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Computer Science Unit

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A Mystery in the Classroom

Introduction

How many of you have lost a shoe or something in your house and spent a lot of time trying to retrace your steps to find it? It is a mystery that you have to solve in order to find what you lost. To do this you might think back to the last time you saw the item, dig in closets or just hope it turns up eventually. In our daily lives we solve small and large mysteries. They could range from small things like forgetting where you put your shoes or figuring out who took the last cookie to bigger things like crimes that the police solve. To solve mysteries people use logic, which is a way of thinking about think that is supported by evidence. Today we are going to read a story about a missing teacher and use logic to figure out where she has gone.

Computer Science Connection

Computer Scientists use logic everyday to solve problems with computers. Sometimes when they are trying to create a new computer game or program they run into problems. The game might not be working the way they want. They have to use logic to go back to the program and figure out what they should change. They have to figure out what is not working and then change the code so it can work.

Massachusetts Digital Literacy and Computer Science Standards

3-5.CT.a.1 Use numbers or letters to represent information in another form (e.g., secret codes, Roman numerals, abbreviations).

Learning Objectives

Students will be able to:

- Decode and solve puzzles using logic
- Discuss how logic was used to create the secret codes and then solve them

Materials

- The Mystery of Missing Mrs. Becker Readers' Theatre Script (both the student and teacher versions)
- Whiteboard

Procedure

1) Explain to the students that today we will be reading a mystery script called The Mystery of Missing Mrs. Becker . It will be up to us to figure out where the missing teacher has gone. Each student will get a role and after each scene we will have to stop and solve a clue to get the next scene. Each clue will help us get closer to figuring out where and why the teacher is missing.

2) Assign each student in the class a role from the readers; theatre script. Have each student write down their role so they do not forget. If there are too many roles the teacher can ask for volunteers to play two roles. If there are not enough roles Mr. Swift's role can be broken up into different parts.

3) Hand out scene one of the student script to all students. Make sure they do not flip the page and start solving the clue. Have the students read.

4) When they reach the end of the scene the teacher should say the grayed out section that is in the teacher script. The teacher should read the first code breaker code. When the students have figured out the answer the teacher should put the code breaker up on the board. This will give students a hint as to how they will solve the clue.

5) Give the students a few minutes to attempt to solve the clue. If they have trouble they can turn to a friend next to them and get help.

6) When most students are finished the teacher should ask the students what their clue said. The teacher should write the first clue up on either the board or a piece of poster paper.

7) Hand out the second scene to each student and repeat steps 4-6

8) Continue steps 3-7 until all six scenes are read. There should be five clues written on the board.

9) At the end of the sixth scene the teacher should have a discussion with students using the questions at the end of this lesson.

Worksheets/ Tables

- Readers' theatre script for both the students and teacher

Discussion questions

1) How did you solve each clue?
2) How did you use logic to solve the clues? (What helped you figure out what the answer was?)
3) What clue was the trickiest to solve?
4) How do you think computer scientists would use logic in their jobs?

Citation

Hanson, D. (2014). *The Mystery of Missing Mrs. Becker*. Teachers pay Teachers.
https://www.teacherspayteachers.com/Store/Deb-Hanson

Idea adapted from:

https://csta.acm.org/Curriculum/sub/CurrFiles/CSTA_K-12_CSS.pdf

Can we think the way computers do?

Introduction

Has anyone ever played the game 20 Questions? It's a game you play either with other people or against a computer. One player comes up with an object or an animal and the other person has only 20 questions to guess the object. Today as a class we are going to play a game similar to 20 questions to find the students in our class that fits the description of our clues. In order to find the student we will have to use logic. In the last computer science lesson we talked about the importance of logic in computer science to figure out a problem. Computer scientists have to use logic to figure out different problems with their programs. To operate programs computers use a type of logic and math called Boolean Logic. This is the type of logic we will be using today in our activity.

Booleans are a type of data that can only have two answers, either true or false, to each question. All of the questions we ask will only be answered with either true or false. While running a program or a code the computer will ask itself different true or false questions. If the answer is true it will do one action. If the answer is false the computer reacts in a different way. For example if you are playing a videogame and you have to choose which path to take your character down to take the computer will wait to see which one the player selects. The computer sees the path on the right as "true" and the one on the left as "false". That does not mean one path is better than the other, but that there are two different stories depending on which path you choose. If you decide to take your character down the one on the right the computer continues with the storyline related to the "true" answer. If you pick the path on the left the computer continues with the "false" story line. The computer uses booleans to understand which choices the player or user makes while they use the computer (code.org).

Computer Science Connection

Computer scientists use boolean logic and algebra when they are creating the computer programs. They have to understand that one of the ways computers think is in booleans. There is very specific language that the computer scientist has to use in order for the computer to understand the booleans it uses. The computer scientists use IF….THEN statements, just like you would in a science hypothesis. For an example we could continue using the path game from the introduction. In the game when you come across a path there are two options if you select the

path on the right or the "true" path you meet a wolf in the forest. In order to make the computer do this the computer scientist will tell the computer to do this using the IF….THEN statement. It might look like this: IF the player chooses the "true" path THEN the character will meet a wolf in the forest. The computer now knows that the "true" path leads them to the wolf story line. There could also be more than one response that a computer scientist would want to happen. In that case they would use the words "AND" and "OR" in the IF...THEN statement when they write the program. For example if the computer scientist wanted both the "true" and "false" paths to bring the character to the wolf they would say: IF the player chooses the "true" path OR the "false" path THEN the character will meet the wolf. No matter which path you select the character will eventually meet the wolf in the game. A statement with AND in it might look like this: IF the character chooses the "true" path THEN the character meets the wolf AND fights him off. This tells the computer that there are two actions to this response. Computer scientists have to understand how boolean logic works because there is a very specific vocabulary that the computer needs in order to figure out the task. If you find the IF...THEN statements confusing do not worry we will practice them a lot in this activity (code.org).

Massachusetts Digital Literacy and Computer Science Standards
3-5.CT.a.2 Organize information in different ways to make it more useful/relevant (e.g., sorting, tables).
3-5.CT.b.3 Use logical reasoning to predict outcomes of an algorithm.

Learning Objectives
Students will be able to:
- Evaluate simple boolean expressions
- Explain how booleans work by talking about the process of the activity
- Use their understanding of booleans to write their own IF...THEN statement

Materials
- The teacher needs a list of 20 questions about physical traits and favorite things (included below)
- 3x5 index cards, enough so every student has 20
- Pencils for every student

Procedure
1. Every student should be handed 20 index cards. The students will label each of these notecards 1-20.

2. The teacher will read off each of the 20 questions prepared one by one. When a teacher reads a question the student will write their answer on the note card with the matching number.

3. When the teacher is finished reading off all the questions and the students have recorded all of their answers the teacher and a few volunteers should collect all of the notecards. The teacher should ask one student to collect all of the one and two cards and the next student to collect three and four cards and so on so that way not all of the cards will be mixed together. The people collecting the note cards should be careful to keep all the same numbers together.

4. After the cards are collected the teacher will explain that the teacher is going to read off statements based on the questions they just answered. The questions will narrow down the class until they find the one student who matches all of the answers. The teacher will begin by telling the students "IF you answer false to the question THEN sit down and stay sitting." The teacher should point out how this is an IF...THEN statement. For example if the first question was What color is your hair? and the teacher picked a notecard that said brown the teacher would say out loud to the group "My hair is brown." All of the students who do not have brown hair should sit down.

5. Every student should now stand up and the teacher will begin to read off a statement. Every student that answers false to the question should sit down. If all the students sit down on one question the teacher should ask the students who were just standing to get up and then say a different statement. The teacher can start with question 1 or skip around to different questions. The teacher just needs to make sure that the note card with the student's' answer matches the question number.

6. The teacher should continue asking questions until there is only one student standing. It is okay if not all 20 questions are asked. After they have found the one student that matches all of the questions the teacher should review all of the "true" responses that led to this particular student. The teacher should explain that this is how a computer operates. Each student has a different story and if the user (in this case the teacher) does not pick their story they sit down and are no longer active in the game. In the end there is only one student and story that matches up perfectly with all of the answers.

7. The teacher should then repeat the process again asking different questions with different notecards until another student is left.

8. After this the teacher could pick a student to be the one asking the questions. The teacher should guide the student through the process and make sure they are creating statements from the questions.

9. When a couple of students have gotten a chance to ask the questions the teacher can change the statements a bit so they include more than one answer possibility. For example for the haircolor question the teacher could pick two cards that have different colors and say I have brown OR blonde hair. That means students with blonde or brown

hair can remain standing. It might be a good idea to only use the OR for a couple of questions because it will take longer to cut down the students. The teacher could try this a couple of times.

10. The statements could also be done with AND. If the question asked what pet do they have the teacher could pick two cards and say I have a cat AND a dog. That means in order to remain standing the students would have to have both pets. The teacher could mix the AND statements in with other OR statements so students have to listen closely to figure out if they should sit or stand.

11. The teacher should continue the activity (they can keep switching off with the students) until they feel the students have a good idea of how the boolean process works.

12. After the activity has been tried with IF, OR and AND the teacher should start a discussion about computers and boolean data.

Worksheets/ Tables

There are no worksheets required for the students but it might be good to keep track of the statements said on the whiteboard so at the end they can bring everything together.

The 20 Questions teachers can use:

1) What is your hair color?
2) Do you wear glasses?
3) What is your favorite number?
4) What is your favorite color?
5) What month were you born?
6) How many siblings do you have?
7) What is the last digit of your phone number?
8) What flavor of ice cream do you like the best?
9) What is your favorite season?
10) Name one pet you have at home
11) What is your favorite animal?
12) Would you prefer the beach, mountains or lake?
13) What is your favorite holiday?
14) What is your eye color?
15) Do you prefer the cold or hot?
16) What is your favorite food?
17) What is your favorite song?
18) Would you rather dance or sing?
19) What is your favorite sport?
20) If you could meet anyone in the world who would it be?

Claim/ Evidence Statement

Questions for Discussion:
- Was this activity confusing or difficult for anyone?
- How did we use boolean logic and data in this activity? Be specific
- How was this activity similar to what a computer might do?
- How can we take one of the question and answer pairs and turn it into an IF...THEN statement?
- What did you learn about computer science from this activity?

After the students have answered the questions they should create some of their own IF...THEN statements. There should still be answers up on the board from the last round of the activity, if there is not the teacher should write up a couple of example to use. The students should try and create 5 of their own statements and try to create ones with OR and AND in them. You may have to model some for them based on their age. For example:

1) How many siblings do you have?- Answer: One
2) What is the last digit of your phone number?- Answer: 5 OR 7
3) What flavor of ice cream do you like the best?- Answer: Chocolate OR cookie dough
4) What is your favorite season?- Answer: Fall
5) Name one pet you have at home- Answer: Cat AND dog

1) IF you have one sibling THEN remain standing
2) IF the last digit of your phone number is a 5 OR 7 THEN remain standing
3) IF your favorite flavor of ice cream is chocolate OR cookie dough THEN remain standing
4) IF your favorite season is fall THEN remain standing
5) If you have a cat AND dog at home THEN remain standing

At the end of the lesson students should be able to explain that computers use boolean data to operate in certain games and programs. It is important for computer scientists to learn the language behind boolean data so the computer is able to do what the player has requested

Citation
Booleans and Logic. (n.d.). Retrieved November 26, 2016, from
        https://code.org/curriculum/algebra/13/Teacher

Being Safe on the Internet

Introduction

The internet is a huge place full of information on pretty much every topic out there, fun games to play, and videos on YouTube to watch. Most of us have played fun games that can entertain us for hours or even help us study for a math test. There are also many different videos of cute animals or people teaching you how to build different things and put on makeup. The internet is also an easy way to chat with friends, but we must be careful not to talk with anyone we do not know. You also have to think about what you are sharing. If you are sharing a picture or video of your friend you should make sure they know and are okay with you posting it. Anyone can see the comments and words that you post online so be careful that you are being nice and respectful when you comment on a post or video. Being mean to a friend online is still considered bullying. The internet is a great tool for research, but how do we know the information we are looking at is reliable? Anyone can post information on the internet and we have to be careful that the websites we are looking on are ones that give correct information and are safe. Some websites that we go on can contain pictures or ads that if we click on it can give our computer a virus. A virus is something that gets downloaded onto our computer and can make it sick and not work correctly. We have to make sure to keep our computer safe by only using the websites we trust. It is also really important that while we are on the internet we never share our personal information because we do not know who is on the other side of the screen. Today we will be looking at a couple videos on web safety and play a game to help us determine how to be safe while we are using the internet.

Computer Science Connection

Computer Scientists have to use the internet for most of their job. They are also the ones who try to fix our computer when it gets sick with a virus. Computer scientists know how difficult it can be to get a virus off the computer once it has been downloaded. When they search online they know to be careful and only go to websites they trust and have been recommended by a trusted friend or adult. Not only computer scientists have to be careful on the internet. Everyone who uses the internet has to be cautious and careful or what they are clicking on and what they share with the world. The internet is a great place full of knowledge and entertainment, but it can also be dangerous if you do not know how to use it and are not careful.

Massachusetts Digital Literacy and Computer Science Standards

3-5.CAS.a.3 Identify appropriate and inappropriate uses of technology when posting to social media, sending e-mail or texts, and browsing the Internet.

3-5.CAS.a.4 Explain the proper use and operation of security technologies (e.g., passwords, virus protection software, spam filters, popup blockers, cookies).

3-5.CAS.a.5 Describe ways to employ safe practices and avoid the potential risks/dangers associated with various forms of online communications, downloads, linking, Internet purchases, advertisements, and inappropriate content within constrained environments.

Learning Objectives

Students will be able to…
- Describe how to be safe on the internet
- Create a list of safe websites with the class
- Play a game to decide what is okay to post online

Materials

- A computer for each student
- A whiteboard to create a list with the class
- The link to the Brain Pop video: https://jr.brainpop.com/artsandtechnology/technology/internetsafety/
- The link to the Brain Pop game: https://jr.brainpop.com/games/sharejumper/

Procedure

1) Go over the introduction and the computer science connection with the students.
2) Create a list on the board of five to ten websites that they know are safe and either use at school or their parents let them use at home. Ask students how they know the websites are safe.
3) Show the class the Brain Pop video
4) When the video is over have a brief discussion about the video with the class. Ask the following questions:
   a) What should you do if a stranger sends you a message?
   b) How can you be safe on the internet?
   c) What should you never send on the internet?
      i) Answer: name, address, phone number, birth day, school or pictures
   d) How can you keep your computer safe?
   e) What is a virus?
   f) What is cyberbullying and how can you avoid it?

g) How can you create a strong password? (give them an example using both letters and numbers)

5) After the discussion explain that next they are going to play a game that will have them choose what is okay for them to post online and what they should be careful to send. The game will show a quick video before they start, but after that they should go slow and choose carefully between the two options.

6) The students should play until there are ten minutes left. Then have the students log off and shut the computer down

7) End the lesson with a brief discussion about what they learned

Claim/ Evidence Statement

Discussion Questions
1) What did you learn about being safe on the internet?
2) What will you change to be more safe on the internet?
3) How can you stay safe from strangers when you go online?
4) How can you keep your computer safe?
5) What is cyberbullying? How can you avoid it?

Students should be able to say at the end of the lesson that they should not:
- share passwords, personal information or pictures of themselves.
- talk with people they do not know
-post mean or rude comments or pictures about people
-go on websites that have not been given to them by a trusted adult or peer
-click on ads or download pictures before asking an adult first

Citation
Brain Pop Jr. (n.d.). Internet Safety. Retrieved January 02, 2017, from
https://jr.brainpop.com/artsandtechnology/technology/internetsafety/

Brain Pop Jr. (n.d.). Share Jumper. Retrieved January 02, 2017, from
https://jr.brainpop.com/games/sharejumper/

Exploring the Animals of the Rainforest

Introduction

The Amazon Rainforest is located in South America and is filled with many different types of animals. There are monkeys, frogs, jaguars and hundreds of different types of insects. These animals all live together and interact in the same habitat. Many big businesses are coming in and cutting down tress in the rainforest to make their products. This is causing many of the animals to lose their homes and have to find somewhere else to live or die. The Amazon Rainforest Conservation Foundation is asking you to help them create a list of some of the animals who live in the rainforest. Each of you will pick one animal and will find out different facts about the animal. At the end we will put them into a list and see several different animals that call the Rainforest home.

In computer science lists like these are called databases. A database is a place where people can store their data and use it to look at different facts and patterns in it. Databases are used a lot in everyday life to keep information organized. For example the local library uses a database to keep track of all of the books they have in it. They also list the type of book, who the book is by and when it was published. This keeps the library organized and it helps people easily look up a book or author they are trying to find. Telephone books or the contact list in your phone also is a database. These lists keep track or the person, their different phone numbers, their e-mail address and sometimes lists where they are from. This was all this information is in one location when you look someone up. Databases keep information organized and easy to find.

Computer Science Connection

Computer Scientists use databases to organize their data and to keep it all in one place. The databases also allow them to analyze and sort their data. Having all of the information in front of them allows them to compare different numbers and see any patterns or trends. They can also sort the data by different categories and use it to create graphs. Databases make life easier by keeping data organized and all in one place.

Massachusetts Digital Literacy and Computer Science Standards

3-5.DTC.c.2 Perform searches to locate information using two or more key words and techniques to refine and limit such searches.

3-5.CT.c.1 Describe examples of databases from everyday life (e.g., library catalogs, school records, telephone directories, contact lists).

3-5.CT.c.2 Collect and manipulate data to answer a question using a variety of computing methods (e.g., sorting, totaling, averaging) and tools (such as a spreadsheet) to collect, organize, graph, and analyze data.

Learning Objectives

Students will be able to:

- Search the internet for information on their animal
- Collect data and then put it into a spreadsheet
- Sort the data in different categories to help compare
- Analyze data to see similarities and differences between data points

Materials

- Computer with internet access
- Excel Spreadsheet
- Worksheet to write down data
- Pencils

Procedure

1) The teacher will read the introduction to the students and make sure the students understand what a database is used for.
2) Ask students to choose an animal that lives in the Amazon Rainforest. Each student should pick their own animal. Once a student has picked an animal the teacher should write it on the board so no one else can select that animal. The students can use the internet to look up different animals if needed.
3) Once each student has picked an animal the teacher will hand out the worksheet with the database questions on it. The students will be instructed to go onto a website that has a .org, .edu or a .net at the end to find more information on their animal. The teacher should explain that websites with .org, .edu and .net are run by organization that tend to be more reliable than .com websites. The students should be careful about making sure their information is from a reliable source.
4) The students should take time to find the answers to all of their questions. While the students are working the teacher should open an excel sheet at the front of the classroom with all of the categories listed at the top.
5) One by one the students should come up and enter their data into the spreadsheet.

6) When all of the students have entered their data the teacher will begin to point out different patterns or trends they noticed in the data.

7) The first piece of data the teacher should sort for the students is the color of the animals. The teacher should select all of the data and then click on the data tab on the top of the excel sheet. Under the data tab the teacher will select the sort feature with the letters on it and choose to sort with the a's at the top or the bottom. This will alphabetize the list so students can see what colors are more common and what other ones are not.

8) The teacher can then go on to sort the height and weight of the animal to see which animals are the biggest and which ones are the smallest. This process works the same way using the sort tool.

9) This can be done for as many columns as the teacher wants. The teacher should also explain that this program can also create graphs for the students based on the numbers. To do this the teacher should highlight the name of the animal column and then a column with a numerical value such as the height or weight. Then they should go to the charts tab and select bar graph. This will create a graph where students can see in front of them what animals are the tallest or weigh the most. As the teacher goes through this they should explain each of the steps they went through to help show the students.

10) At the end of the lesson the teacher should use the questions at the end to guide students through a quick analysis and discussion of the data.

Worksheets/ Tables

Each student will get a worksheet of the questions below:

Amazon Rainforest Database Activity Questions

What is the name of your animal?

_____

What type of animal? (mammal, reptile, amphibian, bird or insect)

_____

What is the color of the animal?

_____

What is the texture of the animal's skin?

_____

What do they eat?

_____

Where do they sleep?

_____

What is their average weight?

_____

What is their average height?

_____

Do they have a tail?

_____

How does it move?

_____

Fun fact about your animal

_____

The teacher should also have an excel sheet open at the front of the classroom with each of these questions as a title of a column across the top.

Discussion Questions

At the end of the lesson the teacher will ask the students the following questions to gauge their learning

1) Looking at the graph we made which animal was the tallest? Which one was the shortest?
2) What animal weighed the most? Which weighed the least?
3) How do you think this database could help people who are trying to save the Rainforest?
4) How could a computer scientist use a database to help them?
5) How could you use a database to make your life easier?

Citation

Idea inspired by:

Brady, M. (2002, May 13). Lesson Plans: Creating a Database (Elementary, Computer). Retrieved December 27, 2016, from http://teachers.net/lessonplans/posts/2582.html

Can you crack the code?

Introduction

You are a secret agent working for the Barack Obama, the President of the United States. It is your job to read the President's mail to check that everything is safe for the President to read. One day you open a letter to find not words, but only boxes. Some of the boxes are white and others are colored in black. When you look at it you wonder if it is supposed to be a message for the President. The question is what does this message say and is the president in trouble? When you take out the letter you see that whoever sent the message included an encoder that has all the letters in the alphabet next to boxes. Each letter has eight boxes that represent it and every letter has different boxes colored in. It is up to you to take the decoder and try to figure out what this message says.

In Computer Science this secret code has a name and it is called binary. Computers use the binary system to communicate and store data on their hard drive. In a previous lesson we talked about booleans and how there are only two answers to booleans. The binary system is very similar to that. A computer cannot read words like we can so it needs another way to figure out what you are trying to tell it to do. In the binary system there are boxes, called bits in computer science and there are only two options for the boxes. The boxes could either be colored in black or left blank. Depending on if the box is colored in or left blank tells the computer what it should be doing with this information. Different boxes would be colored in if you asked the computer to delete a document versus saving it to your computer. Today we will practice being a computer to see if we can use the binary code to see what message is trying to say.

Computer Science Connection

Computer scientists have to understand how the binary system works in order to write code, which is the translation from the language we speak to what the computer can understand. We talked about how the computer uses booleans and can understand true or false questions. The binary system works in the same way, but the boxes, or bits, are either turned off or on. The computer scientist has to decide what they want the computer to do during their game and program. They then have to translate that into binary and turn on or off certain boxes. That will tell the computer what it should be doing. Today we will practice being the computer to figure

out what the secret message is trying to tell the president. Once you solve the secret message you will then take a turn being a computer scientist and will write your name out in binary.

Massachusetts Digital Literacy and Computer Science Standards
3-5.CT.a.1 Use numbers or letters to represent information in another form (e.g., secret codes, Roman numerals, abbreviations).

## Learning Objectives
Students will be able to:
- encode binary pictures using a table
- write their name in binary
- Explain how binary is used in computer science

Materials
- Secret message in binary
- The binary encoder card
- The binary cut out strips
- Scissors
- Pencil

Procedure
1) The teacher will begin the lesson by reading through the introduction to students and make sure they review the boolean data from the previous lesson. The teacher should also review the new vocabulary words, binary, code and bit.
2) Before the teacher hands out the secret message they should give every student an encoder card and practice saying a couple of letters out loud to the students. For example the teacher could pick the letter M. The letter looks like this in the binary code:
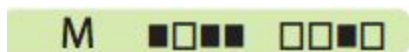
 . The teacher should not show this to the students, but have it in front of them. The teacher will draw 8 blank boxes on the board and ask one student to come up to the board and fill them in as the teacher speaks. Out loud to the class to represent the letter M the teacher should say "color, don't color, color, color, don't color, don't color, color, don't color." As the teacher goes through the student should color in the correct squares on the board. The students will then all use their encoder cards to figure out which letter it is. The students could work in pairs or on their own. Once they figure out the letter the teacher could decide to do a couple more examples all together.

3) Once the students have a good idea of how to encode the letter the teacher should hand each student the secret message they will be trying to solve. The teacher should remind the students that each individual letter is 8 boxes, so every line is a different letter. The students can work in pairs trying to figure out the message. The teacher should walk around as the students are working on this helping whenever they get stuck.

4) Once the students are finished the teacher can go over and check to see if the message is correct. If it is wrong the teacher should guide them back to where they made a mistake. If it is correct the teacher can hand them the initial cut- out strips and have them try to write out their name using the encoder card.

5) Once all of the students are finished encoding the secret message the teacher should stop the students and tell them they will have more time to finish writing their names after they talk about the message. The teacher should begin to discuss the activity using the questions at the bottom of this page.

6) After the discussion the teacher can allow time for students to finish writing their names in binary. When students are finished if there is time they can show off their names to the class.

Worksheets/ Tables

Encoder Card:

Depiction of ASCII Encoder Card

Secret Code:

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Answer to secret code: Barack, Pick up eggs on your way home ~ Michelle

Discussion Questions/ Evidence Statements

To begin the discussion of this lesson the teacher could write a few student's names up on the board in binary and the other students would have to use their encoder to see which student it is in the class. This will give the teacher a good idea if students are understanding the basics of binary. The teacher should then ask students the following questions.

1) What was the most difficult part of this lesson?
2) What is binary language?
3) How do computers use binary to communicate?
4) Why does binary make computer scientists communication with computers easier?

Citation

Thinkersmith. (2013). Binary Baubles. https://code.org/files/CSEDbinary.pdf

Let's Build a Paper Airplane

Introduction
Every morning you wake up and follow different steps to
get ready for school. Your steps, or routine, might be to
wake up, eat breakfast, brush your teeth, comb your hair
and then watch TV before you get on the bus. Your parents
also follow their own routine for getting ready for work or
to take care of the house. They might wake up, take a
shower, make sure you are awake, eat breakfast, make your
lunch, brush their teeth, comb their hair, and then drive you
to school or to the bus stop. We all have our own routines
when we wake up, but we all might do them in our own way or order. But your routine is special
to you because it is what you do every morning to get yourself ready to leave the house.
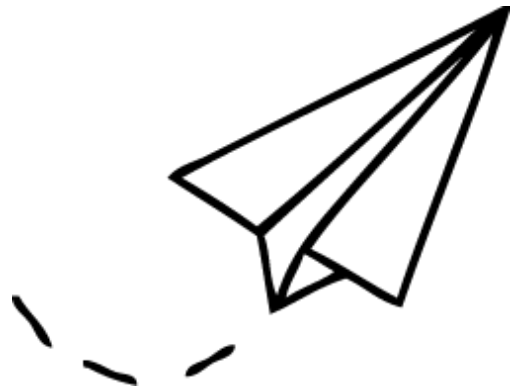
Computers also follow their own routines called algorithms. An algorithm is a list of steps you
can follow to finish a task. The computer follows this list of steps to complete what you are
asking it to do. In the past couple of lessons we have talked about how computers read, think
back to the binary, and now we are going to talk about what the computer reads. When you play
a game on your computer and start clicking on different tasks and characters it creates a list of
steps, or an algorithm, that the computer follows. Just like your morning routine helps you stay
on task of what you should do before school the algorithm helps the computer know how it is
supposed to respond when you click on something and what to do next. Just like our morning
routines are different there might be more than one algorithm that the computer could follow to
get to the end of a game or task. Different algorithms might take you on different adventures in
the game and allow you to play over and over again with different stories. The computer follows
the algorithm to get you to the end of your game or task.

Computer Science Connection
Computer scientists work hard to create the algorithms that the computers follow. They have to
put a list of steps together that the computer will be able to follow. This can be a difficult process
if you are asking the computer to run a complex game like Mario Kart. The computer scientist
would have to break down each little step and put it into either binary or another computer
language. Depending on the game they are creating computer scientists might also have to create
many different algorithms for multiple story lines. This whole process can take a long time and
can be the reason why a company does not come out with a new game for years. It is important
that computer scientists understand each step that is needed in a game so they do not confuse the
computer while you play the game.

Massachusetts Digital Literacy and Computer Science Standards
3-5.CT.b.1 Define an algorithm as a sequence of instructions that can be processed by a computer.
3-5.CT.b.2 Recognize that different solutions exist for the same problem (or sub-problem).

Learning Objectives
Students will be able to:
- Explain that an algorithm is a list of steps that a computer follows to finish a task.
- Build their own paper airplane based on a sequence of steps

Materials
- Blank computer paper
- Real- Life Algorithm worksheet
- Scissors
- Glue
- Rulers
- Painter's tape

Procedure
1) Before the lesson begins the teacher should go through the introduction and make sure students understand what an algorithm is.
2) The teacher should also mark out a safe space in the classroom using painter's tape where student can test their paper airplanes to see how far they go. This space should be away from other students if possible.
3) The teacher should pass out a Real- Life Algorithm worksheet to every student
4) The students will cut out the steps for making a paper airplane from the worksheet
5) Students should then look at all the different pieces that have just been cut out and decide which six steps are the correct ones to build a paper airplane. There will be three left over once they have decided.
6) The students will then take the six steps they chose and decide which order they go in to build the best paper airplane possible
7) Once they have decided the steps glue them in order to a separate piece of paper
8) Students will then find someone else in the classroom who has finished gluing and then trade their steps with them.
9) Using the steps that you got from the other student they will use a blank piece of paper and try to build the paper airplane.

10) Once finished building there will be a place to launch the airplanes to see how far they fly. They will use the rulers to measure how far the airplane went.
11) When all students have gotten the chance to fly their paper airplanes the teacher will begin a group discussion about the topic.

Worksheets/ Tables

Name: _____   Date: _____

U
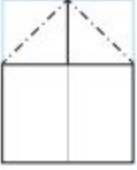Unplugged
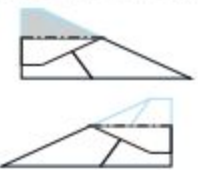
Real-Life Algorithms
Paper Airplane Worksheet

C O
D E

You can use algorithms to help describe things that people do every day. In this activity, we will create an algorithm to help each other make paper airplanes.
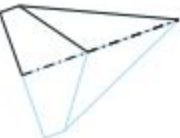
Cut out the steps of making an airplane below. Glue the six the correct steps, in order, onto a separate piece of paper. Trade your finished algorithm with another person or group and let them use it to make an actual flying model paper plane!

CUT CENTER OUT OF PAPER	CREASE PAPER DOWN THE CENTER	CRUMBLE PAPER
FOLD TOP CORNERS TO CENTER	RIP CORNER OFF PAPER	FOLD CORNER SIDES TO CENTER
TOSS FINISHED PLANE	FOLD PAPER IN HALF AGAIN	PULL SIDES DOWN

Discussion Questions/ Evidence Statement

After the students finish building the paper airplanes and flying them the teacher will lead a discussion.

1) What was the most difficult part of this activity?
2) What steps did you follow to build your paper airplane? Did those steps work? Would you change anything about them?
3) At any point did you understand the step but accidentally fold it incorrectly or do the wrong thing? Was it easy to fix it?
4) How can we relate what you did to computers?
5) How do algorithms have to do with computers?

At the end of this lesson students will see that computers follow algorithms to know what to do. Through this activity they will see that sometimes a step could be difficult to carry out, like folding the paper in the activity, and the computer might mess up a step and cause the game or activity to quit or skip. Sometimes computers do not work perfectly like we want them to, but they still try to follow the algorithm that is programmed.

Citation

Real Life Algorithms: Paper Airplanes. (n.d.). Retrieved from
https://code.org/curriculum/course2/2/Teacher#Activity1

Writing Algorithms

Introduction

In the last lesson we talked about Algorithms, which are lists of steps that you can follow to finish a task. We also talked about how video games use algorithms to make the characters move and go through the story of the game. Has anyone heard of the game Angry Birds or maybe have played it on a phone or tablet? The point of the game is to have the birds get rid of all the mean pigs by crashing into them. Today we will go to a website called Code.org and play a version of angry birds. In this version you have to get the red bird through a maze to the pig. In order to do this you will write an algorithm of steps for the bird to follow. If you put in the wrong steps the bird will not make it to the pig and you will have to figure out what went wrong. If you get stuck do not give up, but ask for a hint from the game and try again. There are many different levels and it might take you more than one try to get through a level. Do not worry if you do not make it through all of the levels in this one class period you could finish it at home!

Computer Science Connection

When a computer scientist is designing a new game they have to write algorithms so the computer will follow what the computer scientist wants it to do. The computer scientist will write out each step it wants the computer to follow and give it specific demands. In the last lesson we saw that if the directions are not specific enough a mistake could be made. The computer scientist has to make sure that the computer is able to understand each step along the way. To do this computer scientists have to write a code into a program. The code usually uses English words with parenthesis and commas to separate the different step. This program then takes that code and turns it into binary or another language that the computer can easily understand. This program makes it easier for the computer scientist because they do not have to write everything in binary. Once you finish each level on Code.org there is an option to see the code you made while you created the algorithm. What you see there is what a computer scientist would create to make their algorithm.

Massachusetts Digital Literacy and Computer Science Standards

3-5.CT.b.1 Define an algorithm as a sequence of instructions that can be processed by a computer.

3-5.CT.b.4 Individually and collaboratively create an algorithm to solve a problem (e.g., move a character/robot/person through a maze).
3-5.CT.b.5 Detect and correct logical errors in various algorithms (e.g., written, mapped, live action, or digital).

Learning Objectives
Students will be able to:
- Create their own algorithm to solve a puzzle
- Persist through problems that they might get wrong the first couple tries
- Explain what an algorithm is and how they relate to computers

Materials
- Computer
- Blank computer paper
- Link to Code.org: https://studio.code.org/s/course2/stage/3/puzzle/1
- This is the second maze if they finish the first one:
  https://studio.code.org/s/course2/stage/4/puzzle/1

Procedure
1) The teacher should begin the lesson by going over the introduction and the computer science connection
2) The teacher should explain that the students will be going on Code.org and play a game that will involve algorithms. The game gets gradually harder and more steps may be involved to figure it out. Students should not give up if they cannot solve it but ask their peers or a teacher for help.
3) The majority of this lesson should be spent working through the different levels of the Angry Birds game so students get a good idea of what an algorithm looks like and how it relates to a game. There are two mazes if the students finish the first one.
4) The teacher will have a brief discussion about the activity
5) At the end the students will create their own maze puzzles just like on the website. They will then trade them with another student and create an algorithm for how to solve this puzzle.

Claim/ Evidence Statement

Discussion Questions:

1) What did you learn about algorithms?
2) What was the most difficult part of this activity?
3) How does a computer game use algorithms?
4) What is an algorithm that you use in your everyday life?
5) Do you have any questions about algorithms?

When the discussion is finished the teacher will hand each student a blank piece of paper. The students will be asked to create their own puzzle just like they saw in the game. They can make it complicated or easy, but make sure that it can be solved. The puzzles should have a character moving through a maze towards an object. When they are finished creating it they will switch it with another student. They will then have to write an algorithm for how to solve the puzzle. When the student thinks they have figured it out they should go back to the puzzle maker and discuss the algorithms and whether they are correct.

Citation

Code.org website with the Angry Birds game: https://studio.code.org/s/course2/stage/3/puzzle/1

Code.org link for the second maze: https://studio.code.org/s/course2/stage/4/puzzle/1

Can you Loop the Algorithm?

Introduction

Who has ever played baseball before? The batter goes up to the plate and gets three strikes to hit the ball if they hit it they can try to get on base if they miss the ball their team gets the first out. The batting team gets to try to score until they get three outs. Then the other team goes up to bat and the same process starts over again. Once they get an out then the other team goes back to bat and this process continues 9 times. In computer science this is called a loop. A loop is doing the same thing over and over again. Computers often have to do the same steps over and over again in a program and a loop tells the computer to do that step as many times as the computer scientist wants it to. In the last lesson we talked about algorithms, which is a list of steps that you can follow to finish a task. Last time we went on Code.org and created some algorithms to get the angry bird to get the evil pig who stole its eggs. Today we will also create algorithms with the angry birds maze, but will add loops to the algorithms to help make them shorter and faster than writing out each individual step. This will help when you have to move the angry bird many steps forward. Instead of connecting each block individually you can do all of them at once!

Computer Science Connection

Loops make coding a lot easier for computer scientists. Instead of writing out the same step over and over again they can use a loop. By using a loop they can write five steps in only one. Loops are also helpful for the computer because it can read that one step and know to repeat an action a certain amount of times. It makes writing long algorithms and codes a lot easier for the computer scientist.

Massachusetts Digital Literacy and Computer Science Standards

3-5.CT.d.2 Use arithmetic operators, conditionals, and repetition in programs.

3-5.CT.d.1 Individually and collaboratively create, test, and modify a program in a graphical environment (e.g., block-based visual programming language).

Learning Objectives

Students will be able to:

- Write a loop in an algorithm
- Persist through puzzles that they might get wrong the first couple tries
- Describe loops seen in everyday life and how they relate to computer science

Materials

- Computer
- Link to Code.org: https://studio.code.org/s/course2/stage/6/puzzle/1
- Blank paper

Procedure

1) The teacher should begin the lesson by going over the introduction and the computer science connection
2) The teacher should explain that the students will be going on Code.org and play a game that will involve loops. The game gets gradually harder and more steps may be involved to figure it out. Students should not give up if they cannot solve it but ask their peers or a teacher for help.
3) The majority of this lesson should be spent working through the different levels of the Angry Birds game so students get a good idea of how a loop works and how it relates to a game.
4) The teacher will have a brief discussion about the activity
5) At the end the students will fill out their own exit ticket describing a loop they see in their everyday life. The student should describe how often the cycle repeats

Discussion Questions

1) What is a loop? How does it connect to computer science?
2) How could a computer scientist use a loop?
3) Did you think the loop made the algorithm easier?
4) Did you think the loops were difficult to write at first? Why?
5) What is a loop you see in your everyday life?

Exit ticket:

1) Describe a loop that you see in your everyday life. How does this loop repeat? How often does the loop repeat (everyday, every week, every month)? How does this loop make your life easier?

Citation

Link to Code.org: https://studio.code.org/s/course2/stage/6/puzzle/1

Pick a Card, Any Card

Introduction

At the beginning of this unit we talked about how important logic, more specifically boolean logic, is to computer science. To review, booleans are a type of data that can only have two answers, either true or false, to each question. We talked about how in a video game booleans help the computer figure out which storyline to follow depending on the choices you make as a player. We discussed how computer scientists use IF….THEN statements to write booleans just like you would in a science hypothesis. The statements say If you choose this path THEN this event will happen OR something else could happen. Booleans explain what happens when you select one of the options. This works when you play a game which requires you to choose between two different tasks. To play a more complex game where there could be more than one outcome or are consequences for not picking a certain path the computer scientist would have to write the booleans in a different way. For example if you are playing a soccer game and decide to kick the ball at the goalie there are two possible outcomes. The ball could either go into the net and you score a goal or the goalie could block the ball. To tell the computer what two options are possible and how to respond they would start the statement by using IF….THEN but would add in ELSE to describe the other possible option. The computer scientist would write IF you shoot the ball at the net THEN you will score. ELSE the goalie will block the ball and there is no goal. The use of the ELSE here describes that even though the player shot the ball at the goal they do not automatically score there is an option that the goalie blocks the shot. This statement is called a conditional. A conditional is defined as statements that only run under certain conditions (code.org). It tells the computer that there are different outcomes for the decisions the players make. This type of coding helps bring the more complex games where there are good and bad consequences for each choice a player makes in the game.

The activity we will be doing today will have us practice reading conditional statements. We will break into teams and use cards and conditionals to gain points. Based on what the conditional statement says and the cards you pick from the deck will determine how many points your team

gets. This will give us a good idea of how computer scientists write the conditionals and how a computer might read them.

Computer Science Connection

Before we continue with the lesson for today we have to review algorithms. An algorithm is a list of steps that someone follows to complete a task. We often use algorithms in our everyday lives to get ready for the day and complete simple tasks and more difficult tasks. In everything a computer does it follows an algorithm created by a computer scientist. The algorithm in a computer program tells the computer what it should be doing at each point. In order to write a program a computer scientist needs to use both algorithms and conditionals so the computer knows what to do. The algorithm tells the computer what steps and story it should be following, but when the player comes to a choice a conditional is used to help the computer know which option the player chose and the consequences for that action. Conditionals are part of the algorithm that the computer scientist writes. The computer scientist needs to have a good understanding of how conditionals work so they can plan what happens in their game or program.

Massachusetts Digital Literacy and Computer Science Standards

3-5.CT.d.2 Use arithmetic operators, conditionals, and repetition in programs.

Learning Objectives

Students will be able to:
- Read a conditional and apply it to the card
- Decide if a card satisfies a conditional or not and describe why you think so or not
- Write their own conditionals to be used in the game

Materials

- A shuffled half deck of cards for each group
- Worksheet with the conditionals for each round
- Table to keep track of each round
- Pencils

Procedure

1) Go over the introduction with the students and make sure they understand what a conditional is and how it will be used.
2) Break up the students into groups of four. Two of the students will be on one team blue and the other team will be green. The students can decide which two want to be which color.

3) The teacher will go over a couple of examples of a conditional before the students do it on their own. The teacher should write IF the card is red THEN your team gets a point. ELSE the other team gets a point. The teacher will explain that each round both teams will pick a card and try to earn points for their team. There will be seven total rounds and then the students can create their own conditionals. The teacher will ask a student to pick a card from the deck and hold it up for the whole class to see. The teach will explain that if the card is red the student gets a point for their team if it is black the other team gets a point. The teacher will have the other team in that group choose a card and see what the outcome is.

4) Before the students do the activity on their own the teacher will give a more complicated two step example. The teacher should explain that sometimes conditionals are complicated and might have two conditionals in them. For example IF the card is red THEN your team gets a point. ELSE IF your card is higher than a 9 THEN the other team gets a point. ELSE your team gets the same number of points that are on your card. The teacher should have one team pick a card and talk through this conditional with the entire class. If the card is red then that team instantly gets a point and the other team picks a card. If the card is black then the students look at the other part of the conditional. If the card is higher than a 9 then the other team gets the point, if it's lower than a 9 then the team who drew the card gets the number of points that match the number on the card. The other team then draws a card and they follow the same process. If the class seems to be confused the teacher can practice one more of the two step conditionals.

5) Hand each group a half deck of cards. Tell the students to turn to the worksheet with the conditionals for each round. They should also have the students turn to the table in their packet so one of the group members can keep track of the points their team gets.

6) Have the students play the game and walk around while they are playing. If the students seemed confused at any point try to walk them through the conditional without giving them the answer.

7) When the groups are finished they should continue playing by creating their own conditionals. When every group is finished the teacher should start the group discussion by using the questions at the end.

Worksheets/ Tables

Pick a Card, Any Card Conditionals Activity

Round 1:
IF the card is a heart THEN give your team one point
ELSE the other team gets one point

Round 2:
IF the card is higher than a 9 THEN give your team two points
ELSE the other team gets two points

Round 3:
IF your card is black THEN give your team one point
ELSE give the other team one point

Round 4:
IF your card is a spade THEN give your team two points
ELSE: IF your card is a Jack, King, Queen or Ace give your team five points
        ELSE give the other team five points

Round 5:
IF your card is lower than a 7 THEN give your team two points
ELSE: IF your card is red THEN give your team one point
        ELSE give the other team one point

Round 6:
IF your card is a diamond THEN give your team two points
ELSE: IF your card is lower than a 10 THEN give your team a point
        ELSE the other team gets a point

Round 7:
IF your card is a club (clover shaped) higher than 4 THEN give your team three points
ELSE: IF your card is a Spade THEN give your team two points
         ELSE the other team gets one point

Round 8: Create your own conditional and write it here

IF_____
ELSE_____
Table for the Activity

Round Number	Team Blue points earned	Team Green points earned
1		
2		
3		
4		
5		
6		
7		
End of game total		

Claim/ Evidence Statement
At the end of the lesson the teacher should use these questions to gauge students in a discussion about the lesson.

1) Which team won the game? Was one team winning more rounds than the other or was it even?
2) What conditionals were the most difficult to figure out?
3) Was it difficult for you to follow the conditional if it was more than one step?
4) What is an example of a conditional you created with your group?
5) What is a conditional?
6) How do computer scientists use conditionals to create programs and games?

Citation
Code.org, & Thinkersmith. (n.d.). Conditionals with Cards. Retrieved from https://code.org/files/ConditionalsHoC.pdf

Let's Code!

Introduction

Computer Scientists have a lot to think about when they are creating a new game or program. As we have learned over the past nine weeks someone could not just simply go to a computer and know right away how to code and make the computer understand what they are telling it to do. A computer scientist must know how to think logically like we did in the first couple of lessons. They also must know how a computer communicates and operates using binary. Luckily for computer scientists instead of using binary to write out every single letter of their message we have discovered different computer languages that allow us to type english words that get translated to binary. This allows computer scientists to create their algorithms much faster because they do not have to translate it to binary themselves. The algorithms they put into the computer also must be specific and tell the computer exactly what it should be doing or the computer will get confused and create a problem in the game or program. Computer scientists must know to create specific steps in the algorithms so the computer knows exactly what to do. In the last lesson we learned about conditionals which tell the computer there may be more than one outcome when someone makes a choice in a game. Computer scientists must know the specific language of IF....ELSE so the computer knows exactly what to do no matter what choice a player makes in the game. We also talked about how computer scientists use loops so they do not have to write the same step over and over again. Loops make writing algorithms must simpler but still tells the computer exactly what it should do.

The ideas we learned in the past nine weeks are ones that all computer scientists have to keep in mind while they are coding. These basic ideas will help us code a game like the angry birds mazes we have been doing. Today in our final activity we will go back to code.org and write algorithms for different mazes that start off easy and then get harder as you go along. In these mazes we will use all the ideas we have learned in the past nine weeks to code through more complex mazes. If you forget how to complete a level the videos we watched in previous lessons will be there and you can rewatch them to remind yourself how to do it.

Computer Science Connection

While writing algorithms for big video games and programs computer scientists have think about a lot of different steps. To write complex games computer scientists need to use other more complicated tools that we did not learn about. The coding for more complicated games can sometimes be confusing and tricky, but computer scientists work hard to make sure it works the way it is supposed to. It is important that they never give up and keep going even if they can not figure out the problem. While you are coding it is important to go back to your algorithm and look for the problem to fix it. It is not always easy to find the problem, but testing and retesting the game will help fix all the issues and make the computer do what you wanted it to do. It might not be easy to create a game or a program, but it is rewarding to see the finished product being played and enjoyed by many people!

Massachusetts Digital Literacy and Computer Science Standards

3-5.CT.b.2 Recognize that different solutions exist for the same problem (or sub-problem).

3-5.CT.b.4 Individually and collaboratively create an algorithm to solve a problem (e.g., move a character/robot/person through a maze).

3-5.CT.b.5 Detect and correct logical errors in various algorithms (e.g., written, mapped, live action, or digital).

3-5.CT.d.1 Individually and collaboratively create, test, and modify a program in a graphical environment (e.g., block-based visual programming language).

3-5.CT.d.2 Use arithmetic operators, conditionals, and repetition in programs.

Learning Objectives

Students will be able to:
- Write algorithms to lead a character to the end of a maze
- Use loops to simplify their algorithm into fewer steps
- Use conditionals to help the computer know what to do if their is more than one choice
- Discuss how coding would be used by computer scientists in the world

Materials

- A computer with internet access
- Code.org link: https://studio.code.org/hoc/1

- Discussion questions

Procedure

1) Go over the introduction and computer science connections with students
2) Explain to students that they will be using their time today to put together all the steps they have learned in this unit to code like a computer scientist.
3) Go to https://studio.code.org/hoc/1. Have the students code until there is only ten minutes left.
4) Have the students log of the computers
5) Start the discussion of how their coding went

Discussion Questions

After the students have logged off the computer and the teacher has their full attention ask the following questions

1) How did you feel about writing the algorithms for these mazes?
2) What was the most difficult thing you coded today? Why was it difficult?
3) Was there a level that you kept having to do over and over again? How did you figure it out?
4) Did this activity change the way you think about video games and programs you use on the computer?
5) Did this activity change the way you think about computer scientists?
6) Can you see yourself being a computer scientist in the future? Why or why not?

Citation

Code.org: https://studio.code.org/hoc/1