application 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

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

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 aluminum boats problem 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.

Lesson 3: Exploring Problem Solving

Unplugged

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

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” 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

In this the class students consider a number of computing devices to determine what types of inputs and outputs they use. Groups are assigned to a computing device and based on a teacher-provided definition of input and output, list the inputs and outputs of their device. To conclude the lesson the class examines common activities they do on a computing device and select the inputs and outputs used for that activity from the chart.

Lesson 6: Processing

Unplugged

This lesson dives deeper into the concept of processing that was introduced as part of the definition of a computer. Pairs work together to puta deck of cards in order, a form of processing information. In the end, the class discusses what processing means within the context of solving information problems.

Lesson 7: Storage

This lesson focuses on the storage component of the definition of a computer, within the content of processing information. The class spends the majority of the lesson developing and sharing algorithms to process information, with an emphasis on how much storage is needed for any particular algorithm. The lesson concludes with a discussion of the importance of storage while processing information.

Week 3

Lesson 8: Apps and Problem Solving

Unplugged

This lesson covers the input and output aspects of computers in a context that is relevant and familiar to students: apps. The class evaluates various web applications to analyze the specific problems that they were designed to solve, the inputs that they need to work, and the outputs they provide to users. The class concludes with observations of these apps as well as a teacher led discussion about the impact of apps on society.

Lesson 9: Project - Propose an App

Unplugged | Project

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 highlighting the features of each app. The project is designed to be completed in pairs though it can be completed individually.

Chapter Commentary

In the second half of the unit, students move on to thinking about 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.

Lesson 1: Intro to Problem Solving

Unplugged

Overview

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.

Purpose

This lesson is a fun introduction to the open-ended, collaborative, and creative problem solving students will be doing 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 points 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.

Agenda

Warm Up (10 min)

- **Set the Stage**

Activity (30 min)

- **Building an Aluminum Boat**
- **Iterative Improvement**

Wrap Up (10 mins)

- **Discuss the Challenge**

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 **Aluminum Boats - Activity Guide**

For the teacher

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

Links

For the Students

- **Aluminum Boats** - Activity Guide (**PDF** | **DOCX**)

Teaching Guide

Warm Up (10 min)

Set the Stage

Remarks

> Hello everyone, welcome to Computer Science Discoveries! You may have a lot of questions about what we're going to do or learn this year. All I'll say for now is that we're going to be having a lot of fun learning how we can use computer science to help us build things, express ourselves, and solve problems. In fact, solving problems with or without computers is going to be one of the primary focuses of this class. But enough of me talking, let's get to today's activity.

Teaching Tip

Feel free to use any icebreaker activity or other introduction you like here. The goal is to move quickly to the main activity after which you'll have more opportunity to reflect about problem solving in the context of today's activity.

Group: Put students in groups of 2 or 3.

Distribute: One copy of the **Aluminum Boats - Activity Guide** to each group. As a class, read through the Goal and Rules sections of the activity guide and answer questions.

Activity (30 min)

Building an Aluminum Boat

Prompt: 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.

- **Support:** 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.
- 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.

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 to have this activity in the hallway or some other space if your room is very restrictive.

Iterative Improvement

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.

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.

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.

- **Prompt:** Now that you've had a chance to learn from the first round of boatmaking, 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.

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.

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.

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

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

Wrap Up (10 mins)

Discuss the Challenge

Prompt: What was your favorite part of this activity? What was most challenging?

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

Prompt: Since you are in a computer science class, you also may be wondering, “What in the world did that have to do with computer science?” Find another partner and talk about what you think this activity has to do with computer science.

Discuss: Allow students an opportunity to share their responses with the class.

Remarks

> All of your thoughts around these questions were great. You may be used to thinking about computer science as being all about computers. I'm here to tell you that first and foremost computer science is about solving problems, and that's what we were doing today. A lot of other parts of this activity like improving designs, working in groups, 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.

Discussion Goal

This should be a fairly open-ended discussion of the different components of the activity. Feel free to ask follow up questions if you like but the main goal is just to kick off the later conversation.

Discussion Goal

The second question will give you a chance to hear some of the thoughts and beliefs students have about computer science. Students may suggest things like, teamwork, sharing ideas, making improvements, etc. Again, the goal is not to agree or disagree, but to foster an environment to share those thoughts. It is appropriate to ask follow up questions that are not threatening, such as, “explain that thought to me more”.

Content Corner

Although there are no right or wrong answers for this discussion, for our purposes, the main point is that students solved a problem. They had to define the problem, plan a solution, try a solution, and evaluate it. These concepts will become more apparent as the chapter unfolds.

Lesson 2: The Problem Solving Process

Unplugged

Overview

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 aluminum boats problem 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.

Agenda

Warm Up (5 min)

- **Problems Brainstorm**

Activity (30 min)

- **Introduce the Problem Solving Process**
- **The Problem Solving Process in Context**

Wrap Up (15 min)

- **Create Posters of the Steps**

Extended Learning

- **Article Discussion**

Objectives

Students will be able to:

- Identify the four steps of the problem solving process
- 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 **The Problem Solving Process - Activity Guide**

For the class

- [ ] Poster paper
- [ ] Markers/colored pencils

Links

For the Teacher

- **Problem Solving Process** - Graphic

For the Students

- **The Problem Solving Process** - Activity Guide (**PDF** | **DOCX**)

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. For now let's just say that a problem is a situation that could be fixed or improved.

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)

Introduce the Problem Solving Process

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: **The Problem Solving Process - Activity Guide**

The Problem Solving Process in Context

Step 1: 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.

Step 2: Have students complete the first section of the activity guide by filling in the steps of the previous days' 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.

Step 3: 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: For this first conversation in particular you're making sure students understand the meaning of the 4 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.

Step 4: 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.

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.

Wrap Up (15 min)

Create Posters of the Steps

Set-up: At the front of the room place four large posters with the names of one of the steps of the problem solving process written on each.

Prompt: At your tables review all the work you did today looking at the problem solving process in a number of contexts and pick the two most important strategies for each step in the process. These should be strategies that you think can help in lots of different types of problems when you're working on that step.

Circulate: Walk around the room and check that groups are making progress on picking their strategies. Remind them that these are supposed to be generally useful and not specific to a single type of problem. Once all groups are ready bring the class back together

Share: Go through each step of the problem solving process and ask groups to share their strategies. At the front of the room record the strategies on the appropriate poster. Once all posters have been completed place them somewhere visible in the room.

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?

Lesson 3: Exploring Problem Solving

Unplugged

Overview

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 plan 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. 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.

Agenda

Warm Up (5 min)
- **Setting the Stage**

Activity (75 min)
- **Solving Problems**

Wrap Up (20 min)
- **Understanding the Problem Solving Process**

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 **Solving Problems - Activity Guide** for each student
- [ ] Spend a few minutes exploring **Google Maps - Website**
- [ ] Scratch paper for the Birthday Party problem
- [ ] Poster to record strategies for defining problems in wrap up discussion

Links

For the Teacher

- **Google Maps** - Website

For the Students

- **Solving Problems** - Activity Guide (**PDF** | **DOCX**)

Teaching Guide

Warm Up (5 min)

Setting the Stage

Remarks

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

Teaching Tip

Jump Right In: This lesson involves 3 separate problems and will almost certainly span at least 2 class periods. Since the point here is primarily to give students a chance to use the problem solving process, just jump right in and save the reflection and discussion for the end of the class.

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: Solving Problems - Activity Guide, one copy for each student. For now they can be face down so that the word search isn't visible.

Activity (75 min)

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.
>
> 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

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.

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

Plan a Trip

Students will need to work online for this problem to use **Google Maps - Website** or some other tool that will allow them to plan a road trip.

Demonstrate: Move the class on to the Plan a Trip problem. Each member of the group will individually be developing a plan for a trip that follows criteria they'll develop as a team. Before sending groups off you'll want to demonstrate how the tool they're using will work. A good set of steps to show them might be.

- Find your school on the map.
- Search for something familiar to students close to the school.
- Generate directions from the school to the other location, choosing the method of travel (walking/bus/car/etc.)
- Highlight where the tool shows the total time of the trip

Prompt: Give students time to choose the criteria they'll use to plan their trip. For example there may be certain kinds of activities they'd like to do, places they definitely want to include, people they want to visit, etc.

Circulate: Once groups have criteria they will move through the activity by developing a plan to visit the places in one school day. 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 criteria? Give them several minutes to make improvements to their plan 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 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.)

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.

Practice with the Tool: The tool provided can be confusing to use if students haven't used it before. It is not the focus of the lesson but you will likely need a few minutes to get used to using it yourself if you want to be able to help students with it. Make sure you are comfortable generating directions both to and from the school.

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" itinerary looked like, and this definition could even shift throughout the process.
- **Prepare**: Narrowing down a list of possible destinations is helpful. You may also choose to make the point that this entire activity is an example of preparation. You can't go on every possible trip and then pick the best one, 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 destinations might not end up being that interesting to other group members. Some trips are fun but require too much driving. Feedback is an important part of the reflect step, especially in group work.

Wrap Up (20 min)

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 their purpose? Why are they 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.

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 and recording them on a poster. Ensure that the three strategies indicated in the discussion goal also make their way onto the poster.

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

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.

Discussion Goal

Goal: As a final closing to the lesson, highlight the fact that defining a problem well often makes the rest of the process much easier. This brainstorm should result in a poster of questions or other kind of shared list that you can point to throughout the year to help students better define problems.

Connections: On the final project of the unit students will be asked to use some of these questions to better define a problem of their choosing. In particular they will be asked to consider:

- 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?

You can add these questions to the poster at the end of the conversation if they do not naturally arise.

Lesson 4: What is a Computer?

Unplugged

Overview

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 serves as a transition out of the first chapter of Unit 1 and into the second chapter. Up until now, students have considered the potential of computers as problem solving devices, but not established what a computer actually is. In this lesson, students will consider different types of computers and that these computers input, store, process, and output 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.

Agenda

Warm Up (5 mins)

- **What Problems Do Computers Help You Solve?**

Activity (40 mins)

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

Wrap Up - Journal (5 mins)

- **Journal**

Objectives

Students will be able to:

- Identify a computer as a machine that processes information
- Provide a high level description of the different parts of the Input - Output - Store - Process model of a computer

Preparation

For each group

- [ ] Print out copies of **What is a Computer - Activity Guide**. Note there are two sets of pictures in the document 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

For the Teacher

- **What Makes a Computer, a Computer?** - Video
- **What is a Computer?** - Graphic

For the Students

- **What is a Computer** - Activity Guide (**PDF** | **DOCX**)

Teaching Guide

Warm Up (5 mins)

What Problems Do Computers Help You Solve?

Prompt: In the modern day we use computers almost constantly. What kinds of problems do computers help you solve? How do they help you do this?

Discuss: Run this conversation as a brainstorm, recording ideas on the board. Note and call out similarities you're seeing the kinds of problems students identified.

Remarks

> Computers are clearly an important part of our lives and help us solve all kinds of problems. I want to think more about the kinds of problems computers help us solve, but first I want to ask an important question. What is a computer?

Discussion Goal

Goal: This warm up makes the transition from thinking about problem solving in a generic sense to thinking about how computers help solve certain kinds of problems. While the lesson will eventually reveal that computers are particularly useful at solving information problems, you don't need to make that point during this brainstorm.

Activity (40 mins)

Computer or Not?

Group: Place students in groups of 3 or 4

Distribute: Activity Guide **What is a Computer - Activity Guide** as well as scissors, markers / colored pencils, poster paper, and glue / tape for making posters.

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 take a majority vote. Assure groups that it is ok if one or two people disagree.

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?

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

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.

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 **What Makes a Computer, a Computer? - Video**. The video presents a computer as a machine that helps with certain kinds of thinking work by processing information. It formally introduces a model of a computer as a machine that inputs, outputs, stores, and processes information.

Allow students to revise their posters using the definition they have just learned.

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

Wrap Up - Journal (5 mins)

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 problem?
- What information is input to the computer?
- What information does the computer store?
- What information does the computer process?
- What information does the computer output?

Teaching Tip

Until the Video's Ready: The video referenced here is still being filmed. Not to worry though, you can still present this definition yourself. Write or otherwise the following definition on the board

"A computer is a machine that processes information. All computers need some way of inputting, outputting, storing, and processing information"

Let students know that this is a definition that they'll continue to explore throughout the next several lessons.

Discussion Goal

Again, it's not necessary for everyone to agree on every item on the list. It's more important that the students use discussion of the items to deepen their understanding of what a computer is. 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, and that their understanding will continue to grow as the class continues.

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.

Lesson 5: Input and Output

Overview

In this lesson students consider a number of computing devices to determine what types of inputs and outputs they use. Groups are assigned to a computing device and based on a teacher-provided definition of input and output, list the inputs and outputs of their device. Earlier in the activity students are prompted to focus on more obvious physical inputs and outputs (e.g. a keyboard as an input or a screen as an output) but later discussions lead students to consider less obvious examples (e.g. that a touch screen is both an input and output, or the fact that the Internet can serve as both input and output). Throughout the lesson the teacher records inputs and outputs that are identified on a T-Chart at the front of the room. To conclude the lesson students examine common activities they do on a computing device and select the inputs and outputs used for that activity from the chart.

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.

Agenda

Warm Up (5 mins)
- **Computer "Stuff" is Information**

Activity
- **Brainstorming Inputs and Outputs**

Wrap Up (15 mins)
- **What Inputs and Outputs Do I Use?**

Objectives

Students will be able to:

- Identify the inputs and outputs of common computing devices
- Select the inputs and outputs used to perform common computing tasks

Preparation

- [ ] Prepare copies of **Input and Output - Activity Guide**

Links

For the Students

- **Input and Output** - Activity Guide (**PDF** | **DOCX**)

Vocabulary

- **Input** - A device or component that allows information to be given to a computer
- **Output** - Any device or component that receives information from a computer

Teaching Guide

Warm Up (5 mins)

Computer "Stuff" is Information

Prompt: In the last lesson we learned that a computer is a device that "processes information". That phrase is still a little vague, so let's see if we can clarify it a bit. What kinds of "stuff" do you use, look at, create, or edit on a computer that you think might actually be information?

Discuss: Students should brainstorm silently, then share in pairs, then discuss their ideas with the whole class. This conversation should be pretty open-ended.

Discussion Goal

Goal: In today's lesson students will be talking about how to get "stuff" in and out of a computer. This discussion just aims to replace the word "stuff" with a more useful long-term vocabulary word of "information". It's fine if what that word means is still a little fuzzy at the end of the conversation.

Possible Responses: Photos, documents, videos, music, apps, games, spreadsheets, websites, etc. If need be you can jumpstart conversation by naming one or two of these and seeing if that helps students think about other examples.

Remarks

> Great work, and I'm sure we could think of more examples if we tried. All the examples you just provided are the "information" that we use computers to process. Today we're going to look at an important question of how this information gets in and out of the computer in the first place.

Activity

Brainstorming Inputs and Outputs

Group: Place students in small groups of 2 or 3.

Distribute: Copies of **Input and Output - Activity Guide** to each group.

Display: At the front of the room place a large poster or project a document where you will record all the inputs and outputs students brainstorm in this activity.

Teaching Tip

Give them Physical Examples: This activity guide includes small photos of each category of device but students can and should look at actual computers if they're on hand. Depending on your classroom rules you might say this is one of the only days they **should** have their phones out in class!

Input and Output Activity Guide

Vocabulary: As a class review the two vocabulary words found on the top of the activity guide, input, and output.

Inputs and Outputs - Laptop / Desktop: Have students complete the first row of the activity guide by listing all of the possible inputs and outputs to a laptop. Encourage students to think for now only about the actual computer, not devices you could connect to one.

Discuss: Have students share the results of their brainstorm. As they share them record their answers on the poster at the front of the room.

Inputs and Outputs - Connected Devices: Have students complete the second row of the activity guide by listing all of the possible connected devices of a computer. This can be fairly wide-ranging.

Discuss: Have students share the results of their brainstorm. As they share them record their answers on the poster at the front of the room.

If it does not come up naturally prompt students about how they talk to people using other computers. Call out that communicating over the Internet is a form of input and out.

Inputs and Outputs - Smartphone: Have students complete the final row of the activity guide by listing all of the inputs and outputs of a smartphone.

Content Corner

Possible Responses Laptop / Desktop: The following is a possible list of responses

- **Inputs** Keyboard, mouse, trackpad, other buttons, camera, microphone
- **Outputs** Screen, Speakers

Content Corner

Possible Responses Connected Devices: There are many devices that we commonly connect to computers. Focus attention more on whether students think the device is an input or an output. Note that some devices could serve both roles.

- **Inputs:** External camera, Microphone, USB stick, hard-drive
- **Outputs:** Printer, Router, Another computer, USB stick, hard-drive,

Discuss: Have students share the results of their brainstorm. As they share them record their answers on the poster at the front of the room. In particular call attention to the fact that a screen now serves many roles as both the input and output of a smartphone. Some less obvious inputs may require you to provide examples to students.

For example, if a smartphone shows you where you are on a map then it must somehow know where you are. In other words there must be some kind of input (a GPS system) that provides that information.

Similarly if a phone knows when it's been rotated then there must be some kind of input device that is detecting how a phone is positioned.

Wrap Up (15 mins)

What Inputs and Outputs Do I Use?

Prompt: Brainstorm three everyday activities you or people you know do with a computer.

What is the input used for that activity?

What is the output?

Circulate: Have students brainstorm with their groups and record their ideas on their activity guides. Point students towards the list of inputs and outputs you've listed on the board.

Discuss: As a class discuss the examples students brainstorm.

Content Corner

Possible Responses Smartphone: The following is a list of possible responses

- **Inputs:** The following is a list of possible responses Touch screen, Buttons, Microphone, GPS, Motion sensor (e.g. to rotate the screen), Light sensor (e.g. to make screen dimmer at night), Camera, Stylus (on some phones), Internet connection
- **Outputs:** The following is a list of possible responses Touch screen, Speakers, Headphones, Vibration, Internet connection, etc.

Discussion Goal

Goal: 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

Lesson 6: Processing

Unplugged

Overview

Students complete two unplugged card sorting activities to explore the meaning of processing and its relationship to problem-solving. The first has few constraints and is used to introduce a high-level definition of processing. The next introduces more constraints that forces students to develop an algorithm that will always successfully process the cards. Students iteratively develop, test, and share their algorithms with classmates. A wrap-up discussion has students reflect on the different types of problem-solving they used in these activities and the value of producing an algorithm to solve a problem.

Purpose

This lesson is primarily another opportunity for students to collaboratively problem-solve. The main activity is a challenging problem that emphasizes the importance of testing solutions on multiple inputs, breaking down large problems, and iterative improvement. In sharing their solutions students see that there are many equally valid solutions to the same problem. These are features students will see in many of the problems they will encounter through the course.

The definitions of processing and algorithms presented in this lesson are intentionally high-level. Students should understand that processing is whatever a computer does to turn inputs to outputs, and that using a computer to process information requires developing an algorithm that reliably does so. The goal of this lesson is NOT for students to understand and compare different classic sorting algorithms, or even necessarily to formalize their own.

Agenda

Warm Up (10 min)
- **Sorting Cards**

Activity (30 mins)
- **Card Sorting Algorithms**

Wrap Up (10 min)
- **Solving Problems with Computers**

Objectives

Students will be able to:

- Define processing as the work done (possibly by a computer) to turn an input into an output
- Define an algorithm as the series of commands a computer uses to process information
- Develop and iteratively improve an algorithm for processing information based on given constraints

Preparation

- [ ] Prepare one deck of cards for every 8 students, removing face cards. Pairs will need roughly 8 cards each.
- [ ] Alternately, print and cut out the number cards **Number Cards**. Pairs will need roughly 8 cards each.
- [ ] Prepare one copy of **Card Sorting - Activity Guide** for each student

Links

For the Teacher

- **Number Cards** (**PDF** | **DOCX**)

For the Students

- **Card Sorting** - Activity Guide (**PDF** | **DOCX**)

Vocabulary

- **Algorithm** - A precise sequence of instructions for processes that can be executed by a computer

Teaching Guide

Warm Up (10 min)

Sorting Cards

Remarks

> So far we've explored what inputs and outputs mean in the context of a computer. Today we're going to look more closely at processing by doing a couple of unplugged activities.

Group: Place students into pairs.

Distribute: Give each pair roughly 10 cards. Place the cards in a stack face down between pairs. Ask students not to touch the cards until you say so.

Announce the rules of the challenge:

- No talking during the challenge
- The goal is to get the cards in a line, face up, in number order
- When you are done, a team member should say "Done!" and the teacher will give the team a time

Once the class understands the activity and is ready, begin the challenge. You might choose to project a stopwatch if you like for comparison. Once groups have finished give them another opportunity to improve their times.

Teaching Tip

How Many Decks?: This lesson can be completed with one deck of cards for every 8 students. If you don't have access to decks of cards you may run the activity essentially identically using the **Number Cards** instead. It is fine if groups have duplicate cards.

Exclude Face Cards: Many students have no experience using playing cards. There's no need to use face cards in this activity, and even knowing the suits is not important. Feel free to pull out the face cards and emphasize that all that matters is the numbers.

Before and After: This image shows what cards should look like before and after the sort.

Prompt: Ask students to silently journal about the following prompts:

- What are the input, output, and processing in this activity?
- How is your approach to solving this problem different from how a computer might have to approach it?

Discuss: Give students an opportunity to talk at their tables about the prompts. Once they are ready to share ask a couple of groups to share their responses to each question.

Discussion Goal

Goal: Try to highlight the following points as you synthesize comments from the room.

- The input is the unsorted deck. The output is the sorted deck. The processing is the actual sorting process that turns the input into the output.
- Students may say any number of things here. It's better to take a "no wrong answers" approach unless students offer ideas that truly contradict things they've already seen in the class.

Remarks

> There are many ways your solutions might be different from how a computer would solve this problem. In general, however, the biggest difference is that computers need to be programmed with a plan without knowing the exact cards that they are going to get. In the next activity we're going to look at how a computer might solve this same problem.

Activity (30 mins)

Card Sorting Algorithms

Activity Guide - Sorting Cards

> **Distribute:** Give each student a copy of **Card Sorting - Activity Guide** to each student (or pair of students).
>
> **Processing Uses Algorithms:** Read this section together as a class, calling out the new vocabulary word algorithm.
>
> **Review Instructions:** Have students read the activity instructions, then review as a class.
>
> **Circulate:** Walk around the room and listen to the types of ideas students are discussing. Encourage students to practice using the Tips section on the activity guide. Reinforce the idea that they should have a strategy that works for every arrangement of the cards, not just the ones that they have out currently. Ensure pairs are switching between Sorter and Pointer roles.
>
> **Share and Test:** After several minutes have groups share the approaches they are using. The aim here is to give students a chance to hear how others are approaching the problem. Ask students to actually walk through their algorithms with the other group. The activity guide provides some possible test-cases that students could consider.

Teaching Tip

Model the Rules: You will likely need to model the rules of the activity. For unplugged activities like this one misconceptions can easily arise. Leave time early in the activity for questions to avoid students spending time on the wrong problem.

Iterate: Based on what they observed from other groups, ask groups to update, revise, or improve their own algorithm. They should be aiming to create algorithms that work for greater numbers of cards (ideally any number of cards) and that work regardless of the original organization of the cards.

Circulate: Have students return to the challenge, encouraging them to move to more cards. Once teams have an algorithm they think works, have them write or draw a description of it on the activity guide in the space provided.

Wrap Up (10 min)

Solving Problems with Computers

Prompt: Either as a discussion or silent journal ask students to consider the following prompt, also found on their activity guides.

- What step of the problem-solving process did you think was most important in this activity?
- Why would someone create an algorithm to process information if they already know how they would do it by hand?

Discuss: Have students share their responses with a partner and then share as a whole class.

Remarks

Computers help us solve problems by processing inputs to make outputs. As we saw in the second activity today, that can often mean more work up front to develop very specific steps a computer could use to process the information. It can be tricky and require lots of our problem-solving skills to do this. The benefits, however, are once you have the problem solved once you can make a computer solve that problem for you every time after that.

Teaching Tip

Speed is Less Important: In the warm up activity the timing can help with motivation. In this activity the focus is much more on more deliberate problem solving. So long as their solutions work considerations of speed or efficiency aren't important for the goals of this lesson.

Start with Fewer Cards: Encourage the class to start with just three or four cards before trying to test their algorithms on eight or more.

Teaching Tip

What's Success Look Like?: To achieve the learning objectives of this lesson students don't necessarily need to develop an algorithm that works for 8 cards, or even one that always works. If students have an algorithm that is working for fewer cards or only works sometimes they still will have grappled with the different type of problem-solving required in this activity and will be able to participate in the debrief discussion.

Discussion Goal

Goal: Use the first prompt to connect the activity to the problem-solving process. As students will likely call out that there were many challenges in this activity, validate their responses. They may also call out, however, that sometimes they thought their algorithm worked only to find later it didn't. Or they didn't even know how to start and needed to just break down the problem. Call out that many of the skills they used in this lesson are just general problem solving skills that they've been working on and will see throughout the course.

The second discussion should highlight that while figuring out an algorithm is usually more time-consuming, it means you could then give the instructions to a computer to do that task for you. For example, with an algorithm a computer could sort a million cards, or a million piles of cards, faster than humans and without getting bored. It is a different type of problem-solving that emphasizes eventually automating the solution.

Lesson 7: Storage

Overview

Students explore the importance of storage within the Input-Storage-Processing-Output model of a computer. The warm-up activity asks students to reflect on the types of information they have seen computers store in the past, like documents, photographs, or videos. The unplugged main activity has students develop an algorithm to process a small pile of cards in search of specific cards within the deck. Constraints on how students can move the cards force them to consider the importance of storage even while they are processing the deck. The lesson concludes with a discussion of the two types of storage students saw in this lesson and the importance of storage while processing information.

Purpose

This lesson serves many roles. It is centered around another collaborative problem-solving challenge which will continue to develop students' problem-solving skills. It completes students' exploration of the Input-Storage-Processing-Output model by providing two perspectives on the importance of storage. It builds upon the previous lesson where students learned that algorithms are structured ways that computers process information to solve a problem.

As with the previous lesson, the understandings of the computer science content addressed in this lesson are intentionally high-level. Students should understand that in order to process information at all, a computer must store it. Students aren't expected to understand the technical details of how this is achieved, or even consider the implications of this fact. In Unit 2 students will have more opportunities to think about the implications of their information being stored and published online, and in Unit 3 students will learn to use various means of storing information while developing programs.

Agenda

Warm Up
- **What is Storage?**

Activity
- **Finding Cards**

Wrap Up (15 mins)
- **Reviewing Storage and Processing**

Objectives

Students will be able to:

- Provide examples of common types of information that is stored on a computer
- Explain the need for storage as part of processing information with a computer
- Develop an algorithm that incorporates storage considerations

Preparation

- [ ] Print copies of **Storage and Processing - Activity Guide**
- [ ] Several decks of cards to share among the class
- [ ] Packs of sticky notes or squares of paper

Links

For the Students

- **Storage and Processing** - Activity Guide (**PDF** | **DOCX**)

Teaching Guide

Warm Up

What is Storage?

Prompt: So far we have looked closely at input, output, and processing. We haven't looked much at "storage" in the context of a computer. What things might a computer need to store in order to work? Can you think of any examples of something a computer stores?

Discuss: Have students brainstorm a list of examples at their tables. When ready have students share their answers with the class and record their answers on the board. Create a running list.

Remarks

> When we think of storage we often think of files. Music, photos, documents, movies, and plenty of other things need to be stored on a computer to use them. What we don't often realize, however, is the importance of storage even inside the processing of information. Today we're going to explore algorithms again with a new challenge, this time that shows us a little bit about how computer scientists think about storage.

Discussion Goal

Goal: The prompt alone highlights the fact that today's lesson will be focused on storage. The discussion is intended to highlight common ways people think about storage in a computer. It's okay to slightly "mislead" students towards long term storage or files here as you lead the discussion, e.g. with prompts like "what other kinds of things do you think a computer has to store"? The following transitional comment acknoweldges those ideas and highlights that today's lesson examines a different kind of short term storage computers.

Potential answers to the prompt include: photos, documents, videos, video games, text messages, emails, programs

Activity

Finding Cards

Group: Place students in groups of 2 to 3. Larger groups likely will not be productive

Distribute: Storage and Processing - Activity Guide to each group as well as a deck of a cards and a small stack of post its

Storage and Processing Activity Guide

Storage and Processing: As a class or out loud read through this section introducing the point of the activity.

Setup and Rules: Read through the rules together and answer questions students have about them. You may wish to demonstrate how the activity will work as well.

Challenge 1 - Smallest Card: Ask students to first work in small groups to develop their algorithm by hand. They should run them a few times with new small stacks of cards to make sure it works and follows the rules.

Once they have a working algorithm have students write the steps of their algorithms as well as how many safe spaces they need on their activity guide so that another group would be able to follow the steps.

Trade Rules: Each group should then trade their rules with another group and ensure the algorithms work.

Discuss: Have groups share whether their algorithms were the same and how many safe spaces they needed to use.

Challenge 2 - Largest Card: This challenge is almost identical to the last. Once again have students develop an algorithm to find the largest card.

Trade Rules: Once again each group should then trade their rules with another group and ensure the algorithms work.

Discuss: Have groups share similarities and difference they noticed between their algorithms and the one they tried. Again compare how many safe spaces students needed to use.

Challenge 3 - Second Largest Card: Repeat the same steps for this challenge.

Content Corner

The Role of Storage in Processing: Computers don't just "remember" information, they need to store it to come back later. The "safe spots" in this activity are a visual representation of how a computer might store results during an algorithm (processing) in order to keep track of its progress. Many people might be more aware of how computers store files with documents, spreadsheets, movies, and photos. This activity shows that storage is just as necessary during the actual processing of information as well.

Teaching Tip

Demo the Rules: This rules video provides a quick explanation of the rules of the activity. Rather than having kids read the rules just demo the rules yourself. This **teacher-facing video** provides some insights into the point of the activity.

Teaching Tip

Input and Output: To reinforce the role of "input" and "output" the activity asks students to record the inputs and outputs of their algorithm. In each case the input will be the small pile of cards they begin with and the output will be the card they are looking for.

Challenge 4 - Middle Card: This challenge is quite difficult and may need to be scaffolded by asking students to find the "third largest" card and see what they come up with. Their eventual realization should be that they need at half the number of cards worth of safe spots to complete this challenge successfully. Give students time to come to this realization or help them understand why it is the case.

Teaching Tip

Increase the Challenge: When groups share you can make it harder by having them start run the algorithm themselves and then stop partway through before trading.

Wrap Up (15 mins)

Reviewing Storage and Processing

Prompt: Ask students to consider each of the following questions as part of a debrief conversation from the activity. This can also be completed as a journal. It may make sense to run a conversation after each prompt rather than have students write responses to all three.

- What were the inputs, outputs, storage, and processing in this activity?
- Why did you need to store information as a part of your algorithms in this activity?
- When have you ever used a computer to find the "largest" or the "smallest" of something? What are the inputs and outputs in that example?

Discuss: Students should share their responses in small groups before discussing as a whole class.

Remarks

> We now have a pretty firm understanding of what is meant by the input-output-store-process model of a computer. Next time we're going to explore in more detail how the apps we use everyday use this model to help us solve problems.

Discussion Goal

Goal: The first prompt makes sure that students can accurately identify the inputs, outputs, storage, and processing in this activity. If students have used the activity guide they should understand that the input is the stack of cards, the output is the card they were looking for, the storage was being done on the safe spots, and the processing was the algorithms they wrote.

The second prompt seeks to highlight the role of storage in the processing of information. Students may note that they "lose" information if it's not stored on a safe spot. The same is true for a computer which cannot "remember" things, it needs to store them. As a result storage and processing go hand in hand.

The third prompt should be used to discuss real-world situations where a "largest" or "smallest" thing is found. This is a chance to make some connections. Possible examples include

- Finding the cheapest product online, Input: info on all products Output: cheapest
- Finding the most liked photo today, Input: info on all photos Output: most liked
- Finding the most watched video Input: info on all videos Output: most watched

See how many others students can think of and use this as a chance to reinforce an understanding of the inputs and outputs in everyday computing tasks. Students will see this in more detail in the following lesson.

Lesson 8: Apps and Problem Solving

Unplugged

Overview

This lesson covers the input and output aspects of computers in a context that is relevant and familiar to students: apps. In pairs, students evaluate various web applications to analyze the specific problems that they were designed to solve, the inputs that they need to work, and the outputs they provide to users. The class concludes with observations of these apps as well as a teacher led discussion about the impact of apps on society.

Purpose

In Chapter 1 of this unit, students learned the problem solving process. In chapter 2, students learned how computers solve problems. Students began with broadening their understanding of what a computer is, and in subsequent lessons, engaged in activities which allowed them to experience problem solving within the computer model. 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 choose between various 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.

Agenda

Warm Up (5 min)

- **Solving Problems with Computers**

Activity (40 min)

- **App Exploration**
- **Guided Practice**

Wrap Up (10 min)

- **Sharing Findings**

Extension Activities

- **App Store Exploration**

Objectives

Students will be able to:

- Identify the information that an app uses as input or produces as output
- Identify the information an app would need to be provided as input in order to produce a given output

Preparation

- [ ] Print a copy of **App Exploration - Activity Guide** for each student

Links

For the Students

- **App Exploration** - Activity Guide (**PDF** | **DOCX**)

Teaching Guide

Warm Up (5 min)

Goal: Help students apply their model of how a computer works to an app intended to solve a particular problem.

Solving Problems with Computers

Review: Quickly review the input, storage, processing, and output model of a computer

Display: Display the photo of the translation app in Stage 8 Level 2 (or direct students to log into the Code Studio level).

Code Studio levels

- Levels
- **2**

Student Instructions

View on Code Studio

Input / Output

Look at the picture below.

Discussion Questions

- What problem does this piece of software address?
- What information is input to the smartphone?
- What information is stored in the smartphone?
- What information is processed by the smartphone?
- What information is output by the smartphone?
- What other types of input are available to the smartphone?

Discuss: Students discuss the prompts: “How does this piece of software input, store, process, and output information?” If a human were to do the same task, how would it be the same or different from how the computer does it?

Prompt: What other types of input can a smartphone use?

Write the student responses on the board. It's not necessary that students produce every possible type of input, but make sure that they understand that input can come from the Internet (such as a list of restaurants in the area), from direct user input (such as pressing a button or filling in a form), and from phone sensors (such as the GPS or gyroscope).

Discussion Goal

Students should understand that there are different types of input to a computer, which may be appropriate for different types of programs. They also may see that some information (English-Spanish dictionary) can either be stored on the computer itself, or accessed over the Internet as input. Students should be able to identify the camera image (Spanish text) as input, the translation as processing, and the display screen image (English text) as output. They should also see that a person would use essentially the same methods and resources to complete the task.

Activity (40 min)

App Exploration

Remarks

> Today you'll be working in groups to figure out what sorts of inputs a computer (in this case, a smartphone) would need to solve various problems. You'll be acting as the software in processing the information you get from the inputs, and determining the output that you want to communicate to the user, just as the translation software processed the Spanish text and displayed the English text as output to the user.

Group: Put students in groups of 2-3

Distribute: App Exploration - Activity Guide

Transition: Send students to Code Studio Lesson 8, if they were not already there for the warm up.

Guided Practice

Review the instructions for Challenge 1 (in Level 3 of the Lesson).

Code Studio levels

- Levels
- **3**

Student Instructions

View on Code Studio

Challenge 1

This piece of software tells you whether or not it's Halloween.

Look at the possible information that you can input to your app, and decide which ones your app needs to work. Remember, you can use the phone to get information that is specific to the user, and use the Internet to get general information about the world.

Once you have the information that you need as input, decide what your app will output.

Teaching Tip

Students should note that the app only needs two pieces of information to work: the current date and the date of Halloween. The current date, in this activity, comes from the clock, but students may note that it's possible to get the date from the Internet as well. The date of Halloween, in this activity, comes from the Internet, but students may note that this information could also be stored in the phone, because it doesn't change between uses of the app.

For the improved version of the app, the inputs are the same (current date and the date of Halloween), but the students must process the information differently. Rather than simply check whether the two dates are the same, students will need to calculate the numbers of days between them.

Input from Phone Sensors

Sensor	Input Information
Date (Clock)	September 5
Location (GPS)	N 41° 15' 1" ; W 101° 18' 32"
Light Sensor	Very bright
Motion Sensor	Not moving

User Input

User Prompt	User Information
Birthday	January 7
Favorite Holiday	St. Patrick's Day
Favorite Flavor of Ice Cream	Neopolitan

Input from the Internet

Request	Information
The Date of Halloween	October 31
The Temperature Anywhere in the World	Shanghai: 77F
	Adelaide: 54F
	Paris: 75F
	Cairo: 79F
	Buenos Aires: 52F
	Boston: 66F
	Vancouver: 63F
	Guam: 84F
The Most Popular Song This Week	"Closer"

Remarks

> Let's do one together. Everyone go to the third bubble in the stage, called "Challenge 1", which goes along with the "Challenge 1" on your worksheet. Think about the problem that your app is intended to solve. What information does it need to solve that problem? Now, look at the various places your phone can get input and write down what information it needs to know to work. Once you have all the information you need, decide what output the software will produce.

Circulate: Support students as they work in pairs through the first challenge, including the extension question. If students finish a challenge early, encourage them to think of other improvements they could make to the app.

Discussion Goal

Students should note that the input for the original app and improved app were the same. All that changed between them was the processing done on that input.

Discuss: What did this app need to know, and what was the output to the user? What about the improved app? Were there any changes to the input you needed? What needed to change about the program?

Circulate: Allow students to work on Challenge 2, supporting them as they complete both the initial challenge and the improved app.

Code Studio levels

- Levels

- 4

Student Instructions View on Code Studio

Challenge 2

This app addresses the problem of someone's cell phone ringing in class. It should be able to figure out when the phone is at a school, and turn the ringer off during that time, but turn it back on when the user leaves school.

Look at the possible information that you can input to your app, and decide which ones your app needs to work. Remember, you can use the phone to get information that is specific to the user, and use the Internet to get general information about the world.

Once you have the information that you need as input, decide what your app will output.

Teaching Tip

For the initial app, the inputs are the location of the phone (from the GPS) and the locations of schools in the area (from the Internet). Note that students do not need a map because the process is only to check whether there is a match in location. At this point, the output is a command to turn the ringer off, because the phone is located at a school.

For the improved app, students should also take in the noise level from the microphone and the movement from the accelerometer. At this point, the output is to leave the ringer on, because the noise and movement levels indicate that the user is not in class.

Students may also suggest that the phone use time of day, calendar, and bell schedule to determine whether class is in session at the time. These are all good ideas for how to improve this app.

Input from Phone Sensors

Sensor	Input Information
Microphone:	There is a lot of talking in the environment
GPS Location	N 41° 15' 1" ; W 101° 18' 32"
Motion Sensor	The phone is moving quickly
Camera	The image from the camera is all black

User Input

User Prompt	User Information
Name	Arik
School Mascot	Tiger
Grade Level	8th grade
Favorite Class	Science

Input from the Internet

Request	Information
Locations of Schools in the Area	
	3rd Street Elementary School: N 41° 14' 56" ; W 101° 18' 2"

Request	Information
	Edison Middle School: N 41° 15' 1" ; W 101° 18' 32"
	City High School: N 41° 15' 54" ; W 101° 19' 3"
List of Major Holidays	
	New Year's Day
	Martin Luther King Day
	President's Day
	Memorial Day
	Independence Day
	Labor Day
	Veterans Day
	Thanksgiving
	Christmas
The Temperature Anywhere in the World	Shanghai: 77F
	Adelaide: 54F
	Paris: 75F
	Cairo: 79F
	Buenos Aires: 52F
	Boston: 66F
	Vancouver: 63F
	Guam: 84F
Phone Numbers of Schools in the Area	
	3rd Street Elementary School: 123-123-1234

Request	Information
	Edison Middle School: 123-123-4321
	City High School: 123-123-7890

Share: For the last challenge, what inputs did you identify? What sort of processing did you need to do on the information to determine the output? What extra inputs did you need for the improved version?

Prompt: For these two challenges, you've used inputs, outputs, and processing, but so far you haven't stored any of your information. Is there any information that you think your phone should store? What types of information are generally stored on a smartphone?

Share: Allow students to share out their responses, and write them on the board.

Direct students to Challenge 3.

Circulate: Support students as they complete the last two challenges.

Code Studio levels

- Levels
- **5**
- **6**

Student Instructions

View on Code Studio

Challenge 3

This app helps the user figure out what to wear in the morning.

Look at the possible information that you can input to your app, and decide which ones your app needs to work.

Once you have the information that you need as input, decide what your app will output.

Teaching Tip

In the initial app, the inputs are the weather report and the planned activities for the day.

For the improved app, there is no "correct" answer, and students may choose to make any reasonable improvement. For example, the app may remind the user to take a change of clothes for an activity later in the day. The app could also take into account holidays, or school dress code requirements.

Input from Phone Sensors

Sensor	Input Information
Microphone:	The environment is quiet
GPS Location	N 41° 15' 1" ; W 101° 18' 32"
Motion Sensor	The phone is not moving
Camera	The image from the camera is all black

User Input

User Prompt	User Information
Name	Arik
Grade Level	8th grade

User Prompt	User Information
Favorite Color	Orange
Outfits	Sunglasses, Orange T-Shirt, Red Shorts, Sandals
	White Polo Shirt, Khaki Slacks, Dress Shoes
	Knit Cap, Scarf, Red Sweater, Jeans, Boots
	Orange T-Shirt, Jeans, Sneakers
Planned Activities for the Day	
	Field trip to Power Station
	Drama Club
	Dinner with Grandparents

Input from the Internet

Request	Information
List of Major Holidays	
	New Year's Day
	Martin Luther King Day
	President's Day
	Memorial Day
	Independence Day
	Labor Day
	Veterans Day
	Thanksgiving
	Christmas
The Temperature Anywhere in the World	
	Guam: 84F

Request	Information
	Shanghai: 77F
	Adelaide: 54F
	Paris: 75F
	Cairo: 79F
	Buenos Aires: 52F
	Boston: 66F
	Vancouver: 63F
The Time Anywhere in the World	
	Guam: 7:17 AM
	Shanghai: 5:17 AM
	Adelaide: 6:47 AM
	Paris: 11:17 PM
	Cairo: 11:17 PM
	Buenos Aires: 6:17 PM
	Boston: 5:17 PM
	Vancouver: 2:17 PM
List of Top Tourist Attractions	
	Grand Bazaar, Istanbul
	The Zocalo, Mexico City
	Times Square, New York City
	Meiji Jingu Shrine, Tokyo
	Niagara Falls
	Forbidden City, Beijing

Request	Information
List of Local Restaurants	
	Skyline Diner
	The Sizzling Griddle
	Grandma's Kitchen
	Machos Tacos
	Pizzazilla
Local Weather Report	
	Sunny, 45° F

Student Instructions

View on Code Studio

Challenge 4

This piece of software helps the user decide what movie to go to.

Look at the possible information that you can input to your app, and decide which ones your app needs to work. Remember, you can use the phone to get information that is specific to the user, and use the Internet to get general information about the world.

Once you have the information that you need as input, decide what your app will output.

Input from Phone Sensors

Sensor	Input Information
Microphone:	There is a lot of talking in the environment
GPS Location	N 41° 15' 1" ; W 101° 18' 32"
Motion Sensor	The phone is moving quickly
Camera	The image from the camera is all black

User Input

Teaching Tip

Students have a variety of "correct" inputs for this app. They may consider the user's favorite books, television shows, and movies; the reviews for a movie; the age of the user; and the user's location.

Here are some factors students may want to consider in choosing a movie for the user.

- **Since Then** is showing close to the user and has good reviews, but the user doesn't appear to enjoy comedies very much.
- **Mills** is showing close to the user and has good reviews. It is also based on one of the user's favorite books. However, it is rated R, so the user may not be old enough to see it.
- **The Wait** is showing close to the user and is in a genre that the user enjoys (Mystery), but is has bad reviews.
- **Cargo** is in a genre that the user enjoys, but only has okay reviews.
- **The Watch 2** is the sequel to one of the user's favorite movies, but it is not showing close to the user.

User Prompt	User Information
Name	Taylor
School Mascot	Tiger
Grade Level	8th grade
Favorite TV Shows	
	The Secret Town (Mystery)
	100 Years (Drama)
Favorite Books	
	Whistler (Mystery)
	Mills (Drama)
Favorite Movies	
	The Watch (Action)
	Further (Mystery)
	The Last Night (Drama)

Input from the Internet

Information Type	Information
List of Major Holidays	
	New Year's Day
	Martin Luther King Day
	President's Day
	Memorial Day
	Independence Day
	Labor Day
	Veterans Day

Information Type	Information
	Thanksgiving
	Christmas
The Temperature Anywhere in the World	
	Guam: 84F
	Shanghai: 77F
	Adelaide: 54F
	Paris: 75F
	Cairo: 79F
	Buenos Aires: 52F
	Boston: 66F
	Vancouver: 63F
Movie Reviews	
	Since Then: 4/5 "Hilarious!"
	Mills: 5/5 "Even better than the book!"
	The Wait: 2/5 "Boring and predicatable."
	Cargo: 3/5 "Exciting, but not much more."
	The Watch 2: 3/5 "If you loved the first one, you'll want to see this."
Movie Locations	
	Central Cinemas: **Since Then** (PG - Comedy), **Mills** (R - Drama), **The Wait** (PG - Mystery), **Cargo** (Action)
	Midtown 5: **The Watch 2** (PG - Action), **Since Then** (PG - Comedy), **Mills** (R - Drama)

Information Type	Information
	Highlights 8: **The Wait** (PG - Mystery), **Cargo** (Action), **Since Then** (PG - Comedy), **Mills** (R - Drama)
Time Anywhere in the World	
	Guam: 7:17 AM
	Shanghai: 5:17 AM
	Adelaide: 6:47 AM
	Paris: 11:17 PM
	Cairo: 11:17 PM
	Buenos Aires: 6:17 PM
	Boston: 5:17 PM
	Vancouver: 2:17 PM
Cinema Locations	
	Central Cinemas: N 41° 15' 15" ; W 101° 18' 20"
	Midtown 15: N 41° 10' 17" ; W 101° 12' 2"
	Highlights 8: N 41° 20' 41" ; W 101° 20' 50"
Restaurants	
	Skyline Diner
	The Sizzling Griddle
	Grandma's Kitchen
	Machos Tacos
	Pizzazilla

Wrap Up (10 min)

Sharing Findings

Discuss: Students share their answers to the questions, and compare the differences between them.

Remarks

> Most of the apps that we rely on in everyday life, ones that give us directions or recommend restaurants in the area, fairly open ended. That means that there are many different outputs that could be considered correct, and many different ways that the apps could use the inputs they have available to them.

Discussion Goal

As students compare answers, they should note that there are many different ways to solve these problems, and that while the success criteria for the first two challenges were very clear, the last two challenges were more open ended. Students should realize that their may be more than one appropriate output for the apps.

Prompt: Now, take a few minutes to think of an app that you think is useful, then imagine a way that it could be improved. Share your thoughts with your elbow partner, and work together to think of what extra input you might need to make those improvements work.

Remarks

> You'll have a chance to try out some of your ideas as we look to our unit project in which you will create a prototype of an app.

Extension Activities

App Store Exploration

Have students visit an app store like Google Play or Apple's App Store. Instruct them to find a non-gaming app and conduct the same analysis as in the activity guide (problem it solves, information it needs, output it provides to the user).

Lesson 9: Project - Propose an App

Unplugged | Project

Overview

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.

Agenda

Warm Up (10 min)
- **Introduce the Project**

Activity (150 min)
- **Project Guide**

Wrap Up
- **Presenting Apps**

Extended Learning
- **Shark Tank**

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

For the Students

- **Apps and Problem Solving** - Project Guide (**PDF** | **DOCX**)
- **Apps and Problem Solving** - Peer Review (**PDF** | **DOCX**)
- **Apps and Problem Solving** - Rubric (**PDF** | **DOCX**)

Teaching Guide

Warm Up (10 min)

Introduce the Project

Say: This whole unit we've been learning about the problem solving process and how computers process information to help solve problems. In the previous lesson you learned how apps 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.

Distribute: **Apps and Problem Solving - Project Guide**, once copy for each student, as well as **Apps and Problem Solving - Rubric**. 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.

Activity (150 min)

Project Guide

Step 1: Choose a Partner: Place students in pairs or groups of 3

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.

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

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.

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 what 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 birthday 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.

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.

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.

Discussion Goal

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.

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.

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.

Wrap Up

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 presentation collect the completed project guides, peer feedback forms, and posters from each group.

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