Course 4 Supplement

Code Studio Lesson Plans

for

Course Four

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Algorithms: Tangrams

Lesson time: 20 Minutes Basic lesson time includes activity only. Introductory and Wrap-Up suggestions can be used to delve deeper when time allows.

LESSON OVERVIEW

This lesson shows us something important about algorithms. If you keep an algorithm simple there are lots of ways to use it. If you want to make sure everyone ends up with the same thing, then your algorithm needs more detail.

This activity will show both options.

TEACHING SUMMARY

Getting Started - 10 minutes

1) Review
2) Vocabulary
3) Intro to Tangrams

Activity: Algorithms with Tangrams - 20 minutes

4) Algorithms

Wrap-up - 10 minutes

5) Flash Chat: What did we learn?
6) Vocab-Shmocab

Assessment - 10 minutes

7) Algorithm Assessment

LESSON OBJECTIVES

Students will:

- Tackle the challenge of translating an image into actionable instructions
- Convey instructions to teammates in order to reproduce an image
- Analyze the work of teammates to determine whether an outcome was successful

TEACHING GUIDE

MATERIALS, RESOURCES AND PREP

For the Student

- Tangram Set & Algorithm Card Images Pack
- Scratch paper for writing algorithms or building images

- Tangram Assessment Worksheet
- Pens/Pencils
- Scissors

For the Teacher

- Print one Algorithm Card Images Pack per group
- Print one Tangram Set per student
- Print one Tangram Assessment Worksheet per student
- Provide student with scissors, paper, pens & pencils

GETTING STARTED (10 MIN)

1) Review

This is a great time to review the last lesson that you went through with your class. We suggest you alternate between asking questions of the whole class and having students talk about their answers in small groups.

Here are some questions that you can ask in review:

- What did we do last time?
- What do you wish we would have had a chance to do?
- Did you think of any questions after the lesson that you want to ask?
- What was your favorite part of the last lesson?

LESSON TIP *Finishing the review by asking about the students' favorite things helps to leave a positive impression of the previous exercise, increasing excitement for the activity that you are about to introduce.*

2) Vocabulary

This lesson has one important word to review:

Algorithm - Say it with me: Al-go-ri-thm
A list of steps that you can follow to finish a task

3) Intro to Tangrams

Your students may or may not have played with tangrams before. If they have, you can skip this portion, and move

right to explaining the Algorithms activity.

Usually, Tangrams are used to solve puzzles. You receive a set of seven Tans and must use them all (without overlapping any) to recreate an image that has been given to you. Often, this is done as an individual activity, and the player is allowed to see the image that they are trying to recreate. Many times, you can lay your pieces right on top of the image silhouette to be sure that the solution is just right.

LESSON TIP

If your class has never used Tangram pieces, you can choose to do an example for them or even have an entire Tangram lesson. There are several good ones on the Internet. Here is a lesson that you can do in the classroom and here is a game that you can play online.

ACTIVITY: ALGORITHMS (20 MIN)

4) Algorithms

We are going to use our tangrams in a slightly different way than most. Instead of looking at our puzzles and trying to guess which shape goes where, we are going to get puzzles that already tell you where each shape goes.

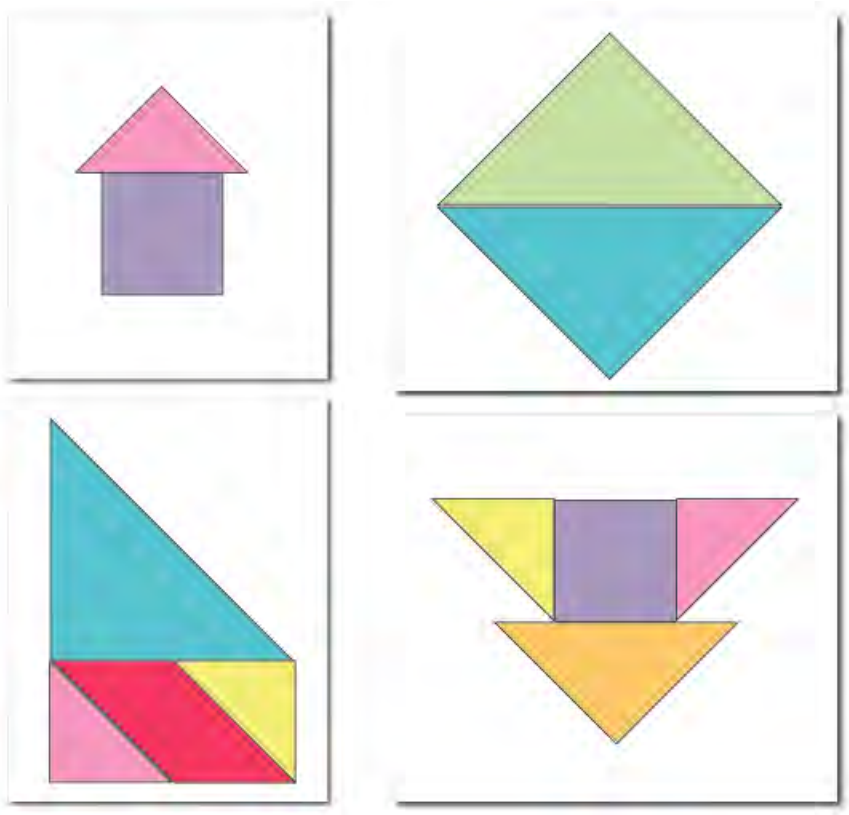
You might think that this will make it easier, but it won't, because students will also not get to actually *look* at the image that we are trying to recreate! Instead, a teammate will be *describing* the image to us.

To keep it from getting too difficult, we will not use puzzles that require all seven pieces.

Directions:

1. Divide into groups of 3-5.
2. Each player should cut out their own set of tangrams.
3. Have one member of each group select an Algorithm Card without showing it to anyone else.
4. The person with the Algorithm Card will try to explain the image to everyone else without letting them actually see it.
5. The other players will build their pictures off of the description given by the Card Holder.
6. When the Card Holder is done, everyone will show their pictures and see if they all ended up with the same image.
7. If everyone ends up with the same drawing, the Card Holder can show the card and see if everyone matched the card.
8. If any of the pictures in the group are different from each other, have the Card Holder try describing the image again, using more detail.
9. Choose a new Card Holder and a new Algorithm Card and repeat until everyone has had a chance to describe an image.

Play through this several times, with images of increasing difficulty.



WRAP-UP (10 MIN)

5) Flash Chat: What did we learn?

- What did we learn today?
- Was it easier or harder than you thought it would be to describe an image to one another?
- Did any group end up having arrangements that all matched?
- Can you share some tricks that you came up with that helped your group match the Image Card exactly?

6) Vocab Shmocab

You can choose to do these as a class, or have the students discuss with an elbow partner and share.

- Do you remember the definition of the word "algorithm"?

  "A list of steps that you can follow to finish a task"
  "An algorithm that has been coded into something that can be run by a machine"
  "Finding and fixing problems in your algorithm or program"

ASSESSMENT (10 MIN)

7) Algorithm Assessment

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

At Your Word

- Make up simple Tangram Algorithms for your class, and have them figure out how many different images they can create that follow that algorithm to the letter.
  - Choose a couple of drawings to analyze against the algorithm.

- Move toward more specific algorithms that leave little room for variation.

Shapely Debugging

- Create an algorithm for an image, and provide the class with a Tangram Arrangement that doesn't *quite* match.
  - Ask the class if the image matches the algorithm.
  - Can they figure out where it went wrong?
  - Do you need to throw the whole arrangement out and start over or can you just start from where the algorithm went wrong?

LESSON TIP

Try to focus on misplacements that allow the class to back up only a few steps to fix the algorithm. We want to get it in the students' heads that they don't have to delete entire programs if something doesn't work, they just need to find the error and fix that bit (and any bit that was relying on that instruction).

CONNECTIONS AND BACKGROUND INFORMATION

ISTE Standards (formerly NETS) Satisfied by this Lesson Include:

- 1c. Use models and simulations to explore complex systems and issues
- 2d. Contribute to project teams to produce original works or solve problems
- 4b. Plan and manage activities to develop a solution or complete a project
- 6c. Troubleshoot systems and applications

The activities in this lesson support CSTA K-12 Computer Science Standards:

- CT.L1:6.01 - Understand and use the basic steps in algorithmic problem-solving
- CT.L1:6.02 - Develop a simple understanding of an algorithm using computer-free exercises
- CPP.L1:6.05 - Construct a program as a set of step-by-step instructions to be acted out

Other standards, including the NGSS, and Common Core Math & Language Arts

- CCLA-K:SL.2 - Confirm understanding of a text by asking or answering questions
- CCLA-1:SL.2 - Ask and answer questions about key details in a text

Name: _____ Date: _____

Algorithms

Tangrams Algorithm Activity

This lesson shows us something important about algorithms. If you keep an algorithm simple there are lots of ways to use it. If you want to make sure everyone ends up with the same thing, then your algorithm needs to have a lot of detail.

This activity will show both options.

Directions:

1. Divide into groups of 3-5.
2. Each player should cut out their own set of tangrams.
2. Have one member of each group select an Algorithm Card without showing it to anyone else.
3. The person with the Algorithm Card will try to explain the image to everyone else without letting them actually see it.
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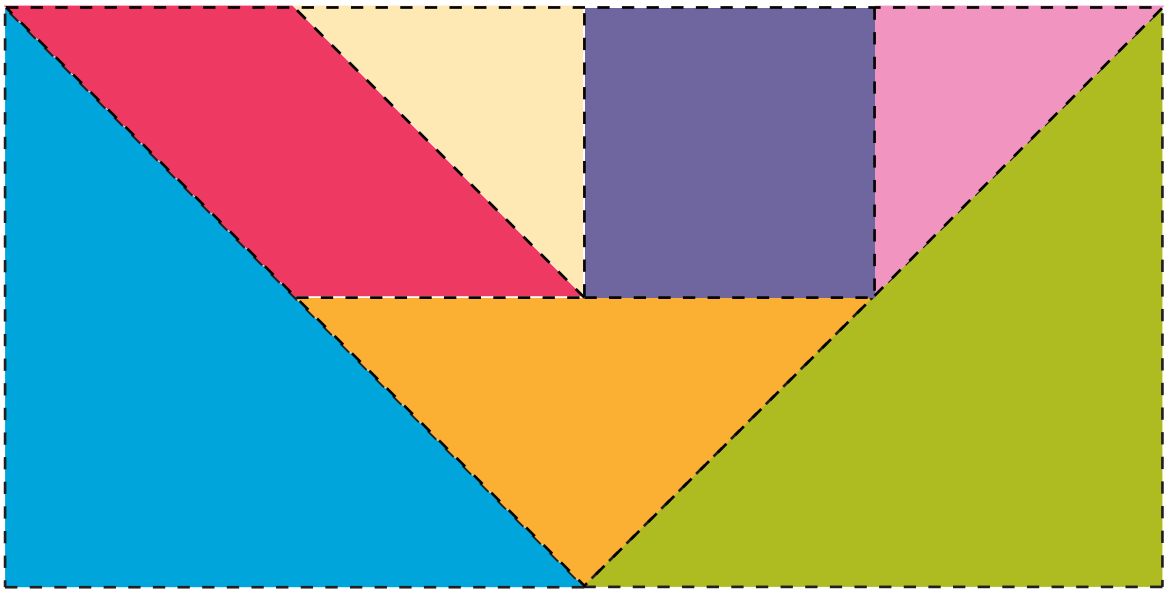

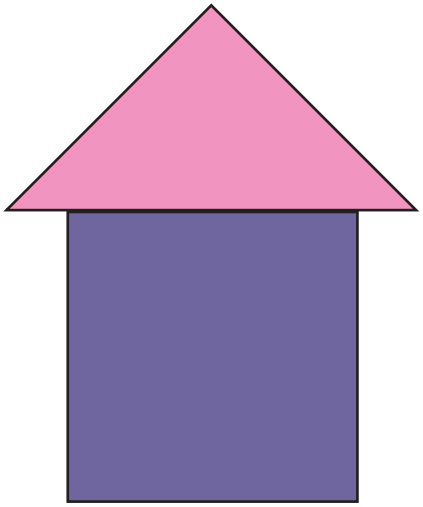

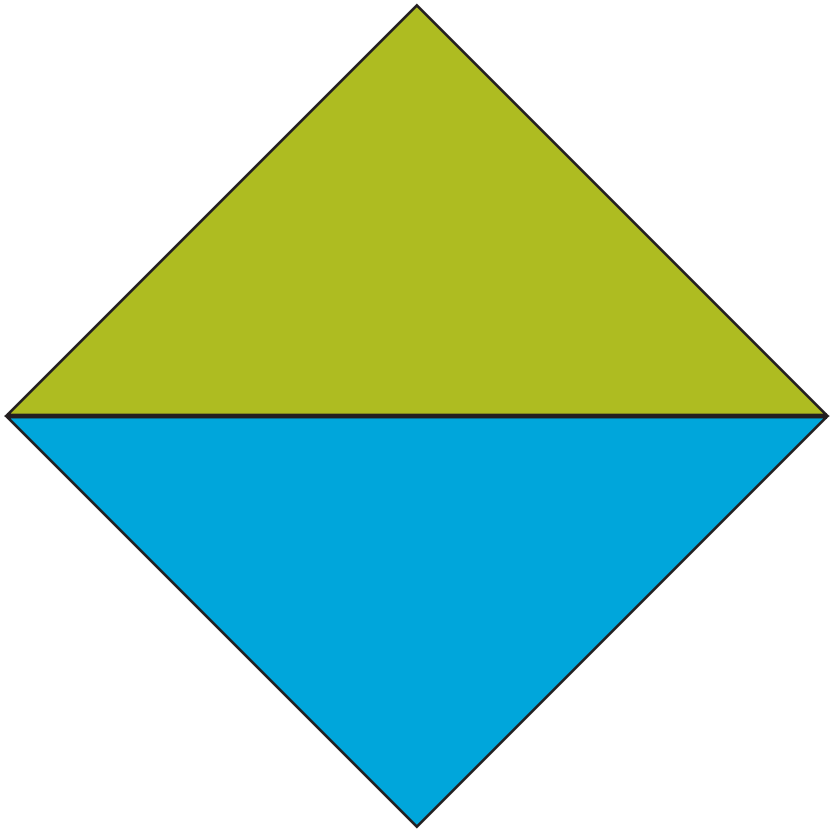

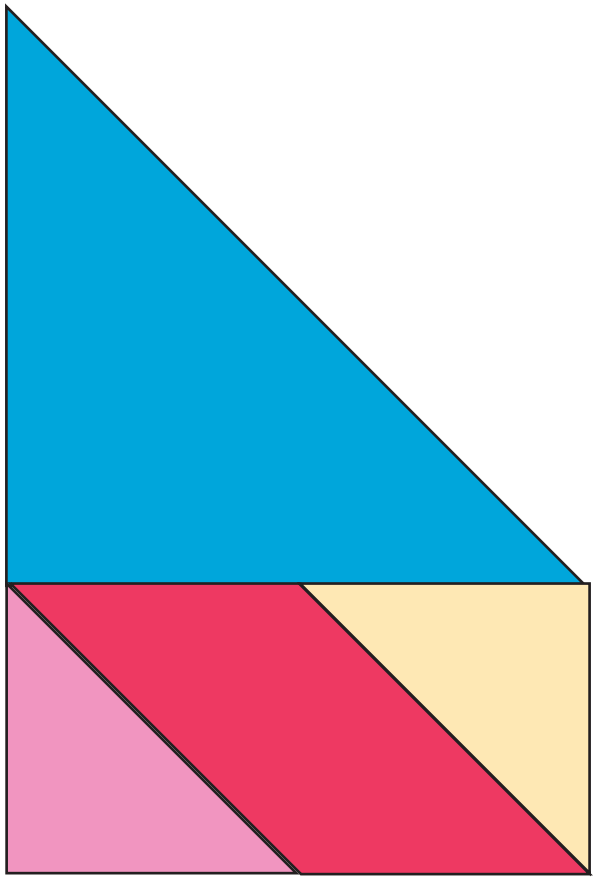

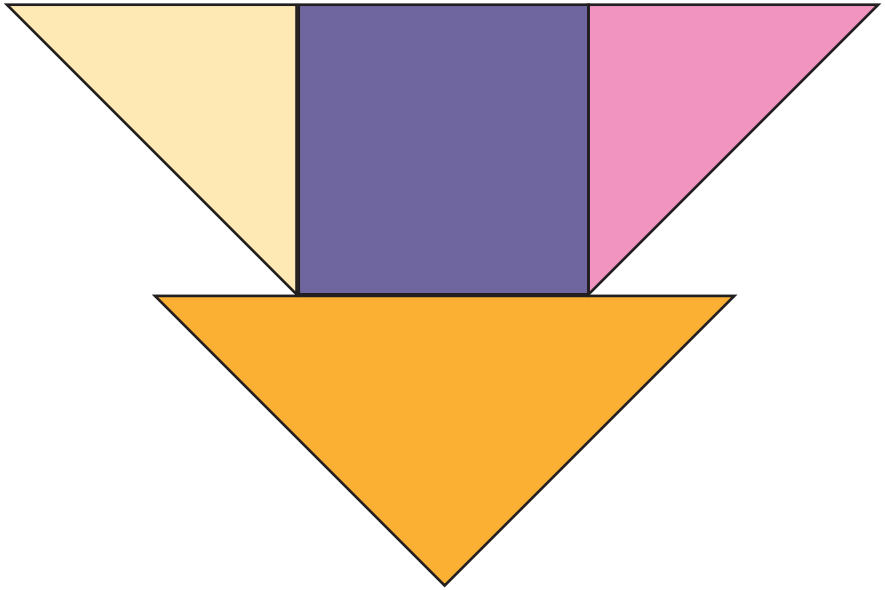

Name: _____ Date: _____

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Algorithms

Tangrams Assessment Worksheet

C O D E

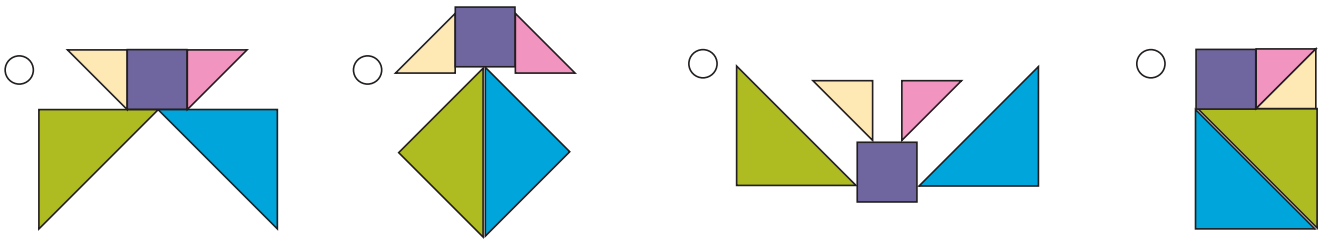
Very specific algorithms help multiple people create identical products.

Less specific algorithms allow a great deal of flexibility for every person to have something different.

Circle the drawing that does not follow the algorithm provided.

Algorithm #1

1) Put two large triangles at the bottom of the image.
2) Put a square on top of those two triangles.
3) Put two little triangles beside the square.



Circle the algorithm that goes with Drawing 1.

Algorithm A

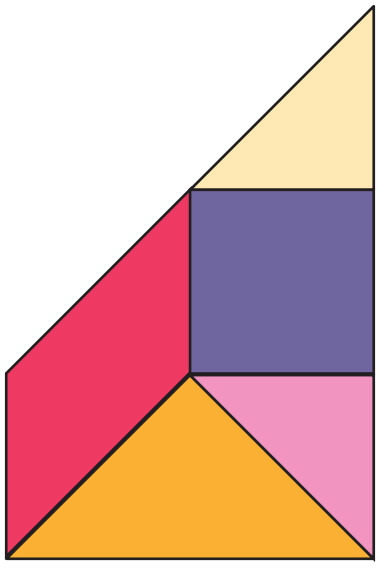
1) Use two triangles, a square, and another piece
2) Line two triangles up with the square
3) Put the last piece on top of the square

Algorithm B

1) Use three triangles, a rhombus, and another piece
2) Put the rhombus at the bottom
3) Put all three triangles above the rhombus
4) Put the final piece to the left of everything else

Algorithm C

1) Use three triangles, a square, and another piece
2) Line two triangles up with the square
3) Put a third triangle beneath the other shapes
4) Put the last piece on the left



Drawing 1

2

Course 4 | Lesson 2

Maze and Bee

Lesson time: 30 Minutes

LESSON OVERVIEW

This course is a review of maze concepts from Courses 2 and 3. Students will first help the zombie get to the sunflower using a combination of sequences and loops, then review conditionals with the flower-hunting bee.

TEACHING SUMMARY

Getting Started

Introduction

Activity: Maze and Bee

Maze and Bee

Extended Learning

Extension Activities

LESSON OBJECTIVES

Students will:

- Create a program for a given task using sequential steps
- Count the number of times an action should be repeated and represent it as a loop
- Analyze a problem and complete it as efficiently as possible
- Employ conditional statements to assess which actions are correct for a given step

GETTING STARTED

Introduction

Review with students the basic maze navigation, particularly:

- Moving forward
- Turning left/right
- Looping
- Conditionals

ACTIVITY

Maze and Bee

As your students work through the puzzles, observe how they plan the path for the zombie or bee. Identify different strategies used and ask students to share with the whole class. This helps students to recognize that there are many ways to approach these problems. You may want to go through a few puzzles on the projector. While doing this you can ask a one student to trace the path on the screen while another writes the directions on a whiteboard.

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Create Your Own

In small groups, let students design their own mazes and challenge using checkerboards and strips of paper. Can they recreate a bee conditionals puzzle using red and black checkers?

3

Course 4 | Lesson 3

Artist: Loops Review

Lesson time: 30 Minutes

LESSON OVERVIEW

This is a review of loops and nested loops. Students will use the traditional artist character, as well as a very artistic zombie, to complete and recreate repetitive drawings.

TEACHING SUMMARY

Getting Started

Introduction

Activity: Artist: Loops Review

Artist: Loops Review

Extended Learning

Extension Activities

LESSON OBJECTIVES

Students will:

- Create programs that utilize repetition to create gorgeous designs
- Use trial and error to recreate detailed designs in proper scale
- Divide the number of degrees in a circle into even segments
- Calculate the angles in equilateral and 30 60 90 triangles
- Decompose a shape into its smallest repeatable sequence

GETTING STARTED

Introduction

Review with students the basic artist navigation, particularly:

- Moving forward
- Turning left/right
- Looping
- Angles

ACTIVITY

Artist: Loops Review

Students will see a variety of shapes in this lesson. Some of the designs get pretty intricate. Your class may find it helpful to have a protractor and paper on hand. Feel free to promote trial and error as well.

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Paper Snowflakes

Hand your class small square sheets of paper and have them fold the papers in half then cut simple designs. How many times is the design repeated? What are the points of symmetry? What happens when you fold another piece of paper a second time and cut a pattern? How many times is it repeated? What do you think will happen if you fold the paper three times? Four?

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Variables in Envelopes

Lesson time: 20 Minutes Basic lesson time includes activity only. Introductory and Wrap-Up suggestions can be used to delve deeper when time allows.

LESSON OVERVIEW

Variables allow for a lot of freedom in computer science. This lesson helps to explain what variables are and how we can use them in many different ways. Use this activity before (or in conjunction with) the lesson on abstraction to really hit the idea home.

TEACHING SUMMARY

Getting Started - 10 minutes

1) Review
2) Vocabulary
3) Introducing Variables

Activity: Envelope Variables - 20 minutes

4) Envelope Variables

Wrap-up - 10 minutes

5) Flash Chat: What did we learn?
6) Vocab-Shmocab

Assessment - 10 minutes

7) Variables Assessment

LESSON OBJECTIVES

Students will:

- Identify variables and determine their values
- Define and call variables in the context of real-life activities
- Create situations which require the use of variables
- Utilize teamwork to enrich creative game play

TEACHING GUIDE

MATERIALS, RESOURCES AND PREP

For the Student

- Blank Paper
- 6 envelopes per group, labeled with the names (name1, name2, Name1, eyes1, sisters1, sisters2)
- 1 Envelope Variables Worksheet per group

- Pens/Pencils/Markers
- Variables Assessment Worksheet

For the Teacher

- Prepare your variable presentation by writing variable names on the back of envelopes and stuffing them with appropriate values
- Print one Envelope Variables Worksheet per student
- Print one Variables Assessment Worksheet
- Provide students with envelopes (details above), paper, pens & pencils

GETTING STARTED (10 MIN)

1) Review

This is a great time to review the last lesson that you went through with your class. We suggest you alternate between asking questions of the whole class and having students talk about their answers in small groups.

Here are some questions that you can ask in review:

- What did we do last time?
- What do you wish we would have had a chance to do?
- Did you think of any questions after the lesson that you want to ask?
- What was your favorite part of the last lesson??

LESSON TIP *Finishing the review by asking about the students' favorite things helps to leave a positive impression of the previous exercise, increasing excitement for the activity that you are about to introduce.*

2) Vocabulary

This lesson has one important word to review:

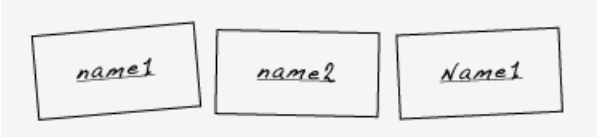
Variable - Say it with me: Vayr-ee-ah-buhl
A placeholder for a piece of information that can change

3) Introducing Variables

On the board (or under your document camera) write the sentence:

"Hello, my name is name1 ."

In your hand, you should hold three envelopes. One labeled "name1", another labeled "name2", and another with an imperfect variation of name1 -- such as "Name1".



- Be sure that only the envelope called "name1" has your correct name in it (ideally the name that you expect the class to identify for you).

Call attention to the board and inquire:

"If this sentence on the board is for me, what should go into the blank called 'name1'?"

Let the students register their guess, then have someone come check the envelope. Be sure that they pick the envelope from the three (this can make for a fun and interesting extra bit to the lesson if they should happen to choose the 'Name1' envelope and see a word like "Monkey".) You can use that as an opportunity to introduce the fact that, for this game, capitalization matters.

Next, ask:

- "Does this sentence only work for me?"
- "How could I get it to work for someone else in the class?"

Hopefully the students will recognize that they just need to put a new name in the envelope. If they don't get that idea right away, help guide them to that answer. You will want to be very specific about which envelope that name needs to go into.

- Feel free to do multiple examples using different envelopes.
- Work your way up to using two or more envelopes in one sentence.
  - Have fun with it. Incorporate students. You can do first and last names, ages, or even positive qualities about individuals.

ACTIVITY: ENVELOPE VARIABLES (20 MIN)

4) Envelope Variables

Now it's the students' turn!

Once the students understand how the envelopes relate to the sentences, challenge the students to create their own sentences that can work for anyone in the group as long as they change what goes into the envelope.

Give the students some sample sentence templates to begin with.

Directions:

1) Divide students into groups of 2-4.

2) Have groups assign a sentence to each person.

3) Each student will out a slip of paper to put inside of their envelope “variable” to fill in the blank from their sentence.

4) Once everyone has an answer in their envelope, students will throw the envelopes into the middle of the table.

5) Starting with question 1, students will try to guess the value of every team member’s variable, then

pull the envelope with that variable name to see if they were right.

6) Once all filled envelopes have been revealed, students should switch questions and start again.

If they finish early, encourage students to come up with their own templates to share with the class.

1. My name is _____ .
(name1)

2. My last name is _____ .
(Name1)

3. My eyes are _____ .
(eyes1)

4. I have _____ sisters.
(sisters1)

5. My sister's name is _____ .
(sisters2)

WRAP-UP (10 MIN)

5) Flash Chat: What did we learn?

- What did we learn today?
- Can you think of anywhere that you have seen variables before?
- There is at least one variable at the top of most homework hand outs? Can you think of what it could be?

6) Vocab Shmocab

You can choose to do these as a class, or have the students discuss with an elbow partner and share.

- Do you remember the definition of the word "variable"?

  "A four sided parallelogram"
  "A placeholder for a piece of information that can change"
  "The wheels on the bottom of chair legs"

ASSESSMENT (10 MIN)

7) Variables Assessment Worksheet

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

What's in the box?

- Draw boxes on a piece of paper with simple mathematical operators between them.
  - For instance [] + [] = []
- Have similar size squares with numbers between 1 & 20.
- Ask one student to come create a true equation, using the numbers provided.
- Once the student has finished (and the class verifies the equation) exchange one of the numbers with another one, then remove a second number entirely.
  - Tell the students that there is a hidden number in the empty box that makes that equation true again.
  - What number is in the box?
- Play this game over and over again until you can remove the number from any location and the students can figure out what it is supposed to be.

CONNECTIONS AND BACKGROUND INFORMATION

ISTE Standards (formerly NETS) Satisfied by this Lesson Include:

- 1c. Use models and simulations to explore complex systems and issues
- 2d. Contribute to project teams to produce original works or solve problems
- 4b. Plan and manage activities to develop a solution or complete a project
- 6c. Troubleshoot systems and applications

The activities in this lesson support CSTA K-12 Computer Science Standards:

- CT.L1:6.01 - Understand and use the basic steps in algorithmic problem-solving
- CT.L1:6.02 - Develop a simple understanding of an algorithm using computer-free exercises
- CPP.L1:6.05 - Construct a program as a set of step-by-step instructions to be acted out

Other standards, including the NGSS, and Common Core Math & Language Arts

- CCLA-K:SL.2 - Confirm understanding of a text by asking or answering questions
- CCLA-1:SL.2 - Ask and answer questions about key details in a text

Name: _____ Date: _____

Unplugged

Variables in Envelopes

Variables Worksheet

Here are some sample sentences that you might fill in differently depending on how they apply to you.

* Work with your group to assign a sentence to each person.
* Fill out a slip of paper to put inside your envelope "variable" to fill in the blank from your sentence.
* Once everyone has an answer in their envelope, throw the envelopes into the middle of the table.
* Start with question 1 and see if you can guess the value of every team member's variable. Pull the envelope with that variable name. Were you right?

---

1. My name is _____ .
(name1)

2. My last name is _____ .
(Name1)

3. My eyes are _____ .
(eyes1)

4. I have _____ sisters.
(sisters1)

5. My sister's name is _____ .
(sisters2)

6. My favorite band's name is _____ .
(name2)

Name: _____ Date: _____

Variables in Envelopes

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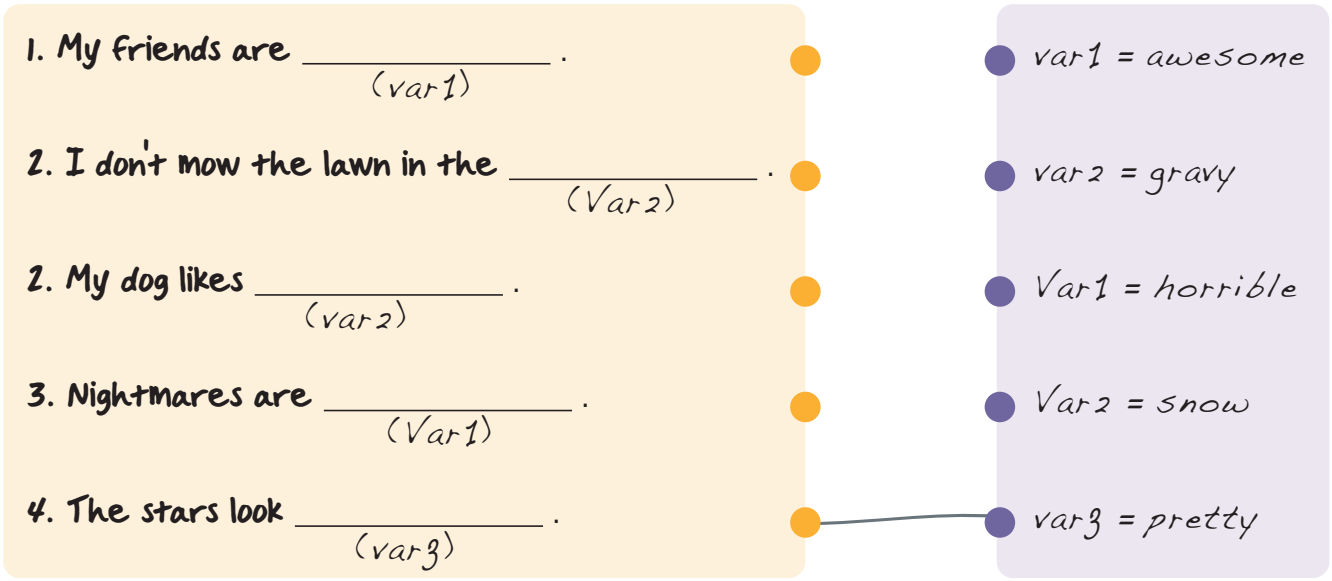
Variables Assessment Worksheet

Match the sentence to the variable that it calls by drawing a line from one to the other. The last one has been done for you.



To create this sentence, we're only going to use one variable, but we're going to use it five times. Follow the variable as its value changes before each line, and write the final sentence in the box below.

var1 = flowers

var1 = blooming

var1 = petals

var1 = closed

I like to look at the _____ (var1),
when the _____ (var1)
are _____ (var1) and when
the _____ (var1)
are _____ (var1) .

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Abstraction with Mad Glibs

Lesson time: 20 Minutes Basic lesson time includes activity only. Introductory and Wrap-Up suggestions can be used to delve deeper when time allows.

LESSON OVERVIEW

Abstraction is one of the most important skills for a computer scientist to understand. It simplifies problems and prevents unnecessary repetition. A good coder uses abstraction just about every time she creates a program. This activity will have your students analyze stories for differences so that they can abstract them away. Those abstracted stories become templates for fun and crazy new ones.

TEACHING SUMMARY

Getting Started - 10 minutes

1) Review
2) Vocabulary
3) An Abstract Reminder

Activity: Mad Glibs - 20 minutes

4) Mad Glibs

Wrap-up - 10 minutes

5) Flash Chat: What did we learn?
6) Vocab-Shmocab

Assessment - 10 minutes

7) Abstraction Assessment

LESSON OBJECTIVES

Students will:

- Have the chance to internalize the idea of “abstraction”
- Combine writing and abstraction to test their own creativity
- Analyze their day to find differences that they can turn into similarities

TEACHING GUIDE

MATERIALS, RESOURCES AND PREP

For the Student

- Mad Glibs Abstraction Worksheet
- Abstraction Assessment Worksheet
- Pens/Pencils

For the Teacher

- Print one Mad Glibs Abstraction Worksheet per student
- Print one Abstraction Assessment Worksheet
- Provide student with paper, pens & pencils

GETTING STARTED (10 MIN)

1) Review

This is a great time to review the last lesson that you went through with your class. We suggest you alternate between asking questions of the whole class and having students talk about their answers in small groups.

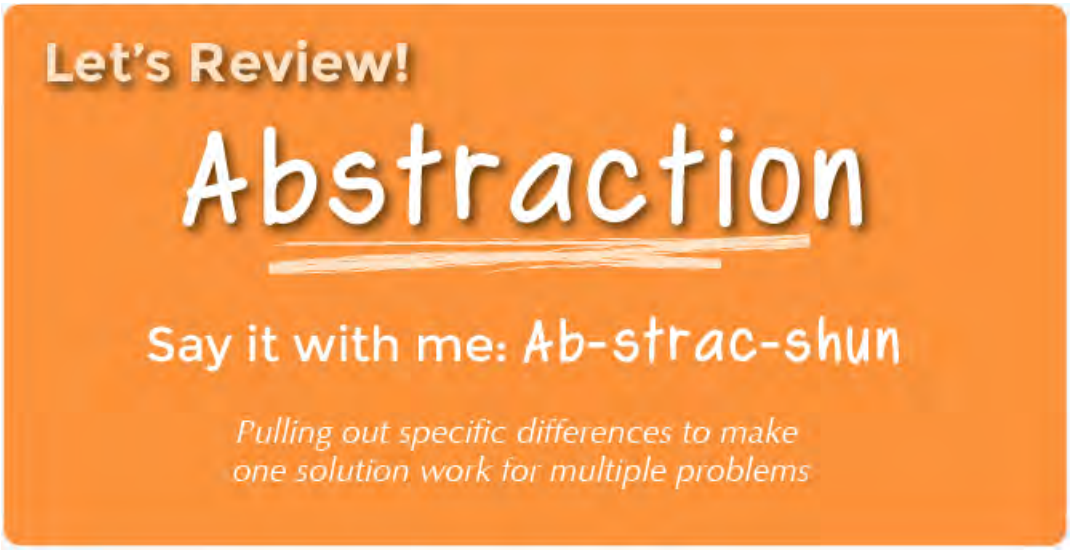
Here are some questions that you can ask in review:

- What did we do last time?
- What do you wish we would have had a chance to do?
- Did you think of any questions after the lesson that you want to ask?
- What was your favorite part of the last lesson??

LESSON TIP *Finishing the review by asking about the students' favorite things helps to leave a positive impression of the previous exercise, increasing excitement for the activity that you are about to introduce.*

2) Vocabulary

This lesson has one important word to review:



Abstraction - Say it with me: Ab-strac-shun
Pulling out specific differences to make one solution work for multiple problems

3) An Abstract Reminder

When you finish your review, try taking your class by surprise.

"So, what did you have for waffles this morning?"

Your students might look perplexed?

> "No one? Okay, what did you have for toast yesterday?"

You may start to get some hands raising, and people eager to share and agree because they want to relate, but possibly not because they understand.

> "See what I was doing there? I identified my experience in a very specific manner, and that made it harder for everyone else to relate to. What could I have said that more people would have understood?"

At some point, they'll start to come up with the idea of using "breakfast" in place of the actual food that was consumed.

> "In a way, the word 'breakfast' is like a variable that we use to hold a space for whatever it is we ate this morning. By taking the specific word out and replacing the space it leaves with 'breakfast,' we are using abstraction to make something work for multiple people."

Ask the class to give you some examples of other places that they may naturally use abstraction to allow more people to understand them. The idea of lunch and dinner will most-likely come up. Is there anything *not* food related?

ACTIVITY: MAD GLIBS (20 MIN)

4) Mad Glibs Abstraction Worksheet

The next step is to pass out a "fill-in-the-blank" story (see the Mad Glibs Abstraction Worksheet for a copy to print out) . Let them know that this started as a specific story about one thing, but we used abstraction to turn some of the specific words into blanks, and now the story can be about lots of things. Ask them what they can make their story about.

Story 1

First you take your _____ then add a layer of _____
before you pour on a hearty dose of _____ .
Next, press some _____ down into the _____ before
covering with a sprinkle of _____ .
That's how I make a _____ !

WRAP-UP (10 MIN)

5) Flash Chat: What did we learn?

- What did we learn today?
- How might you be able to use abstraction when describing things outside?
- Can you think of ways to use abstraction when talking about animals?

6) Vocab Shmocab

You can choose to do these as a class, or have the students discuss with an elbow partner and share.

- Do you remember the definition of the word "abstraction"?

> "A list of steps that you can follow to finish a task"
> "An object that looks like a triangle from one direction and a circle from another"
> "Pulling out specific differences to make one solution work for multiple problems"

ASSESSMENT (10 MIN)

7) **Abstraction Assessment Worksheet**

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Mad Drawing

- Challenge the students to use these same ideas to make puzzles out of drawings.
  - Have the students fold two pieces of paper in half three times and re-open them to lay them flat.
  - On one of those pieces, have them make a drawing where they leave one of the resulting rectangles blank.
  - Have them cut the other folded piece along the creases to wind up with eight rectangle shapes.
    - Encourage the students to make different drawings on all eight rectangles that believably complete their original drawing.
- Be sure to allow students time to share.

Prep for Songwriting with Parameters

- Can students find songs where there are phrases that repeat, except for one or two words that change?
  - Using "Old MacDonald" or "Five Little Monkeys" will prepare the students nicely for an activity that is coming up.

CONNECTIONS AND BACKGROUND INFORMATION

ISTE Standards (formerly NETS) Satisfied by this Lesson Include:

- 1c. Use models and simulations to explore complex systems and issues
- 2d. Contribute to project teams to produce original works or solve problems
- 4b. Plan and manage activities to develop a solution or complete a project
- 6c. Troubleshoot systems and applications

The activities in this lesson support CSTA K-12 Computer Science Standards:

- CT.L1:6.01 - Understand and use the basic steps in algorithmic problem-solving
- CT.L1:6.02 - Develop a simple understanding of an algorithm using computer-free exercises
- CPP.L1:6.05 - Construct a program as a set of step-by-step instructions to be acted out

Other standards, including the NGSS, and Common Core Math & Language Arts

- CCLA-K:SL.2 - Confirm understanding of a text by asking or answering questions
- CCLA-1:SL.2 - Ask and answer questions about key details in a text

Name: _____ Date: _____

U

Unplugged

Mad Glibs

Abstraction Worksheet

C O D E

Write a story using the Mad Glibs template below. Fill in the blanks with words to create something fun to share. Then, create a second story by writing another version on the lines at the bottom of the page.

Story 1

First you take your _____ then add a layer of _____ before you pour on a hearty dose of _____ .

Next, press some _____ down into the _____ before covering with a sprinkle of _____ .

That's how we make a _____ !

Story 2

Name: _____ Date: _____

Mad Glibs

Unplugged

Abstraction Assessment Worksheet

The Mad Glib template that we used to make these stories has vanished! Look at the stories and figure out which words are supposed to be blanks, then recreate the template at the bottom of the page.

Story 1

Early last year, my mom gave me an old skateboard. She told me about the days when she would ride it from her school in her hometown. I tried to ride it once, but tripped over my shoelaces. It didn't take long before I decided that it was best to leave the skateboarding to my mom.

Story 2

Sometime last year, my mom told me an old story. She told me about the days when she would hear it from her father in her childhood. I tried to tell it once, but tripped over my words. It didn't take long before I decided that it was best to leave the storytelling to my mom.

Create new template here:

6

Course 4 | Lesson 6

Artist: Variables

Lesson time: 30 Minutes

LESSON OVERVIEW

In this lesson, students will explore the creation of repetitive designs using variables. Students will learn how variables can be used to make code more simple to write and easier to read.

TEACHING SUMMARY

Getting Started

Introduction

Activity: Artist: Variables

Artist: Variables

Extended Learning

Extension Activities

LESSON OBJECTIVES

Students will:

- Create programs that utilize repetition to create gorgeous designs
- Use trial and error to recreate detailed designs in proper scale
- Calculate angles by dividing 360 by the number of sides in a polygon
- Decompose a shape into its smallest repeatable sequence

GETTING STARTED

Introduction

Remind your students of the unplugged lesson from a previous class.

- What if you wanted to draw a square on the board and each side was labeled "side"
  - What would happen if you had an envelope labeled "side" with "10 inches inside"?
  - What would happen to the square if you switched the paper in the "side" envelope to "20 inches"?
  - What if you labeled the sides of the square with "2*side"?

Next, review with students the basic artist navigation, particularly:

- Moving forward
- Turning left/right
- Looping
- Angles

ACTIVITY

Artist: Variables

This lesson explores the use of variables as a way to quickly change many values at one time. Not only will the students be dealing with the looping of designs and repetition of angles, they'll also be doing math on variables. It can be helpful for them to have paper and pencil to figure out values as they go. Also, let them know ahead of time that there will likely be some puzzles that confuse or frustrate them. This is normal, and expected. Students should prepare themselves for persistence and perseverance.

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Get Steppin'

Get a few volunteers to come to the front of the room. Assign the group a shape (like a line, a triangle, or a square) with each side length "side". Give each volunteer an envelope labeled "side" with different numbers of steps inside of each. Have them all start walking to make whatever shape you assigned, but each only gets to walk the number of steps inside their envelope before they turn.

- Do one sample, then ask the class if they can tell where the variable came in
- After you've done the square, ask the class how we might be able to use the same variable to create a rectangle with a length that's twice the width.
- How else might we use the same variable to change our polygons?
- Where could we use a second variable? What might we call it?

7

Course 4 | Lesson 7

Play Lab: Variables

Lesson time: 30 Minutes

LESSON OVERVIEW

In this activity, students will have the opportunity to play with variables in a situation that illustrates just how useful they can be. Students will edit games to give themselves the advantage and make their characters more powerful using variables as parameters.

TEACHING SUMMARY

Getting Started

Introduction

Activity: Play Lab: Variables

Play Lab: Variables

Extended Learning

Extension Activities

LESSON OBJECTIVES

Students will:

- Identify the numbers that are responsible for specific elements of a program
- Create a game that incorporates numerical parameters
- Replace numbers with descriptive variables

GETTING STARTED

Introduction

Review the previous lesson, paying particular attention to the use of variables.

- What is a variable, and how many ways can you think to use them?
- Now you're going to create games online using variables instead of entering numbers.

ACTIVITY

Play Lab: Variables

This lesson will guide the students from a place where they are playing a game programmed using numbers traditionally, to a place where they substitute variables for numerical values so that their program is easier to read.

The challenges with this stage come about most when they are trying to remember to use variables in free play at the end. It may be helpful to walk around and ask the students to show you where and how they are using variables, and why they chose the names that they came up with.

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Variable Surprise

Bring your students back to Play Lab and have them create any game they want, with the requirement that they each have variables called "step" and "fly".

- Once students have had a chance to make something, encourage the class to walk around to look at one another's programs.
  - Did any of the games have similarities?
  - How might the variable names have influenced the creation of the games?
- Have the students go back to edit their games.
  - Ask the students to set "step" to 2 and "fly" to 20 and share out how that changed their original creations.
    - Did it affect anyone in a way that was unexpected?
    - Note that the students all had the same variable names, but they likely used them differently.

U

UNPLUGGED

For Loop Fun

Lesson time: 25 Minutes Basic lesson time includes activity only. Introductory and Wrap-Up suggestions can be used to delve deeper when time allows.

LESSON OVERVIEW

We know that loops allow us to do things over and over again, but now we're going to learn how to use loops with extra structure built right in.

TEACHING SUMMARY

Getting Started - 15 minutes

1) Review
2) Vocabulary
3) For One and All

Activity: For Loop Fun - 25 minutes

4) For Loop Fun

Wrap-up - 10 minutes

5) Flash Chat - What did we learn?
6) Vocab-Shmocab

Assessment - 5 minutes

7) Conditionals with Cards Assessment

LESSON OBJECTIVES

Students will:

- Determine starting value, stopping value, and interval of "for loop"
- Illustrate the counter values hit each time through a for loop during runtime

TEACHING GUIDE

MATERIALS, RESOURCES AND PREP

For the Student

- Dice (3 per pair of students)
- Pens & Pencils
- For Loop Fun Worksheet
- For Loop Fun Assessment

For the Teacher

- This Teacher Lesson Guide
- Print one For Loop Fun Worksheet per group
- Print one For Loop Fun Assessment for each student

GETTING STARTED (20 MIN)

1) Review

This is a great time to review the last lesson that you went through with your class. We suggest you alternate between asking questions of the whole class and having students talk about their answers in small groups.

Here are some questions that you can ask in review:

- What did we do last time?
- What do you wish we would have had a chance to do?
- Did you think of any questions after the lesson that you want to ask?
- What was your favorite part of the last lesson??

LESSON TIP *Finishing the review by asking about the students' favorite things helps to leave a positive impression of the previous exercise, increasing excitement for the activity that you are about to introduce.*

2) Vocabulary

This lesson has one new and important word:

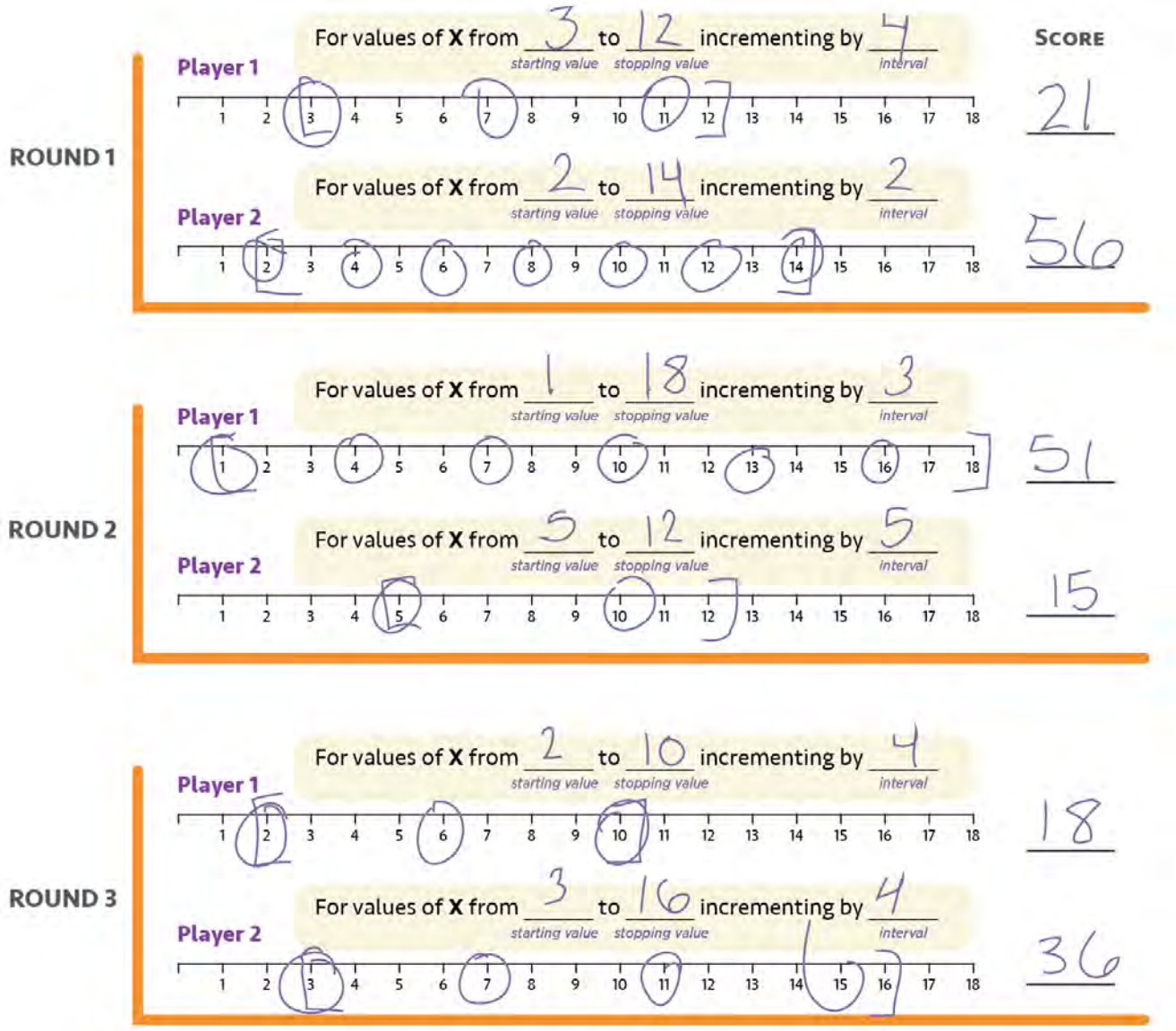
For Loop - Say it with me: For-Loop
Loops that have a predetermined beginning, end, and increment (step interval)

3) For One and All

- If you did the original loops lesson (remember The Iteration?) you can call back to the usefulness of loops in general
- Point out that there are certain loops that happen very frequently, for example, loops where you need to keep track of how many times you have been through
  - Sometimes, you don't want to start with one

- Sometimes, you don't want to count by ones
- For Loops give you a powerful way to keep a counter that starts when you want, ends when you want, and increases by whatever size step that you want

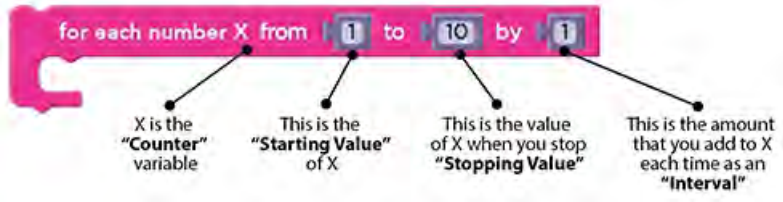
Here, you can jump right into a sample of the game



ACTIVITIES: (20 MIN)

4) For Loop Fun

Sometimes we want to repeat things a certain number of times, but we want to keep track of values as we do. This is where a “for loop” comes in handy. When you use a for loop, you know right from the start what your beginning value is, what your ending value is, and how much the value changes each time through the loop.



Directions:

1) Divide students into pairs

2) To start the round, each student rolls three times:
- One die to determine the starting value of X
- Three dice to determine the stopping value for X
- One die to determine the step interval of X each time through

3) Use one of the provided number lines to trace the for loop that they've made
- Start at the starting value of X
- Count down the number line, circling the numbers at the rolled interval
- Stop when you get to the predetermined stopping value

4) Add all of the circled values to your score, then let the other player take a turn

5) Best 2 out of 3 wins

LESSON TIP

When you play this game, it's as if you're running through a loop like this

```
for (x=startValue; x <= stopValue; x = x + interval){
circle currentXvalue;
add currentXvalue to roundScore;
}
```

It may be difficult for young students to understand this written in pseudocode, but it may be helpful to have you explain out loud (and perhaps with a diagram) what they will be using as the content of a for loop.

WRAP-UP (5 MIN)

5) Flash Chat: What did we learn?

- What would your interval need to be if you wanted to count from 4 to 13 by threes?
- What kinds of things do you think you could do with a for loop?
- Can you reproduce a normal loop using a for loop?
  - What would you need to do?

LESSON TIP

Flash Chat questions are intended to spark big-picture thinking about how the lesson relates to the greater world and the students' greater future. Use your knowledge of your classroom to decide if you want to discuss these as a class, in groups, or with an elbow-partner.

6) Vocab Shmocab

- Which one of these definitions did we learn a word for today?

"Doing something more than once the exact same way"
"Loops that have a predetermined beginning, end, and increment."
"Statements that only run under certain conditions"

...and what is the word that we learned?

ASSESSMENT (5 MIN)

7) For Loop Fun Assessment

- Hand out the assessment worksheet and allow students to complete the activity independently after the instructions have been well explained.

- This should feel familiar, thanks to the previous activities.

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Run it Backward

- Try this activity again, but this time have the start number be selected using three dice, and the stop number with only one. Make sure to have a *negative* increment!

Hop Scotch

- Using chalk, draw a hop scotch diagram outside on the blacktop
  - Number the squares from bottom to top
  - Have students give each other a start square, stop square, and how many at a time they need to jump
  - When the jumper is done, have them write down the loop they just performed
  - Start adding additional activities to be done at each square, this will add complexity to the written portion, as well

CONNECTIONS AND BACKGROUND INFORMATION

ISTE Standards (formerly NETS) Satisfied by this Lesson Include:

- 1.c - Use models and simulation to explore complex systems and issues
- 2.d - Contribute to project teams to solve problems

The activities in this lesson support CSTA K-12 Computer Science Standards:

- CT.L1:6.01 - Understand and use the basic steps in algorithmic problem-solving
- CT.L1:6.02 - Develop a simple understanding of an algorithm using computer-free exercises

Other standards, including the NGSS, and Common Core Math & Language Arts

Name: _____ Date: _____

For Loop Fun

Number Lines and Score Sheet

Unplugged

Directions:

* Use the number lines to trace the "for loop" for each turn
    * Start at the starting value of X
    * Count down the number line, circling the numbers at the correct interval
    * Stop when you get to the stopping value
* Add all of the circled values to get the score for your round
* Best 2 out of 3 Wins

ROUND 1

Player 1

For values of **X** from _____ to _____ incrementing by _____
starting value *stopping value* *interval*

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Player 2

For values of **X** from _____ to _____ incrementing by _____
starting value *stopping value* *interval*

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Score _____

ROUND 2

Player 1

For values of **X** from _____ to _____ incrementing by _____
starting value *stopping value* *interval*

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Player 2

For values of **X** from _____ to _____ incrementing by _____
starting value *stopping value* *interval*

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

_____

ROUND 3

Player 1

For values of **X** from _____ to _____ incrementing by _____
starting value *stopping value* *interval*

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Player 2

For values of **X** from _____ to _____ incrementing by _____
starting value *stopping value* *interval*

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

_____

U

Unplugged

Name: _____ Date: _____

For Loop Fun

Sample Game Sheet

C O D E

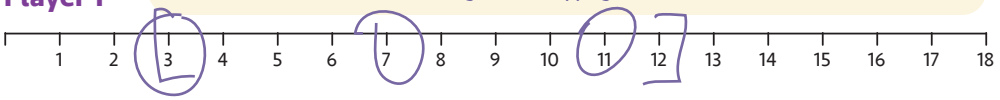
Directions:

* Use the number lines to trace the "for loop" for each turn
  * Start at the starting value of X
  * Count down the number line, circling the numbers at the correct interval
  * Stop when you get to the stopping value
* Add all of the circled values to get the score for your round
* Best 2 out of 3 Wins

ROUND 1

Player 1

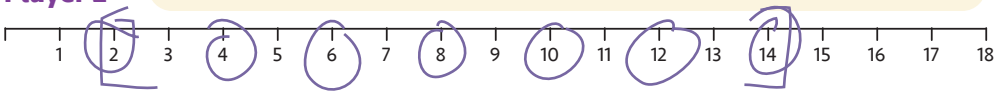
For values of **X** from 3 (starting value) to 12 (stopping value) incrementing by 4 (interval)



Score 21

Player 2

For values of **X** from 2 (starting value) to 14 (stopping value) incrementing by 2 (interval)

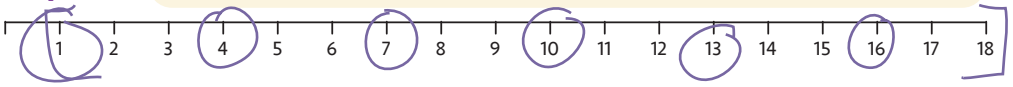


56

ROUND 2

Player 1

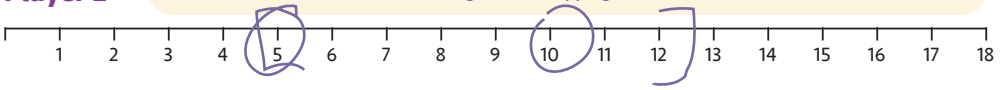
For values of **X** from 1 (starting value) to 18 (stopping value) incrementing by 3 (interval)



51

Player 2

For values of **X** from 5 (starting value) to 12 (stopping value) incrementing by 5 (interval)

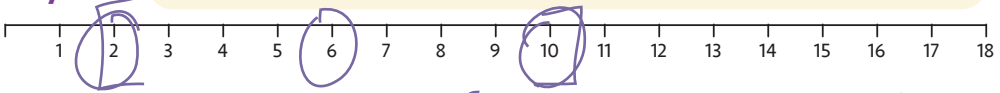


15

ROUND 3

Player 1

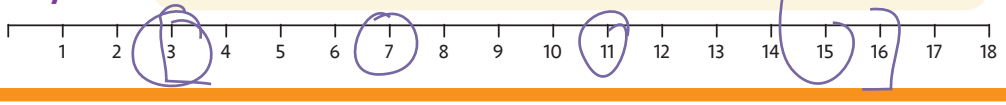
For values of **X** from 2 (starting value) to 10 (stopping value) incrementing by 4 (interval)



18

Player 2

For values of **X** from 3 (starting value) to 16 (stopping value) incrementing by 4 (interval)



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Unplugged

Name: _____ Date: _____

For Loop Fun

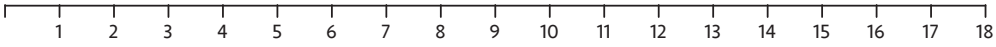
Assessment Worksheet

Below, you will find three rounds of the For Loop Game, along with what each player rolled during their turn. Fill out the number lines and tally the scores for each round.
Who won the game?

ROUND 1

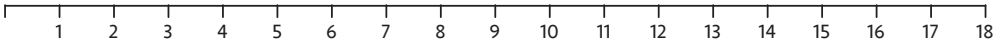
Player 1

For values of **X** from 1 (*starting value*) to 18 (*stopping value*) incrementing by 4 (*interval*)



Player 2

For values of **X** from 3 (*starting value*) to 11 (*stopping value*) incrementing by 2 (*interval*)

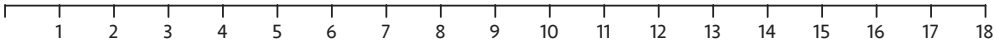


SCORE _____ _____

ROUND 2

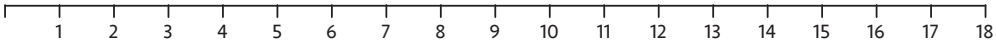
Player 1

For values of **X** from 3 (*starting value*) to 17 (*stopping value*) incrementing by 5 (*interval*)



Player 2

For values of **X** from 5 (*starting value*) to 17 (*stopping value*) incrementing by 3 (*interval*)

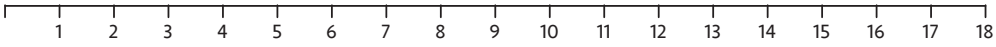


_____ _____

ROUND 3

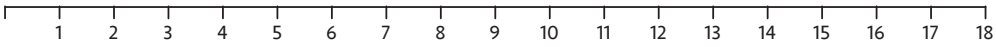
Player 1

For values of **X** from 6 (*starting value*) to 11 (*stopping value*) incrementing by 1 (*interval*)



Player 2

For values of **X** from 2 (*starting value*) to 15 (*stopping value*) incrementing by 6 (*interval*)



_____ _____

WHO WON?
PLAYER # _____

Directions:

* Use the number lines to trace the "for loop" for each turn
    * Start by circling the number at the starting value of X
    * Count down the number line, circling the numbers at the correct interval
    * Stop when you get to the stopping value
* Add all of the circled values to get the score for your round
* Best 2 out of 3 Wins

9

Course 4 | Lesson 9

Bee: For Loops

Lesson time: 30 Minutes

LESSON OVERVIEW

Students use the Bee environment to write programs that use loops with embedded counters/index variables. These loops are called for loops, and they utilize predetermined start and stop values.

TEACHING SUMMARY

Getting Started

Introduction

Activity: Bee: For Loops

Bee: For Loops

LESSON OBJECTIVES

Students will:

- Break one long sequence of steps into shorter looped sequences
- Use the "for loop" structure to repeat an action a variable number of times each iteration.

GETTING STARTED

Introduction

ACTIVITY

Bee: For Loops

This activity walks students through the differences between loops and for loops. In many cases, it is possible to solve problems with brute force that can easily be solved using for loops instead. As you walk around, look for students who are correctly using for loops and counters, then point out why the counters make the program easier.

The final stage counts down, collecting less nectar as the counter increases. This is expected to cause a small amount of frustration. Encourage students to talk about what is supposed to be happening out loud. That should help them stumble upon the answer on their own.

10

Course 4 | Lesson 10

Artist: For Loops

Lesson time: 30 Minutes

LESSON OVERVIEW

Students use the Artist environment to write programs with for loops, similar to what they did in the previous Bee level.

TEACHING SUMMARY

Getting Started

Introduction

Activity: Artist: For Loops

Artist: For Loops

Extended Learning

Extension Activities

LESSON OBJECTIVES

Students will:

- Predict the number of steps needed to increment in each for loop iteration
- Determine start and stop values for multiple for loop examples

GETTING STARTED

Introduction

ACTIVITY

Artist: For Loops

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

11

Course 4 | Lesson 11

Play Lab: For Loops

Lesson time: 30 Minutes

LESSON OVERVIEW

Building on the previous Play Lab activity, students will add deeper interactivity as they build their own video games.

TEACHING SUMMARY

Getting Started

Introduction

Activity: Play Lab For Loops

Play Lab: For Loops

Extended Learning

Extension Activities

LESSON OBJECTIVES

Students will:

- Utilize for loops to count from 1 to 100
- Count by tens repeatedly using the for loop structure
- Employ skills from previous lessons to create more difficult looping algorithms

GETTING STARTED

Introduction

ACTIVITY

Play Lab: For Loops

Play Lab allows students to combine their new for loop skills with skills from past lessons to create fun games that are relevant to their life. The last puzzle of this stage is fairly unstructured, so a watchful eye may be helpful to encourage the class to integrate for loops into their final game.

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

12

Course 4 | Lesson 12

Artist: Functions

Lesson time: 30 Minutes

LESSON OVERVIEW

Students use the Artist environment to draw complicated images using functions for repeated tasks.

TEACHING SUMMARY

Getting Started

Introduction

Activity: Artist: Functions

Artist: Functions

Extended Learning

Extension Activities

LESSON OBJECTIVES

Students will:

- Identify repeated movements and utilize functions to simplify their program
- Use trial and error to re-create complex patterns
- Break complex tasks into smaller repeatable sections
- Combine simple shapes into complex designs with functions

GETTING STARTED

Introduction

In this stage, students will walk from using repetitive instructions into learning how to integrate functions as a simplification technique.

ACTIVITY

Artist: Functions

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

U

UNPLUGGED

Songwriting with Parameters

Lesson time: 20 Minutes Basic lesson time includes activity only. Introductory and Wrap-Up suggestions can be used to delve deeper when time allows.

LESSON OVERVIEW

One of the most magnificent structures in the computer science world is the function. Functions (sometimes called procedures) are mini programs that you can use over and over inside of your bigger program. This lesson will help students intuitively understand why combining chunks of code into functions is such a helpful practice.

TEACHING SUMMARY

Getting Started - 20 minutes

1) Review
2) Vocabulary
3) Sing a Song

Activity: Songwriting with Parameters - 20 minutes

4) Songwriting with Parameters

Wrap-up - 5 minutes

5) Flash Chat - What did we learn?
6) Vocab-Shmocab

Assessment - 10 minutes

7) Songwriting Assessment

LESSON OBJECTIVES

Students will:

- Locate repeating phrases inside song lyrics
- Identify sections of a song to pull into a function (chorus)
- Modify functions to accept parameters
- Describe how functions and parameters can make programs easier to write

TEACHING GUIDE

MATERIALS, RESOURCES AND PREP

For the Student

- Songwriting Worksheets
- Pens & Pencils
- One Songwriting Assessment for each student.

For the Teacher

- This Teacher Lesson Guide
- Print several Songwriting Worksheets for each group
- Print one Songwriting Assessment for each student.
- Access to the internet, or pre-downloaded songs and lyrics for activity

GETTING STARTED (20 MIN)

1) Review

This is a great time to review the last lesson that you went through with your class. We suggest you alternate between asking questions of the whole class and having students talk about their answers in small groups.

Here are some questions that you can ask in review:

- What did we do last time?
- What do you wish we would have had a chance to do?
- Did you think of any questions after the lesson that you want to ask?
- What was your favorite part of the last lesson?

LESSON TIP *Finishing the review by asking about the students' favorite things helps to leave a positive impression of the previous exercise, increasing excitement for the activity that you are about to introduce.*

2) Vocabulary

This lesson has two new and important words:

Function - Say it with me: Func-shun
A piece of code that you can call over and over again

Parameter - Say it with me: Pa-ram-eh-ter
An extra piece of information that you pass to the function to customize it for a specific need

3) Sing a Song

- Let the class know that today is song day!
- We're going to learn a song together.
  - Start with a simple song either written out or projected on the screen
  - Point to the chorus and be sure that the class knows how it goes before you begin on the rest of the song
  - Blast through the song, singing it with them in the beginning, then see what happens when you get to the part where it calls the chorus

Chorus:

Little bunny Foo Foo
Hopping through the forest
Scooping up the field mice
And bopping 'em on the head
Down came the Fairy
And she said
"Little bunny Foo Foo
I don't wanna see you
Scooping up the field mice
And bopping 'em on the head"

Song:

Chorus

I'll give you 3 chances.
Then I'll turn you into a goon!
The next day...

Chorus

I'll give you 2 chances.
Then I'll turn you into a goon!
The next day...

Chorus

I'll give you 1 more chance.
Then I'll turn you into a goon!
The next day...

Chorus

"I gave you two chances.
Now I'll turn you into a goon!"
(POOF!)
And the moral of the story is:
Hare today, goon tomorrow!

- It's quite likely that the majority of the class will sing the lyrics for the chorus when you point to that bit.
  - Stop the song once that happens, and explicitly highlight what just happened
    - You defined the chorus
    - You called the chorus
    - They sang the chorus
- Ask the class why they suppose you only wrote the chorus once at the top of the paper instead of writing it over

and over in each place where it is supposed to be sung.
    - What are other benefits of only writing the chorus once when you sing it many times?

Now, imagine that this song is a computer program. Defining a title (like "chorus") for a little piece of code that you use over and over again is called creating a *function*. This is helpful to computer scientists for the some of the same reasons that it is helpful to songwriters. - It saves time not having to write all the code over and over in the program - If you make a mistake, you only have to change it one place - The program feels less complicated with the repeating pieces defined just once at the top

What about songs where the chorus isn't exactly the same every time? You can still use a chorus, but you have to have a way to let the singer know what special words you will use for each verse.

- These special words are called parameters.
- In programming, parameters are passed as special instructions to functions like this:

```
chorus(parameter1, parameter2)
```

Feel like this is starting to get complicated? Don't worry. We're going to play with songs a little more to try to really understand how this technique is used!

LESSON TIP

To add more interest, you can look up the lyrics for some popular songs on the Internet. Show the students that the standard for repeating lyrics is to define the chorus at the top and call it from within the body of the song.

ACTIVITIES: (20 MIN)

4) Songwriting

- A fantastic way to compare functions to something we see in our everyday lives is to look at songs. Songs often have certain groups of lyrics that repeat over and over. We call that a chorus.

Directions:

1) Divide into groups of 4, 5, or 6.

2) Give each group several copies of the Songwriting Worksheet

3) Play a short song for the class that contains a clear chorus that does not change from verse to verse.

4) Challenge the class to identify (and write down) the chorus.

5) Compare results from each group. Did everyone get the same thing?

6) Try the activity again, but this time with a song that changes during each repetition of the chorus. Good examples are: Old MacDonald, Baby Bumblebee, or The Hokey Pokey

- Can the students identify a chorus when some words change?
- How might they use the same idea of calling a chorus when the chorus is different from verse to verse?
- These changing words and phrases are called “parameters” and you can pass them into the chorus like this: chorus(cow, moo)
- Play this game over and over until the class has little trouble identifying the choruses.

It is often easier just to have the class listen to (or watch) the song, then vote on what the chorus is by singing it together, rather than writing the whole thing down. If you choose this method, consider having the class do a written chorus for the final song selection to be sure that the visual learners get proper reinforcement.

LESSON TIP

It's most exciting for students to do this lesson with popular music from the radio, but if you're having a hard time finding appropriate songs where the lyrics repeat exactly, here are a few timeless options:

- 5 Little Monkeys
- Old MacDonald
- Hokey Pokey
- BINGO
- Baby Bumble Bee

WRAP-UP (5 MIN)

5) Flash Chat: What did we learn?

- Would you rather write lyrics over and over again or define a chorus?
- Do you think it's possible to make multiple choruses for the same song?
- Does it make sense to make a new chorus for every time it's needed in a song?

LESSON TIP

Flash Chat questions are intended to spark big-picture thinking about how the lesson relates to the greater world and the students' greater future. Use your knowledge of your classroom to decide if you want to discuss these as a class, in groups, or with an elbow partner.

6) Vocab Shmocab

- Which one of these definitions did we learn a word for today?

  "A piece of code that you can call over and over again"
  "A small shard of wood"
  "Getting help from a large group of people to finish something faster"

  ...and what is the word that we learned?

- What about parameters?
  - Why do we use them?
  - Can you pass more than one parameter to a chorus function?
  - Can you pass more than two?

ASSESSMENT (5 MIN)

7) Songwriting Assessment

- Hand out the assessment worksheet and allow students to complete the activity independently after the instructions have been well explained.
- This should feel familiar, thanks to the previous activities.

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Create Your Song

- Start by creating a chorus together, then repeat it between verses of a song that you develop around it.
- Make a change to the chorus, and ponder how much easier it is to change in just one place.
- Change the chorus again, making it much longer than it was originally.
- Add a second chorus and alternate between them in your verses.

- Add parameters to one of your choruses and see how many more options you have.

Songwriting a Program

- What if we acted out songs instead of singing them? All of the sudden, our chorus would be a function of repeated actions, rather than words.
- Use the concepts of the arrows from the Graph Paper Programming lesson and create a program with lots of repeating instructions.
  - Circle those repeating actions so that the class can see where they are.
  - Define a function called "Chorus" above the program.
  - Cross out everywhere the repeating actions appear in the program and write "Chorus" instead.
- Repeat until the class can go through this process fairly undirected.
- Can you figure out how to pass parameters in this exercise?

CONNECTIONS AND BACKGROUND INFORMATION

ISTE Standards (formerly NETS)

- 1.a - Apply existing knowledge to generate new ideas, products, or processes.
- 1.c - Use models and simulation to explore complex systems and issues.
- 2.a - Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
- 2.d - Contribute to project teams to solve problems.
- 4.b - Plan and manage activities to develop a solution or complete a project.
- 4.d - Use multiple processes and diverse perspectives to explore alternative solutions.
- 6.c - Troubleshoot systems and applications.

CSTA K-12 Computer Science Standards

CL.L1:3.2 - Work cooperatively and collaboratively with peers teachers, and others using technology.
CT.L2:2.1 - Use the basic steps in algorithmic problem solving to design solutions.
CT.L2:2-6 - Describe and analyze a sequence of instructions being followed.
CT.L2:2-7 - Represent data in a variety of ways: text, sounds, pictures, numbers.
CT.L2:2-8 - Use visual representations of problem states, structures, and data.
CT.L2:2-12 - Use abstraction to decompose a problem into sub problems.
CT.L3A:1 - Use predefined functions and parameters, classes and methods to divide a complex problem into simpler parts.
CT.L3A:3 - Explain how sequence, selection, iteration, and recursion are building blocks of algorithms.
CPP.L1:6-5 - Construct a program as a set of step-by-step instructions to be acted out.
CT.L2:2-14 - Examine connections between elements of mathematics and computer science including binary numbers, logic, sets, and functions.

NGSS Science and Engineering Practices

- K-2-ETS1-1 - Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- 3-5-ETS1-2 - Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Common Core Mathematical Practices

- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.
- 3. Construct viable arguments and critique the reasoning of others.
- 6. Attend to precision.
- 7. Look for and make use of structure.
- 8. Look for and express regularity in repeated reasoning.

Common Core Language Arts Standards

- SL.2.1.B - Build on others' talk in conversations by linking their comments to the remarks of others.

- SL.2.1.C - Ask for clarification and further explanation as needed about the topics and texts under discussion.
- SL.2.2 - Recount or describe key ideas or details from a text read aloud or information presented orally or through other media.
- SL.2.3 - Ask and answer questions about what a speaker says in order to clarify comprehension, gather additional information, or deepen understanding of a topic or issue.
- RI.2.4 - Determine the meaning of words and phrases in a text relevant to a grade 2 topic or subject area.
- SL.3.1.C - Ask questions to check understanding of information presented, stay on topic, and link their comments to the remarks of others.
- SL.3.1.D - Explain their own ideas and understanding in light of the discussion.
- SL.3.3 - Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.
- RI.3.1 - Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
- L.3.6 - Acquire and use accurately grade-appropriate conversational, general academic, and domain-specific words and phrases, including those that signal spatial and temporal relationships.

Group Name: _____ Date: _____

Songwriting Worksheet Example

Using Lyrics to Explain Functions and Procedures

Song Name: Old MacDonald

Chorus:

Old MacDonald had a farm
e-i-e-i-o
And on that farm he had a **P1**
e-i-e-i-o
With a **P2** here and a **P2** there
Here a **P2**, there a **P2**
Everywhere a **P2**, **P2**

Parameter Examples:

Animal Name	Sound	
(P1)	(P2)	(P3)

Song:

Chorus(Cow, Moo)
Chorus(Pig, Oink)
Chorus(Horse, Neeeeigh)
Old MacDonald had a farm
eeeeeeee-iiiiiiiiii
eeeeeeee-iiiiiiiiii
ohhhhhhhhhhhhh!

U

Unplugged

Group Name: _____ Date: _____

Songwriting Worksheet

Using Lyrics to Explain Functions and Procedures

C O D E

Song Name:

Chorus:

Parameter Examples: _____ (P1) _____ (P2) _____ (P3)

Song:

Name: _____ Date: _____

Songwriting

Lesson Assessment

Look at the lyrics for the two songs below.

If it were your job to write this song as a computer program, what chunk of code would you turn into a function so that you could easily use it over and over again?

Circle the segments of each program that repeat most often. Is everything that you circled exactly the same? What parts are different? Those will need to be parameters.

Finish by filling out the Songwriting Worksheet with the song name, chorus, parameters, and a full version of the song that calls the chorus using the parameters that you chose.

Song: Where is Thumbkin?

Where is Thumbkin?
Where is Thumbkin?
Here I am!
Here I am!
How are you today, sir?
Very well, I thank you.
Run away.
Run away.

Where is Pointer?
Where is Pointer?
Here I am!
Here I am!
How are you today, sir?
Very well, I thank you.
Run away.
Run away.

Where is Middleman?
Where is Middleman?
Here I am!
Here I am!
How are you today, sir?
Very well, I thank you.
Run away.
Run away.

Where is Ringman?
Where is Ringman?
Here I am!
Here I am!
How are you today, sir?
Very well, I thank you.
Run away.
Run away.

Where is Pinkie?
Where is Pinkie?
Here I am!
Here I am!
How are you today, sir?
Very well, I thank you.
Run away.
Run away.

Unplugged

Name: _____ Date: _____

Songwriting Worksheet

Lesson 8 Assessment - Finding the Function in a Song

C O D E

Song Name:

Chorus:

Parameter Examples: _____ (P1) _____ (P2) _____ (P3)

Song:

14

Course 4 | Lesson 14

Artist: Functions with Parameters

Lesson time: 30 Minutes

LESSON OVERVIEW

Students will use the Artist environment to draw complicated images using functions with parameters to create similar shapes with small differences.

TEACHING SUMMARY

Getting Started

Introduction

Activity: Artist: Functions with Parameters

Artist: Functions with Parameters

Extended Learning

Extension Activities

LESSON OBJECTIVES

Students will:

- Identify repeated movements and utilize functions to simplify a program
- Break complex tasks into smaller repeatable sections
- Combine simple shapes into complex designs with functions
- Utilize parameters to make one function work for multiple purposes

GETTING STARTED

Introduction

Students will have experienced functions through Artist in a previous stage. This stage adds the option of parameters, which will allow one function to work for multiple creations. There may be some confusion over creating parameters inside a function, so it is a good idea to have the class watch the associated video, or to watch a function with parameter being created in advance of the lesson.

ACTIVITY

Artist: Functions with Parameters

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other

enrichment.

15

Course 4 | Lesson 15

Play Lab: Functions with Parameters

Lesson time: 30 Minutes

LESSON OVERVIEW

Having experienced the creation and use of functions and parameters, students will get the opportunity to use the skill in the creation of Play Lab games. Later puzzles incorporate the use of multiple parameters.

TEACHING SUMMARY

Getting Started

Introduction

Activity: Play Lab: Functions with Parameters

Artist: Play Lab with Parameters

Extended Learning

Extension Activities

LESSON OBJECTIVES

Students will:

- Identify repeated movements and utilize functions to simplify a program
- Utilize parameters to make one function work for multiple purposes
- Adapt their understanding of functions to allow for the use of multiple parameters

GETTING STARTED

Introduction

While the students will have had some experience creating functions with parameters in earlier stages, this Play Lab stage adds the complexity of using multiple parameters inside a single function. This is a great opportunity to remind students that it is okay to get frustrated and to use trial and error as an effective learning tool.

ACTIVITY

Play Lab: Functions with Parameters

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

16

Course 4 | Lesson 16

Bee: Functions with Parameters

Lesson time: 30 Minutes

LESSON OVERVIEW

This short stage illustrates how students can use their new skills with functions and parameters to change direction using binary logic.

TEACHING SUMMARY

Getting Started

Introduction

Activity: Bee: Functions with Parameters

Bee: Functions with Parameters

Extended Learning

Extension Activities

LESSON OBJECTIVES

Students will:

- Edit existing functions to make them work for specific tasks
- Combine similar functions into a single one by utilizing parameters

GETTING STARTED

Introduction

This lesson gets complicated rather quickly. If your students had an easy time with previous lessons, then they should be able to keep up just fine. If, however, they found the previous stages difficult, you may want to have them revisit Play Lab: Functions with Paramaters first. In this Bee level, students will not only be using multiple parameters iside their functions, they will also be using binary flags (left = 0, right = 1) to allow for logic decisions.

ACTIVITY

Bee: Functions with Parameters

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

U

UNPLUGGED

Binary Images

Lesson time: 20 Minutes Basic lesson time includes activity only. Introductory and Wrap-Up suggestions can be used to delve deeper when time allows.

LESSON OVERVIEW

Though many people think of binary as strictly zeros and ones, our previous courses taught students that information can be represented in a variety of binary options. This lesson takes that concept one step further as it illustrates how a computer can store even more complex information (such as images and colors) in binary, as well.

TEACHING SUMMARY

Getting Started - 10 minutes

1) Review
2) Vocabulary
3) Binary in Review

Activity: Binary Images - 20 minutes

4) Binary Images

Wrap-up - 10 minutes

5) Flash Chat: What did we learn?
6) Vocab-Shmocab

Assessment - 10 minutes

7) Binary Images Assessment

LESSON OBJECTIVES

Students will:

- Identify methods for encoding images into binary
- Relate images to a peer using binary encoding
- Reproduce an image, based on binary code

TEACHING GUIDE

MATERIALS, RESOURCES AND PREP

For the Student

- One Binary Images Worksheet per pair
- One Binary Image Assessment Worksheet per student
- Blank Paper, pens, pencils

- Other trinkets that can display opposites, such as: Playing Cards, checkers, coin, etc. (Optional)

For the Teacher

- Teacher guide
- Print one Binary Images Worksheet per pair
- Print one Binary Image Assessment Worksheet per student
- Gather groupings of items that can show opposites for students to use when coming up with their own binary encodings (Optional)

GETTING STARTED (10 MIN)

1) Review

This is a great time to review the last lesson that you went through with your class. We suggest you alternate between asking questions of the whole class and having students talk about their answers in small groups.

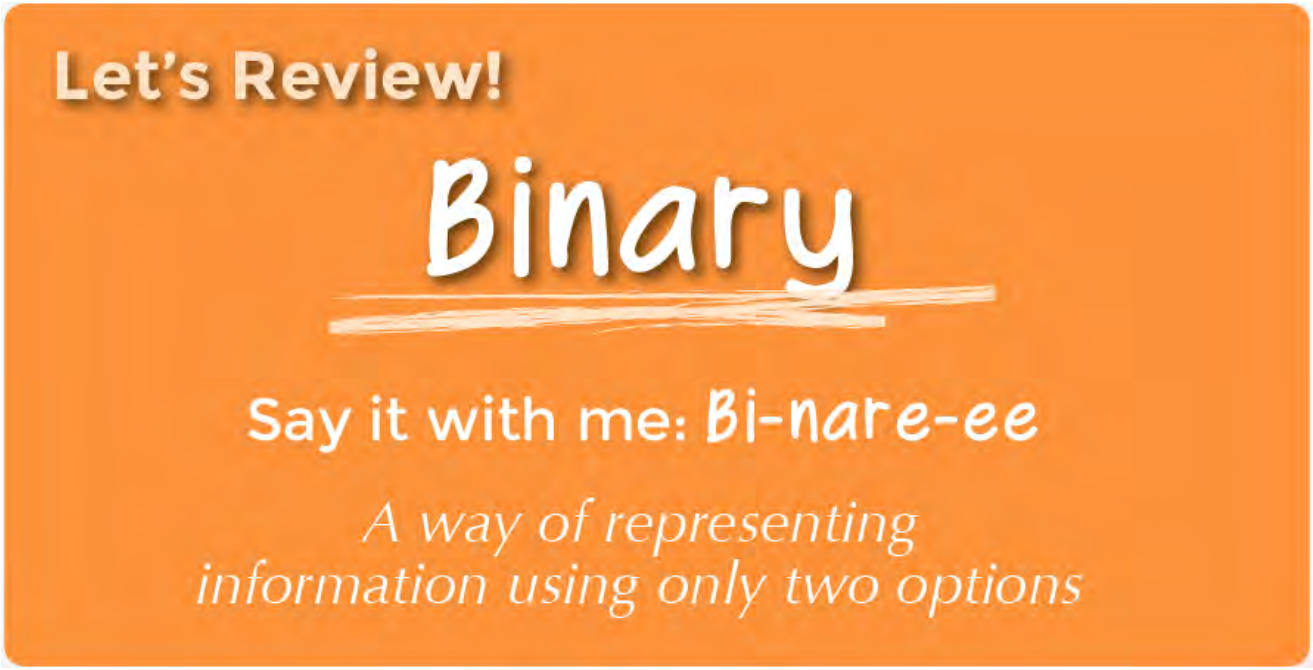
Here are some questions that you can ask in review:

- What did we do last time?
- What do you wish we would have had a chance to do?
- Did you think of any questions after the lesson that you want to ask?
- What was your favorite part of the last lesson??

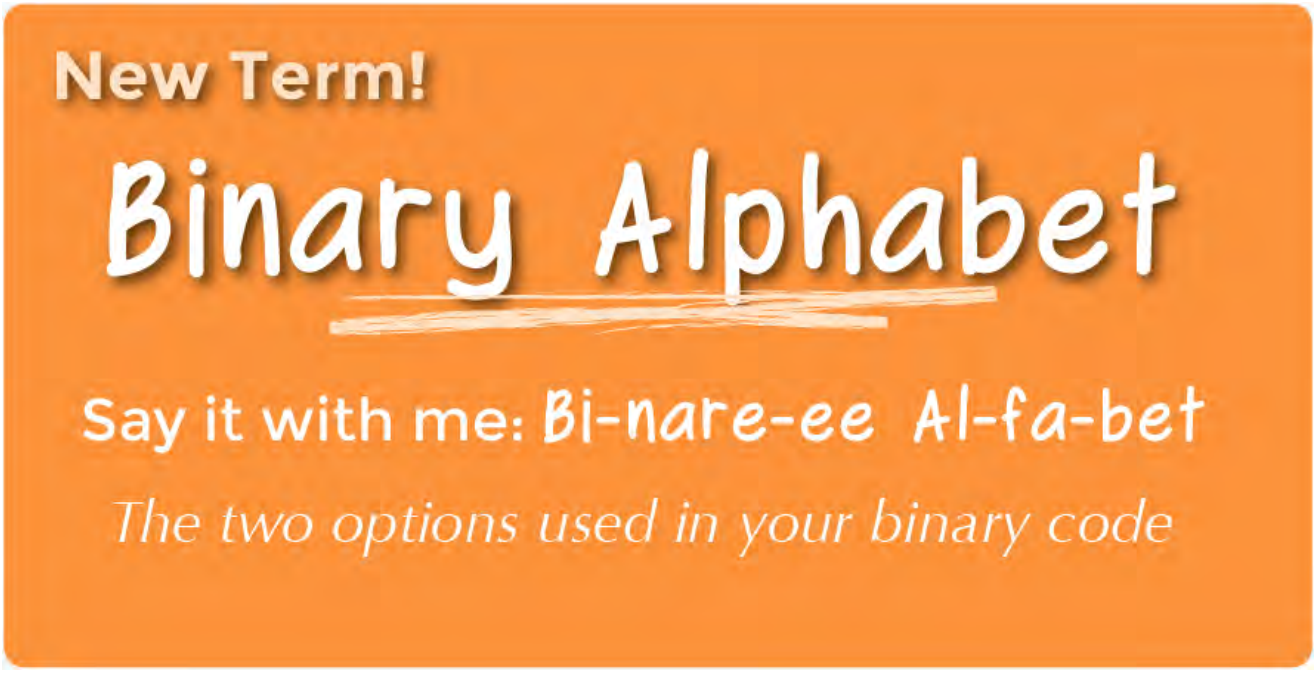
LESSON TIP *Finishing the review by asking about the students' favorite things helps to leave a positive impression of the previous exercise, increasing excitement for the activity that you are about to introduce.*

2) Vocabulary

This lesson has one important word to review and one new term:



Binary - Say it with me: Bi-nare-ee
A way of representing information using only two options



Binary Alphabet - Say it with me: Bi-nare-ee Al-fa-bet
The two options used in your binary code

3) Binary in Review

See if your class remembers the Binary Bracelets lesson from course 2.

> "Do you remember how we used off and on to represent letters?"

You may want to do an example with them using a letter or two to refresh their memory.

> "What other ways could we have represented those letters? What if we couldn't use on and off?"

Encourage your class to come up with some other sets of opposites to represent the same letters that you just did.

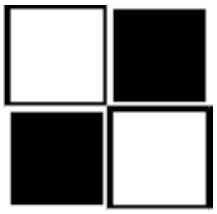
> "Those are great suggestions. Let's use one of them to code a new letter."

Once you code up another letter or two, begin a though exercise.

> "How could we use that same binary alphabet to encode a picture?"

The students may have no idea what you're talking about. That's okay. You can lead them to the answer step-by step.

What if we had a picture like this, where there's only two different options for each square, black or white.



How might we encode this so that someone else could recreate the picture without seeing it?

- Some students might harken back to the Graph Paper Programming lesson. While there could be a lot of similarities, let them know that this is different enough that they should not use that lesson to guide this one

You may hear suggestions like: "Say 'white, black, white, black'."

"That's a great suggestion! Now I'm going to break you up into pairs. Work with your teammate to decide on a binary alphabet."

Decide whether you want your pairs to share their encodings with the other groups ahead of time, and tell them if they will be creating a key, or keeping their methods secret.

"Now, let's encode some images, just like a computer would!"

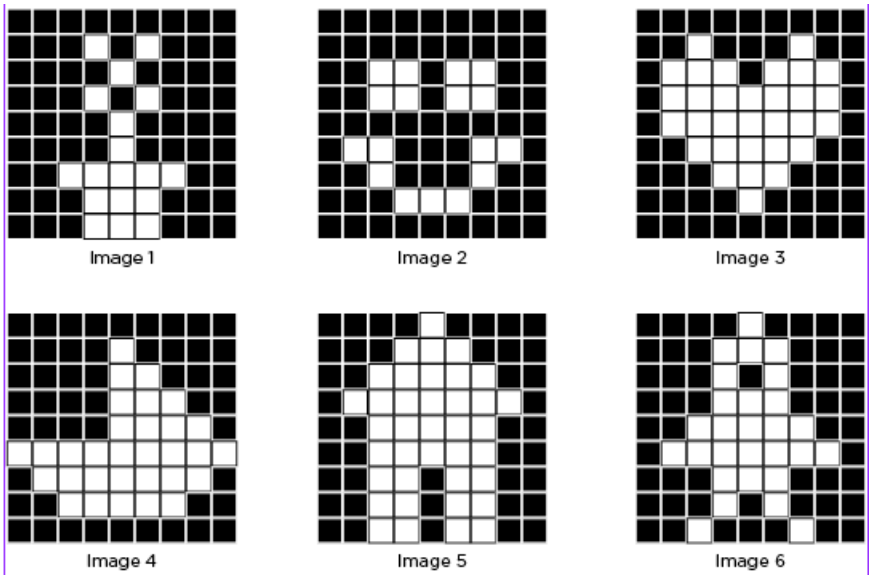
ACTIVITY: BINARY IMAGES (20 MIN)

4) Binary Images

Now it's the students' turn!

Directions:

1) Divide students into pairs.
2) Have them choose an image with their partner.
3) Encourage them to figure out what their binary alphabet is going to be.
4) Have them encode their image using their new binary alphabet.
5) Instruct students to trade encodings with another team and see if they can figure out which picture the other worked on.
6) Choose a Level
- Easy: Let the other team know what your encoding method was
- Tough: Have the other team guess your encoding method.



WRAP-UP (10 MIN)

5) Flash Chat: What did we learn?

- What did we learn today?
- What kind of binary alphabet did you create?
- Can you think of how you could encode an image using only your fingers?
- Do you think you could create a binary alphabet out of sounds?

6) Vocab Shmocab

You can choose to do these as a class, or have the students discuss with an elbow partner and share.

- Do you remember the definition of the term "binary alphabet"?

"The two options used in your binary code"

"A three sided polygon"
"A number larger than zero"

ASSESSMENT (10 MIN)

7) Binary Image Assessment Worksheet

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Storing Color Images

- If your class really gets the idea behind storing binary images, they may want to know how to do color images.
  - First, you'll need to discuss how color works using binary (as in Binary Baubles, page 21).

  - Then, introduce some images that use combinations of those colors
- Encourage your students to come up with ways to code these color images.

Hexadecimal

- Take the idea of color one step further to introduce hexadecimal color codes.

CONNECTIONS AND BACKGROUND INFORMATION

ISTE Standards (formerly NETS) Satisfied by this Lesson Include:

- 1c. Use models and simulations to explore complex systems and issues
- 2d. Contribute to project teams to produce original works or solve problems
- 4b. Plan and manage activities to develop a solution or complete a project
- 6c. Troubleshoot systems and applications

The activities in this lesson support CSTA K-12 Computer Science Standards:

- CT.L1:6.01 - Understand and use the basic steps in algorithmic problem-solving
- CT.L1:6.02 - Develop a simple understanding of an algorithm using computer-free exercises
- CPP.L1:6.05 - Construct a program as a set of step-by-step instructions to be acted out

Other standards, including the NGSS, and Common Core Math & Language Arts

- CCLA-K:SL.2 - Confirm understanding of a text by asking or answering questions
- CCLA-1:SL.2 - Ask and answer questions about key details in a text

Name: _____ Date: _____

Binary Images

Binary Representation Activity

Here are six images. Work with a partner to figure out how you can encode them into binary in such a way that another team can use the code to figure out what image you selected.

DIRECTIONS

1. Choose an image with your partner.
2. Figure out what your binary alphabet is going to be.
3. Encode your image using your new binary alphabet.
4. Trade your encoding with another team and see if you can figure out which picture they worked on.
5. Choose a Level
   * Easy: Let the other team know what your encoding method was
   * Tough: Have the other team guess your encoding method.

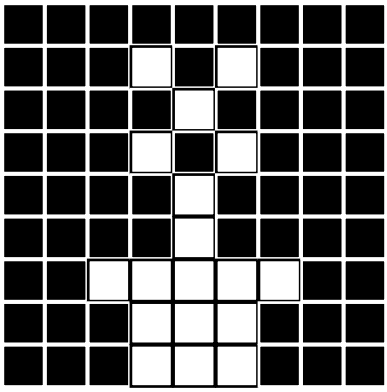


Image 1

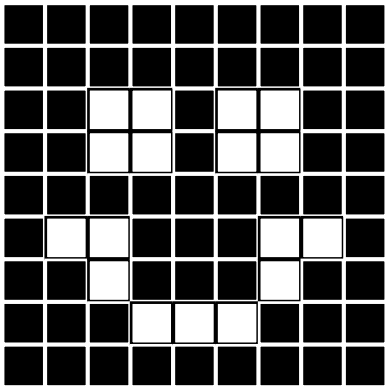


Image 2

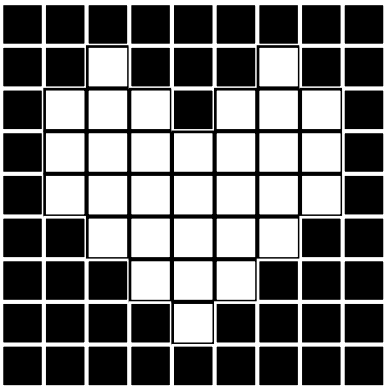


Image 3

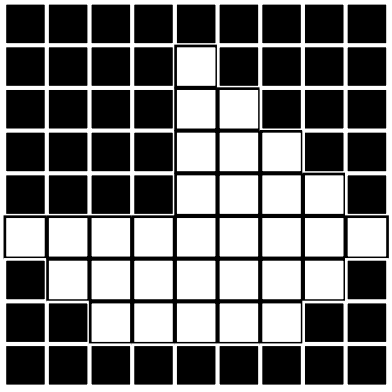


Image 4

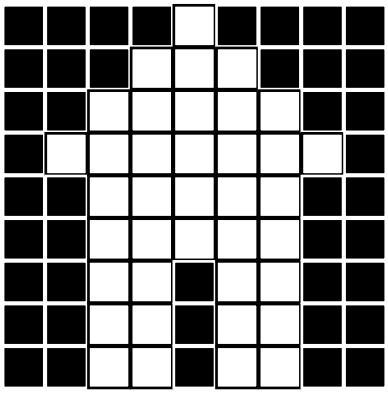


Image 5

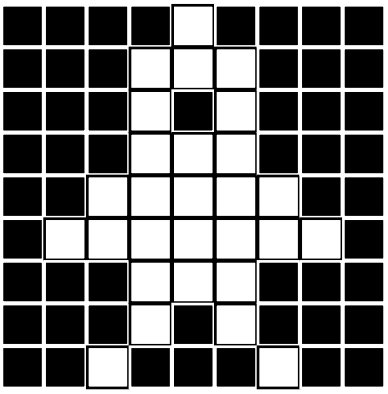


Image 6

Name: _____ Date: _____

Binary Images

Binary Representation Activity

Match the image to the binary code that describes it. In order to get the images correct, you will need to figure out the binary alphabet for each encoding.

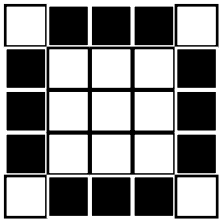


image #1

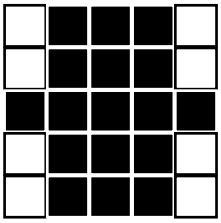


image #2

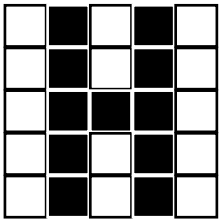


image #3

A) ★✖✖✖★★✖✖✖★✖✖✖✖✖★✖✖✖★★✖✖✖★

✖ = _____ ★ = _____ This encodes image # _____

B) ○●●●○●○○○●●○○○●●○○○●○●●●○

○ = _____ ● = _____ This encodes image # _____

C)

= _____ = _____ This encodes image # _____

How do you know that your answers are correct?

_____

_____

_____

_____

18

Course 4 | Lesson 18

Artist: Binary

Lesson time: 30 Minutes

LESSON OVERVIEW

Rounding out Course 4 is the Artist: Binary lesson. Here, students will build binary images, translating 0s and 1s to offs and ons (or blacks and whites).

TEACHING SUMMARY

Getting Started

Introduction

Activity: Artist: Binary

Artist: Binary

Extended Learning

Extension Activities

LESSON OBJECTIVES

Students will:

- Match binary sequences to encoded images
- Utilize loops and binary code to recreate provided images
- Identify repeated sequences and break long codes up into smaller chunks that can be looped
- Create pictures using unique combinations of on and off

GETTING STARTED

Introduction

To begin, it can be helpful to review the previous lesson, specifically different ways of using binary to indicate how to create an image on a grid. This stage will translate the unplugged activity into a simple, independent online lesson.

ACTIVITY

Artist: Binary

EXTENDED LEARNING

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

The easy, fun, and *active* way to learn computer science!

This book contains lesson plans from Code Studio, Code.org's introduction to computer science for elementary school students and beyond. We have provided lesson plans, worksheets and classroom assessments for each of our courses. We suggest that you follow these lessons in the order presented, but feel free to adapt this plan as needed. You know your classroom best!

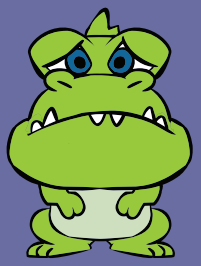
- **Course 1 -** Intended for early-readers who have little or no previous computer science experience.
- **Course 2-** Intended for readers who have little or no previous computer science experience.
- **Course 3 -** Intended for readers who have done Course 2.

Teachers are saying:

"I took a year of Pascal in college and learned nothing. I have actually been doing this course with my students, and I have been learning so much."

"I love trying new things! Oh, I should also mention, I am a 57 year old grandmother!"

"After my daughter (who was never particularly interested in math/coding) finished she said, "Maybe I could be a computer scientist one day."



To view the most updated version of these lesson plans and to view the online activities associated with these lesson plans, please visit http://studio.code.org.

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