Unit 2 Lesson 1

Representation Matters

Resources

Activity Guide - Representation Matters

Recommending a Meal

You and your group will be recommending meals for several people based on a set of data. Each person will tell you something to help you decide which meal is the best. You'll need to work with your group to recommend a meal, then explain your choice based on the data that you have been given. Your data is on a separate page.

"I am allergic to eggs." What meal does your group recommend? _____ Explain your choice using your data. _____ _____ _____	**"My doctor said to eat less sodium."** What meal does your group recommend? _____ Explain your choice using your data. _____ _____ _____
"I'm trying to save money." What meal does your group recommend? _____ Explain your choice using your data. _____ _____ _____	**"I want to post a nice picture of it online."** What meal does your group recommend? _____ Explain your choice using your data. _____ _____ _____

Which recommendation was the easiest to make? _____
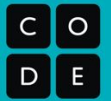
What about the data made it easy? _____

_____

Unit 2 Lesson 2

Patterns and Representation

Resources

Activity Guide - Representing Information

Challenge
You need to create rules that let you represent any word you want using a single row of cards. Another person should be able to use the rules you write on this activity guide to read the words represented by your row of cards without talking to you.

How to Make a Row
Place cards in a single neat row, all face up and in the same direction. The first card should be on the left side.

Representing Letters
Write how each letter will be represented below.

A: _____   J: _____   S: _____

B: _____   K: _____   T: _____

C: _____   L: _____   U: _____

D: _____   M: _____   V: _____

E: _____   N: _____   W: _____

F: _____   O: _____   X: _____

G: _____   P: _____   Y: _____

H: _____   Q: _____   Z: _____

I: _____   R: _____

Your Rules:

_____

_____

_____

Make Your Message
Choose a word and make a stack of cards that uses your rules to represent that word. Leave it next to this activity guide and then switch with another group to see if you can decode their message.

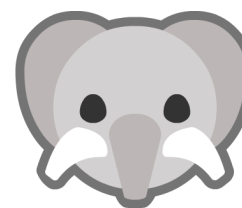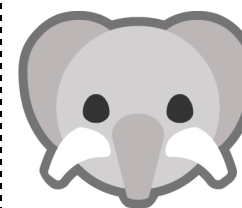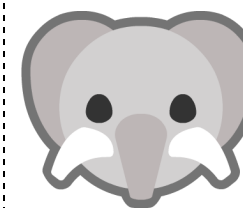| MONKEY | MONKEY | MONKEY | MONKEY | MONKEY | MONKEY |
HIPPO	HIPPO	HIPPO	HIPPO	HIPPO	HIPPO
RABBIT	RABBIT	RABBIT	RABBIT	RABBIT	RABBIT
GIRAFFE	GIRAFFE	GIRAFFE	GIRAFFE	GIRAFFE	GIRAFFE
PIG	PIG	PIG	PIG	PIG	PIG
ELEPHANT	ELEPHANT	ELEPHANT	ELEPHANT	ELEPHANT	ELEPHANT
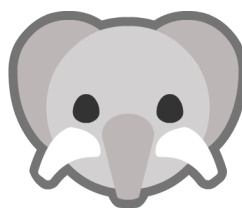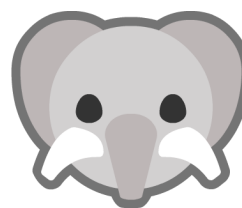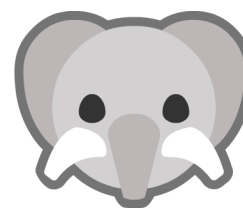
Unit 2 Lesson 3

ASCII and Binary Representation

Resources

Resource - ASCII Text

ASCII Text

In order to input, output, store, and process information computers need to represent it first. Engineers used the tools they had at hand, which was wires carrying electricity. It's easy to tell if a wire does or doesn't have electricity flowing through it, so engineers needed a system based on just two states of electricity: on or off. Since this system needed to only represent two states of information, it is called a binary system.

There are many possible binary systems for representing letters, but the most popular is called ASCII (pronounced ask-ee). You can see the way patterns of ons and offs represent each letter in the table below.

🟡 = On   ⚫ = Off

Letter	Pattern	Letter	Pattern
A	🟡⚫⚫⚫⚫⚫⚫🟡	N	🟡⚫⚫🟡⚫🟡🟡⚫
B	🟡⚫⚫⚫⚫⚫🟡⚫	O	🟡⚫⚫🟡🟡🟡🟡🟡
C	🟡⚫⚫⚫⚫⚫🟡🟡	P	🟡⚫⚫🟡⚫⚫⚫⚫
D	🟡⚫⚫⚫⚫🟡⚫⚫	Q	🟡⚫⚫🟡⚫⚫⚫🟡
E	🟡⚫⚫⚫⚫🟡⚫🟡	R	🟡⚫⚫🟡⚫⚫🟡⚫
F	🟡⚫⚫⚫⚫🟡🟡⚫	S	🟡⚫⚫🟡⚫⚫🟡🟡
G	🟡⚫⚫⚫⚫🟡🟡🟡	T	🟡⚫⚫🟡⚫🟡⚫⚫
H	🟡⚫⚫⚫🟡⚫⚫⚫	U	🟡⚫⚫🟡⚫🟡⚫🟡
I	🟡⚫⚫⚫🟡⚫⚫🟡	V	🟡⚫⚫🟡⚫🟡🟡⚫
J	🟡⚫⚫⚫🟡⚫🟡⚫	W	🟡⚫⚫🟡⚫🟡🟡🟡
K	🟡⚫⚫⚫🟡⚫🟡🟡	X	🟡⚫⚫🟡🟡⚫⚫⚫
L	🟡⚫⚫⚫🟡🟡⚫⚫	Y	🟡⚫⚫🟡🟡⚫⚫🟡
M	🟡⚫⚫⚫🟡🟡⚫🟡	Z	🟡⚫⚫🟡🟡⚫🟡⚫
		(space)	⚫🟡🟡⚫⚫⚫⚫⚫

Activity Guide - ASCII Challenges

Challenges

In each of the challenges below, the ASCII system has been used to represent a **secret message**. Luckily you now know the ASCII system so you're going to be able to decode the messages. Each challenge represents the letters in a different way.
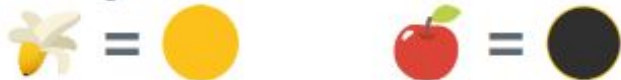
Challege 1

Challenge 2

Challenge 3

Create a Puzzle

Design your own simple ASCII message by designing what the "On" symbol and the "Off" symbol will be. Write your messages using ASCII, then trade with a partner and decode.

_____ = 🟡   _____ = ⚫

Unit 2 Lesson 4

Representing Images

Resources

Unit 2 Lesson 5

Representing Numbers

Resources

Activity Guide - Representing Numbers

Binary Number Cards

Work with your group to figure out which cards should be face up or face down to get the correct number of dots. Put a "U" under a card that should be face up and a "D" under a card that should be face down. The first one has been done for you.

How many dots?	(8 dots)	(4 dots)	(2 dots)	(1 dot)
13	U	U	D	U
5				
10				
2				

What's the lowest number you can make?

_____

What's the highest number you can make?

_____

Using the Pattern

You can use the same pattern even without the cards. Shade over the cards you do NOT want to use to make your number. The first one has been done for you.

7	(shaded 8)	(4)	(2)	(1)
12	(8)	(4)	(2)	(1)

3	(8)	(4)	(2)	(1)
6	(8)	(4)	(2)	(1)

5-bit Numbers

1. | ? | 8 | 4 | 2 | 1 |

In this 5-bit system for binary numbers,
what number should go in the left-most box? _____

2. How would you make...

16? [ ][ ][ ][ ][ ]   27? [ ][ ][ ][ ][ ]   31? [ ][ ][ ][ ][ ]

6-bit Numbers

1. In a 6-bit number system, what numbers should go in each of the boxes? | | | 8 | 4 | 2 | 1 |

2. The record for most skips by a dog and person in one minute is 59. How would you encode 59 in binary? [ ][ ][ ][ ][ ][ ]

Create a Binary Profile

Answer each of the questions on the left, but encode your answers as a binary number on the right.
Use the online widget to help create a personal profile in binary.

Encoded Profile Data

1) How old are you?	☐☐☐☐☐☐
2) What is your birth date? Not the month - just the date	☐☐☐☐☐☐
3) How many siblings do you have?	☐☐☐☐☐☐
4) Estimate how many minutes it takes to get to school each morning	☐☐☐☐☐☐
5) Timestamp: Look at a clock and record only the minutes for what time it is right now.	☐☐☐☐☐☐

Use the online widget and the information above to decode a partner's personal profile in binary

Decoded Profile Data

1) How old are you?	
2) What is your birth date? Not the month - just the date	
3) How many siblings do you have?	
4) Estimate how many minutes it takes to get to school each morning	
5) Timestamp: Look at a clock and record only the minutes for what time it is right now.	

Challenge: Asking Your Own Question

Use the 8-bit binary system to send a question to a classmate and have them answer in binary.
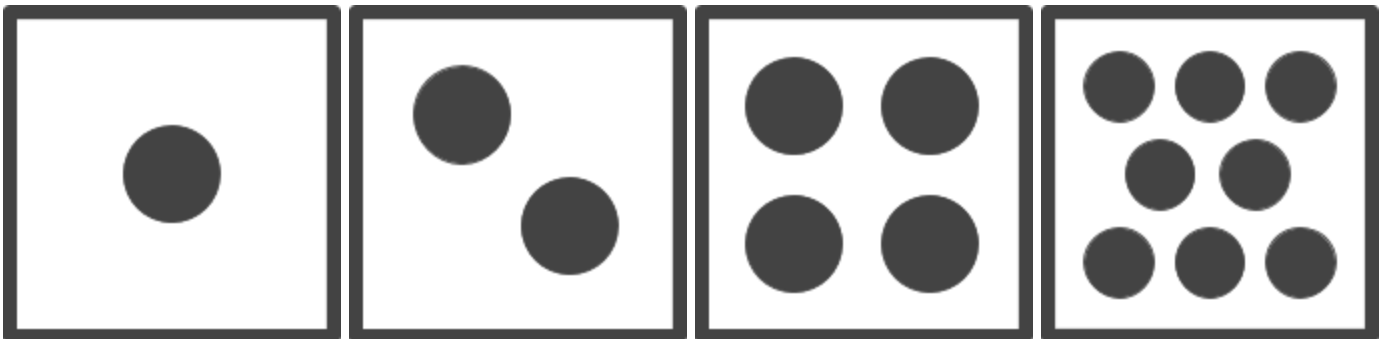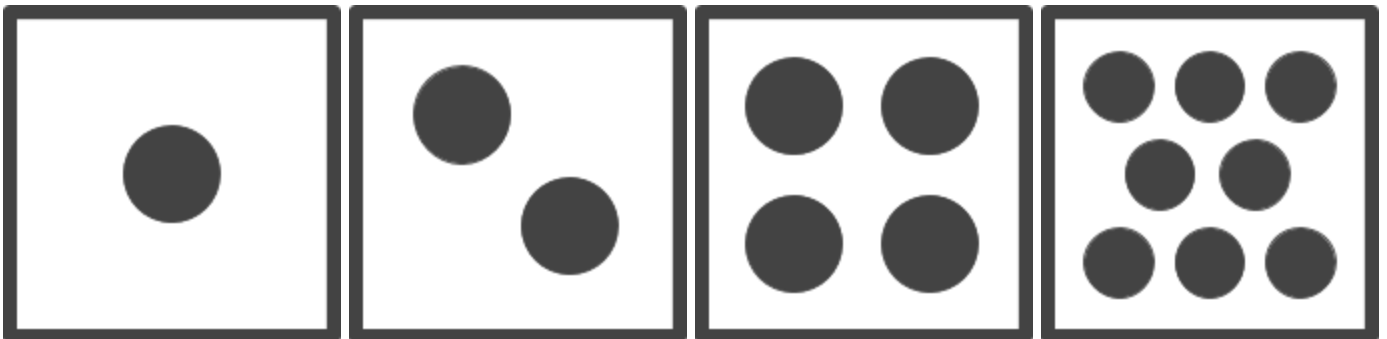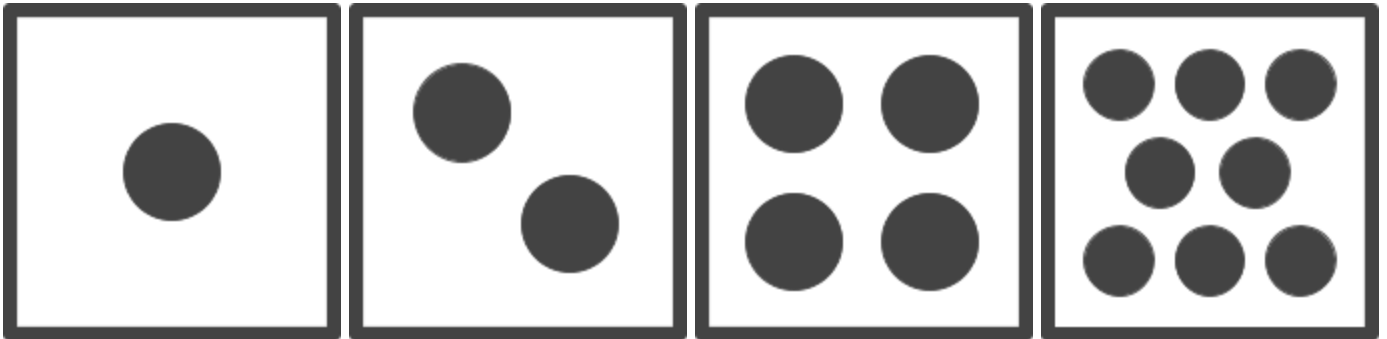
Question: _____

_____

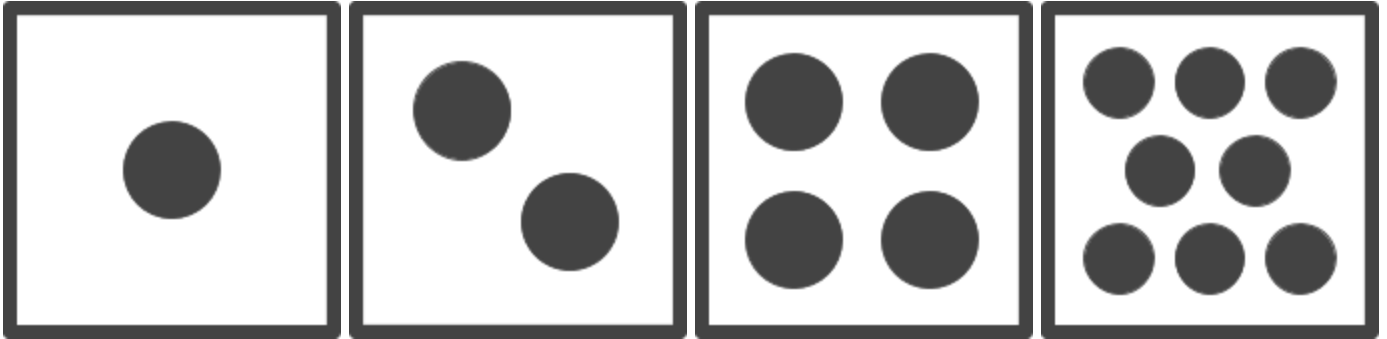Answer: ☐☐☐☐☐☐☐☐

Each group will need one set of number cards.

Unit 2 Lesson 6

Combining Representations

Resources

Activity Guide - Pet Records

Pet Records

A pet shelter is keeping records of all the different pets available for adoption. Each record includes the pet's age, name, and an 8x8 image representation of the pet.

The record is stored in binary, and it's organized into 8-bit sections. Each section of 8 bits is called a **byte**.

- The first byte (00) holds the pet's age as a binary number.

- The next seven bytes (01-07) hold the pet's name. Each byte is one ASCII character.

- The next eight bytes (08-15) hold the 8x8 image of the pet.

Decode the Record

Use what you know about binary numbers and ASCII to decode the age and name of the pet described in the record to the right.

□ = 1   ■ = 0

Fill out the age and name of the pet in the table below.

Age	Name						

What information can you find in the 8x8 picture?

New Record

The pet shelter decided that the image wasn't very useful, so it decided to use the space to save the weight and breed of the dog instead.

The new record is organized as follows:

- The first byte (00) holds the pet's age as a binary number.

- The next seven bytes (01-07) hold the pet's name. Each byte is one ASCII character.

- The next byte (08) holds the pet's weight in pounds as a binary number.

- The next seven bytes (09-15) hold the pet's breed. Each byte is one ASCII character.

Decode the Record

Use what you know about binary numbers and ASCII to decode the age, name, weight, and breed of the pet described in the record to the right.

☐ = 1   ■ = 0
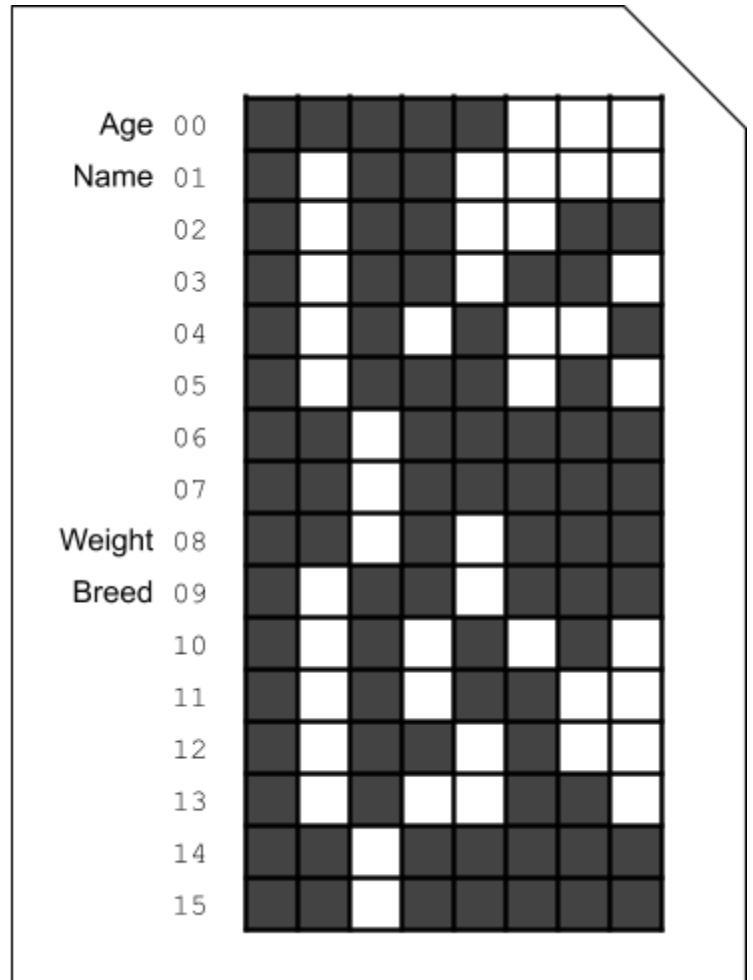
Fill out the age, name, weight, and breed of the pet in the table below.

Age	Name							Weight	Breed						

What other information might someone want to put in the record? _____

How would this information be encoded? _____

ASCII Character to Binary Table

A 0 1 0 0 0 0 0 1	**J** 0 1 0 0 1 0 1 0	**S** 0 1 0 1 0 0 1 1
B 0 1 0 0 0 0 1 0	**K** 0 1 0 0 1 0 1 1	**T** 0 1 0 1 0 1 0 0
C 0 1 0 0 0 0 1 1	**L** 0 1 0 0 1 1 0 0	**U** 0 1 0 1 0 1 0 1
D 0 1 0 0 0 1 0 0	**M** 0 1 0 0 1 1 0 1	**V** 0 1 0 1 0 1 1 0
E 0 1 0 0 0 1 0 1	**N** 0 1 0 0 1 1 1 0	**W** 0 1 0 1 0 1 1 1
F 0 1 0 0 0 1 1 0	**O** 0 1 0 0 1 1 1 1	**X** 0 1 0 1 1 0 0 0
G 0 1 0 0 0 1 1 1	**P** 0 1 0 1 0 0 0 0	**Y** 0 1 0 1 1 0 0 1
H 0 1 0 0 1 0 0 0	**Q** 0 1 0 1 0 0 0 1	**Z** 0 1 0 1 1 0 1 0
I 0 1 0 0 1 0 0 1	**R** 0 1 0 1 0 0 1 0	**(space)** 0 0 1 0 0 0 0 0

Unit 2 Lesson 7

Keeping Data Secret

Resources

Activity Guide - Medical Records

Medical Records

A hospital uses a record to keep track of the medical history of a patient. Patients are required to keep this record in their pocket at all times when in the hospital.

Each record includes the patient's name, age, weight, height in inches, and a special line for medical history. Each box in this line represents the answer to a different medical question. White means "Yes" and black means "No"

1	2	3	4	5	6	7	8

1) Have you ever been to the hospital?
2) Have you ever broken a bone?
3) Have you ever had a panic attack?
4) Have you ever had a dental cavity?
5) Have you ever had a serious sunburn?
6) Do you wear glasses?
7) Do you have asthma?
8) Do you have a severe allergy?

Here's an example medical record and how to decode it:

Name: Rosa
Age: 25
Weight: 138 lbs
Height: 65 inches
Medical History:

1) Have you ever been to the hospital? **Yes**
2) Have you ever broken a bone? **Yes**
3) Have you ever had a panic attack? **No**
4) Have you ever had a dental cavity? **No**
5) Have you ever had a serious sunburn? **No**
6) Do you wear glasses? **Yes**
7) Do you have asthma? **No**
8) Do you have a severe allergy? **Yes**

What are situations where this information would be useful for someone when making a decision?

_____

What are situations where this information could be inappropriate for someone when making a decision?

_____

Protecting Information with Encryption

Encrypted messages have been changed so that only some people are able to read them. We can use encryption to protect just the last row of our medical records so only a doctor can read them. In order to use encryption, we need to know the **algorithm** and the **key**.

The **algorithm** is the method that you use to hide your data.

Your **key** is the code that you use in the algorithm to keep your message secret.

Key:

	▨		▨

Algorithm: Step 1: Copy the encrypted message into the first row.
Step 2: Copy the key into the second row, and keep repeating it until the end.
Step 3: For each box in the third row:
if the two boxes above it are the same (both white or both black), color it black.
Otherwise, leave it white.

This example has been started for you - finish filling in the bottom row to encrypt the medical record

Medical Record			▨	▨			▨	▨
Repeated Key		▨		▨		▨		
Encrypted Record	▨			▨				

Decrypting Information

Use the same process above to decrypt our medical cards and view important medical information. Each of the records below use the same Key:

Key:

▨			▨

Encrypted Record

	▨				▨	▨	▨	
Repeated Key								
Medical Record								

1) Have you ever been to the hospital? ___
2) Have you ever broken a bone? ___
3) Have you ever had a panic attack? ___
4) Have you ever had a dental cavity? ___
5) Have you ever had a serious sunburn? ___
6) Do you wear glasses? ___
7) Do you have asthma? ___
8) Do you have a severe allergy? ___

Encrypted Record

	▨	▨		▨			▨	▨
Repeated Key								
Medical Record								

1) Have you ever been to the hospital? ___
2) Have you ever broken a bone? ___
3) Have you ever had a panic attack? ___
4) Have you ever had a dental cavity? ___
5) Have you ever had a serious sunburn? ___
6) Do you wear glasses? ___
7) Do you have asthma? ___
8) Do you have a severe allergy? ___

Encrypted Record

	▨	▨			▨	▨		
Repeated Key								
Medical Record								

1) Have you ever been to the hospital? ___
2) Have you ever broken a bone? ___
3) Have you ever had a panic attack? ___
4) Have you ever had a dental cavity? ___
5) Have you ever had a serious sunburn? ___
6) Do you wear glasses? ___
7) Do you have asthma? ___
8) Do you have a severe allergy? ___

Encrypted Record

			▨	▨		▨	▨	
Repeated Key								
Medical Record								

1) Have you ever been to the hospital? ___
2) Have you ever broken a bone? ___
3) Have you ever had a panic attack? ___
4) Have you ever had a dental cavity? ___
5) Have you ever had a serious sunburn? ___
6) Do you wear glasses? ___
7) Do you have asthma? ___
8) Do you have a severe allergy? ___

Encrypting Your Own Messages

Encrypt Your Own Message

Encryption can also be used to send secret messages and communicate securely. Use the ASCII tables to create a 3-letter message. Then choose a secret key and encrypt your message to send to a friend.

What is your message? _____ _____ _____   What is your key? _____

Put your unencrypted message on the top row, your repeated key on the second row, and make the encrypted message by coloring in every bit that has two of the same bits (two white or two black) below it.

Unencrypted Message																						
Repeated Key																						
Encrypted Message																						

Post the encrypted message somewhere everyone in the class can see it.

_____

Decrypt a Classmate's Message

Write down your key and trade with someone else, then use their key to decrypt that person's message below.

Encrypted Message																						
Repeated Key																						
Decrypted Message																						

What is their message? _____ _____ _____

Unit 2 Lesson 8

Create a Representation

Resources

Unit 5 Chapter 1 Project Rubric

Key Concept	Extensive Evidence	Convincing Evidence	Limited Evidence	No Evidence
Modeling and Problem Solving with Data: Develop a data-based model	The description of the perfect day clearly relates to each piece of information encoded into the representation.	The description of the perfect day relates to most pieces of information encoded.	The description of the perfect day relates to at least one piece of information encoded.	There is no relationship between the description and encoded information.
Binary Systems	The numbers and characters in the representations have been encoded and decoded correctly.	Most of the numbers and characters in the representation have been encoded and decoded correctly, with some minor errors.	Some of the numbers and characters in the representation have been encoded and decoded correctly.	The numbers and characters are not encoded or decoded correctly, or the representation is blank.
Data Encoding Systems	The representation consistently uses the numbers, characters, and images as agreed upon by the class.	The representation generally uses the numbers, characters, and images as agreed upon by the class, but may have minor inconsistencies.	The representation uses some of the numbers, characters and images as agreed on by the class.	The representation does not follow the structure as agreed upon by the class.
Modeling and Problem Solving with Data: Drawing conclusions from data	The description of the classmate's perfect day clearly relates to the information encoded into the representation.	The description of the classmate's perfect day relates to each piece of information encoded.	The description of the classmate's perfect day relates to at least one piece of information encoded.	There is no relationship between the description and the classmate's encoded information.

Project Guide - Create a Representation

Overview

Representing complex objects or ideas that you care about to a computer is a challenging task. It requires you to understand how computers represent information and will always involve trade offs. For this project you will design a binary system for representing your perfect day. The challenge will be finding a class-wide system to capture all the different elements you care about.

You will…
- Write a short description of your perfect day
- Identify key elements that could be represented to a computer
- Collaborate with classmates to design a class-wide representation system
- Represent your perfect day in that system on a punch card
- Decode a classmate's perfect day punch card

You will submit…
- This completed Project Guide
- Your filled-in punch card
- Your classmates' decoded punch card and feedback

Project Steps

Step 1: Describe Your Perfect Day
Write a 1 paragraph description of your perfect day in the space below

_____

_____

_____

_____

_____

_____

_____

_____

Step 2: Share with a Partner
Switch your description of a perfect day with a classmate. Read through your neighbor's description.

Step 3: Choose Representations
In the table below write the information you'd want to represent to the computer. Place them in the appropriate categories in the table below.

Numbers *(temperature, # people present, when you wake up, etc.)*	Characters *(location name, type of weather, type of activity, etc.)*	Images *(what the location / activity / people / etc. look like)*

Step 4: Review Information Choices
Meet with your partner and share how you identified different kinds of information you'd like to capture. Discuss:

- Whether you think they missed any important information
- What **types of information** you both have in your story. Be ready to share with the class

Step 5: Full Class Activity - Agree on Classwide Punch Card
Look at the punch card on the next page. Your class will need to decide how to use the 3 numbers, 10 characters, and single 8 by 8 image to represent your perfect day. Be ready to discuss what information will be represented by each row.

Step 6: Fill Out Punch Card
Using your class's punch card structure fill out your punch card.

Step 7: Trade and Decode Punch Cards
Give your punch card to **a classmate you have not worked with so far.** Don't tell them anything about your perfect day and have them decode your punch card. Complete the information on the last page of this project guide for your partner's punch card.

Step 8: Reflection
Discuss with your partner how much of their perfect day you were able to understand from their punch card. What was lost in the process of representing this information in binary? Write in your responses on the last page of this project guide

Your Punch Card

Number 1	00								
2	01								
3	02								
Character 1	03								
2	04								
3	05								
4	06								
5	07								
6	08								
7	09								
8	10								
9	11								
10	12								
Image 1	13								
2	14								
3	15								
4	16								
5	17								
6	18								
7	19								
8	20								

Decoder's Name: _____

Number Information
Write what numbers you decoded and what they represent given your classwide representation system

_____

_____

_____

Character Information
Write what characters you decoded and what they represent given your classwide representation system

_____

_____

_____

Image Information
Write what you believe the image is showing

_____

_____

_____

Describe Your Classmate's Perfect Day
Using the information you decoded, write the best description of a perfect day that you can in the space below.

_____

_____

_____

_____

Reflection
Discuss your perfect day with your partner.

What information was lost in representing the perfect day? _____

Why were you unable to represent that information? _____

_____

_____

Unit 2 Lesson 9

Problem Solving and Data

Resources

Name(s)_____ Period _____ Date _____

Activity Guide - Solving a Data Problem
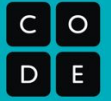
The city is planning a new building for its residents, but the city council isn't sure what it should build. Some members want a fire station, others want an animal shelter, and others want a library. Your job is to use data to make a convincing recommendation to the city council.

Define

What is the problem you are trying to solve?

_____

_____

Prepare

What data do you need to solve your problem?

_____

_____

_____

_____

_____

With your group, find your data on the Internet and record it here. You'll need to combine your data with data from other groups to make the best possible decision, so don't make a recommendation until you hear from all the other groups as well.

_____

_____

_____

_____

_____

_____

Try

What should be built in the new location?   _____

List two reasons for your choice, and the data that supports that reason.

Reason 1	Data for Reason 1
Reason 2	Data for Reason 2

Reflect

What other data might help you to make a better decision?

_____

_____

Where could you find this data?

_____

_____

Unit 2 Lesson 10

Structuring Data

Resources

Activity Guide - Structuring Data

Pizza Party Problem

The local pizza parlor has donated a giant one-topping pizza to an eighth grade class for their annual pizza party, and they have to decide what type of topping they will order for the pizza.

Their choices are: pepperoni, sausage, barbecue chicken, green peppers, mushrooms, pineapple, and extra cheese.

Chart the Data

Use the data to make a bar chart that shows how many votes each topping received.

Pepperoni	Pinapple
Cheese	Peppers
Bbq chicken	Green peppers
Sausage	Pepperonni
Mushrooms	Mushrooms
I will be absent :(	I don't like pizza.
Bbq chicken	Pepperoni
Pineapple	Cheese
Olives	Bbq chicken
Anything is good.	Pizza party!!!!
Just cheese	Pepperoni
Cheese	Four
Sausage	No meat, please!
Barbecue chicken	Pepperoni
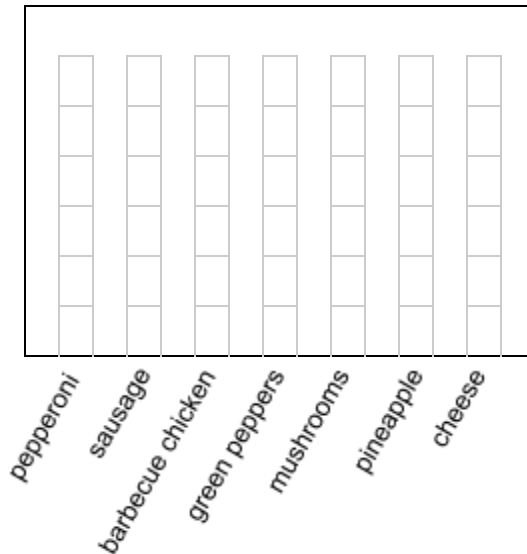
Hardest to Categorize

Sometimes it can be hard to figure out what to do with some of your data. Choose two votes that were hard to put into the chart. For each vote, explain what made it hard and what you finally did with the answer.

Vote	It was hard because…	I decided to...
Vote	It was hard because…	I decided to...

Cleaning The Data

The data from before were only some of the total votes for the pizza party. The rest of the votes are listed below, but many of them will need to be cleaned up before we can use them. For each row, decide if you'd like to keep the data the same, delete the data because it's irrelevant, or update the data to make it fit into a better category. In the end, try to have at most 7 different choices after cleaning the data.

Answer	Cleaning?
Mushrooms	☐ Keep the same ☐ Delete ☐ Change to _____
I will be absent :(	☐ Keep the same ☐ Delete ☐ Change to _____
Bbq	☐ Keep the same ☐ Delete ☐ Change to _____
Pineapple	☐ Keep the same ☐ Delete ☐ Change to _____
cheese	☐ Keep the same ☐ Delete ☐ Change to _____
Anything is good.	☐ Keep the same ☐ Delete ☐ Change to _____
Just cheese please	☐ Keep the same ☐ Delete ☐ Change to _____
Cheese	☐ Keep the same ☐ Delete ☐ Change to _____
Sausage	☐ Keep the same ☐ Delete ☐ Change to _____
Barbecue chicken	☐ Keep the same ☐ Delete ☐ Change to _____
Pinapple	☐ Keep the same ☐ Delete ☐ Change to _____
I'm allergic to mushrooms	☐ Keep the same ☐ Delete ☐ Change to _____
Green peppers	☐ Keep the same ☐ Delete ☐ Change to _____
Pepperonni	☐ Keep the same ☐ Delete ☐ Change to _____
Mushrooms are awful	☐ Keep the same ☐ Delete ☐ Change to _____
I don't like pizza.	☐ Keep the same ☐ Delete ☐ Change to _____
Pepperoni	☐ Keep the same ☐ Delete ☐ Change to _____
Cheese	☐ Keep the same ☐ Delete ☐ Change to _____
chicken	☐ Keep the same ☐ Delete ☐ Change to _____
All the toppings!	☐ Keep the same ☐ Delete ☐ Change to _____
Pepperonni	☐ Keep the same ☐ Delete ☐ Change to _____
Anything vegetarian	☐ Keep the same ☐ Delete ☐ Change to _____
Pepperoni is great	☐ Keep the same ☐ Delete ☐ Change to _____

List all the possible choices for your data after you've cleaned it above: _____
_____

Which answer seems to be the winner after cleaning the data? _____

Unit 2 Lesson 11

Interpreting Data

Resources

Name(s)_____ Period _____ Date _____

Activity Guide - Interpreting Data

Finding Relationships

In order to find relationships between the preferences, you'll do a cross tabulation of the data. That means that you don't just count how many people liked each thing (e.g. "dog"), but how many people liked two things together ("dogs" and "camping"). This will help you see how different answers relate to each other.

Pets and Activities

	Dog	Cat	Bird	Snake
Camping				
Art				
Video Games				
Music				

If someone likes cats, what activity is likely their

favorite? _____

What is one more interesting relationship between favorite pet and favorite activity?

_____

_____

Pets and Sports

	Dog	Cat	Bird	Snake
Swimming				
Soccer				
Basketball				
Volleyball				

What are two interesting relationships between favorite pet and favorite sport?

1. _____

_____

2. _____

_____

Activities and Sports

	Camping	Art	Video Games	Music
Swimming				
Soccer				
Basketball				
Volleyball				

What are two interesting relationships between favorite activity and favorite sport?

1. _____

_____

2. _____

_____

Reflection

How could relationships between these types of data help you to address a real world problem?

_____

_____

Preferences Survey

Twenty five people took a survey about their preferences, and the results are included in the chart below. You can use the results of this survey to find relationships between the respondents' preferences.

#	Favorite Pet	Favorite Activity	Favorite Sport
1	Cat	Art	Soccer
2	Cat	Art	Basketball
3	Dog	Video Games	Soccer
4	Cat	Art	Soccer
5	Dog	Video Games	Soccer
6	Snake	Video Games	Soccer
7	Dog	Music	Soccer
8	Snake	Music	Volleyball
9	Snake	Camping	Basketball
10	Bird	Camping	Basketball
11	Dog	Music	Volleyball
12	Bird	Music	Soccer
13	Cat	Video Games	Swimming
14	Dog	Camping	Swimming
15	Dog	Music	Basketball
16	Cat	Art	Basketball
17	Snake	Camping	Volleyball
18	Dog	Camping	Swimming
19	Dog	Music	Basketball
20	Cat	Art	Basketball
21	Dog	Music	Swimming
22	Dog	Video Games	Swimming
23	Cat	Music	Swimming
24	Cat	Music	Swimming
25	Dog	Music	Swimming

Unit 2 Lesson 12

Making Decisions with Data

Resources

Decision 1 - When to Post

Define
You want to know when to post a picture online to get the greatest response.

Prepare
To answer this question you and your friends posted images to your favorite apps for a week. You kept track of likes and comments to see if there were any different patterns.

Try
You collected information about when you made a post and how many likes and comments you received. Average likes and comments for each time to post are shown below.
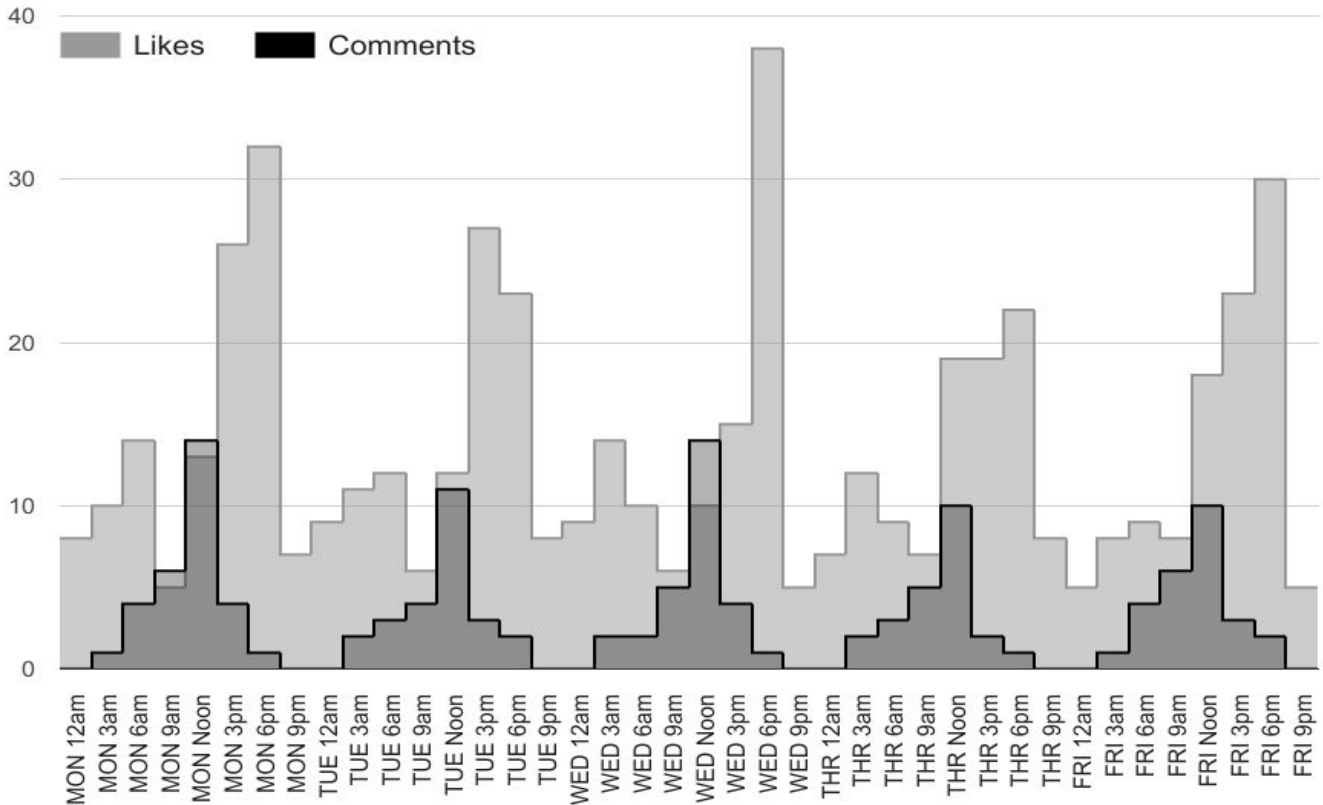
Reflect
Now it's your turn to help. Can you make a recommendation for what time to post:

- If you want the most likes? _____

- If you want the most comments? _____

- What other information would you want to collect to make an even better decision? _____

  _____

Decision 2 - Making Meals

Define
The cafeteria would like to decide how best to reduce their food waste after noticing they are throwing out food each day.

Prepare
To answer their question the cafeteria decided to collect information about the number of meals prepared, daily attendance, the type of meal, and the number of meals eaten vs. wasted.

Try
The cafeteria collected this data and created the chart below.

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Meal	Pizza	Hamburgers	Chicken Fingers	Salad	Grilled Cheese
Meals Prepared	100	100	100	100	100
Attendance	85	90	90	95	85
Meals Eaten	80	82	88	75	80
Meals Wasted	20	18	12	25	20

Reflect
Now it's your turn to help. Can you make a recommendation for how the cafeteria could reduce food waste?

- How many meals should they prepare each day? _____

- Should they vary how many meals they make based on the meal served or attendance? _____

  _____

  _____

- Is there more information you'd want to collect to make your decision? _____

  _____

  _____

Decision 3 - Locker Selection

Define
Starting next year your school has decided to allow you to choose your own locker so that it's most convenient for your schedule. You need to make a data driven decision to decide which locker you're going to request.

Prepare
To answer their question you and your friends collected some information about how long it takes you to walk from each locker to your classes by walking through the halls with a stopwatch.

Try
Here's the data you collected.

	Time to 1st Period	Time to 2nd Period	Time to 3rd Period	Time to 4th Period	Time to 5th Period	Average Time (Go to locker all periods)	Average Time (Skip locker on "Bad" periods)	Most Classes of Books You'll Carry if you skip "Bad" periods
Locker A	1 min (Good)	2 mins (Good)	5 mins (Bad)	5 mins (Bad)	1 min (Good)	2.8 mins	1.3 mins	3 periods
Locker B	2 mins (Good)	3 mins (OK)	2 mins (Good)	4 mins (OK)	3 mins (OK)	2.8 mins	2.8 mins	1 period
Locker C	6 mins (Bad)	1 min (Good)	6 mins (Bad)	1 min (Good)	6 mins (Bad)	4.0 mins	1 min	2 periods
Locker D	0 mins (Good)	5 mins (Bad)	5 mins (Bad)	1 min (Good)	1 min (Good)	2.4 mins	.6 min	3 periods

Reflect
Now it's time to make a decision. Discuss with your group and decide:

- Which locker do you want? _____

- Why? What data convinced you? _____

  _____

- Are there other pieces of data that you'd also like to see before making a decision? _____

  _____

CS Discoveries Problem Solving Processes

Structured problem solving, through our Problem Solving Process, is a tool for student growth and development which has been woven throughout the entire course. While students learn the generalized Problem Solving Process in Unit 1, we have also developed versions of the process which more clearly articulate what each step looks like in the context of Programming, Design, and Data.

Unit	Problem Solving Process
1	The Problem Solving Process
2	The Problem Solving Process for Programming
3	The Problem Solving Process for Programming
4	The Problem Solving Process for Design
5	The Problem Solving Process for Data
6	The Problem Solving Process for Programming

The Problem Solving Process

Having a strategy for approaching problems can help you develop new insights and come up with new and better solutions. This is an iterative process that is broadly useful for solving all kinds of problems.

Define

- Determine the problem are you trying to solve
- Identify your constraints
- Describe what success will look like

Prepare

- Brainstorm / research possible solutions
- Compare pros and cons
- Make a plan

Try

- Put your plan into action

Reflect

- Compare your results to the goals you set while defining the problem
- Decide what you can learn from this or do better next time
- Identify any new problems you have discovered
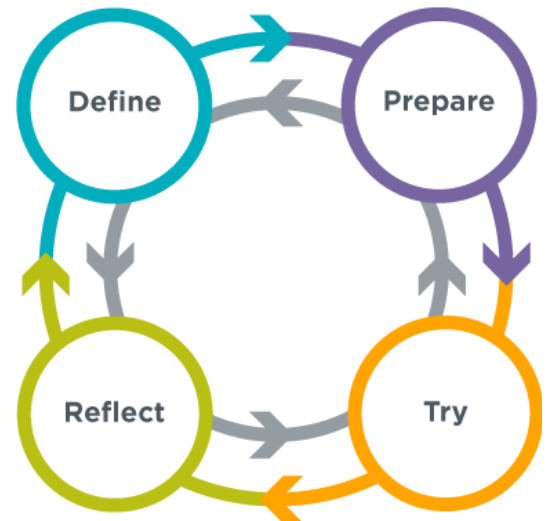
Define

- Read the instructions carefully to ensure you understand the goals
- Rephrase the problem in your own words
- Identify any new skills you are being asked to apply
- Look for other problems you've solved that are similar to this one
- If there is starter code, read it to understand what it does

Prepare

- Write out an idea in plain English or pseudocode
- Sketch out your idea on paper
- List what you already know how to do and what you don't yet
- Describe your idea to a classmate
- Review similar programs that you've written in the past

Try

- Write one small piece at a time
- Test your program often
- Use comments to document what your code does
- Apply appropriate debugging strategies
- Go back to previous steps if you get stuck or don't know whether you've solved the problem

Reflect

- Compare your finished program to the defined problem to make sure you've solved all aspects of the problem
- Ask a classmate to try your program and note places where they struggle or exhibit confusion
- Ask a classmate to read your code to make sure that your documentation is clear and accurate
- Try to "break" your program to find types of interactions or input that you could handle better
- Identify a few incremental changes that you could make in the next iteration
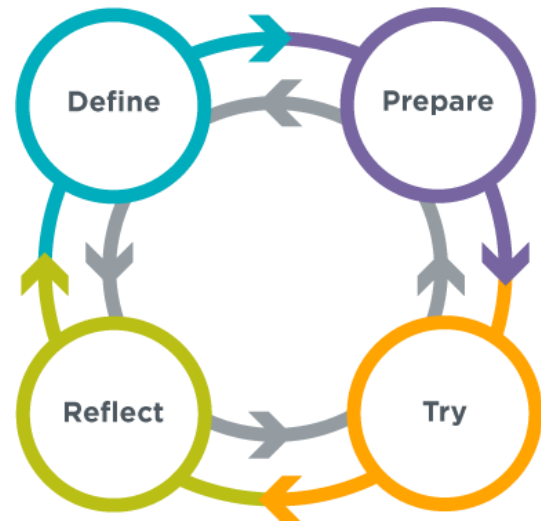
Define

- Identify potential users
- Interview users
- Read user profiles
- Identify needs and wants

Prepare

- Connect needs and wants to specific problems
- Research how others have addressed these issues
- Brainstorm potential solutions
- Discuss pros and cons
- Identify the minimum work need to test your assumptions

Try

- Draw your product on paper
- Develop a low fidelity prototype to communicate your design
- Share prototypes with potential end users for feedback

Reflect

- Present to stakeholders
- Review user feedback
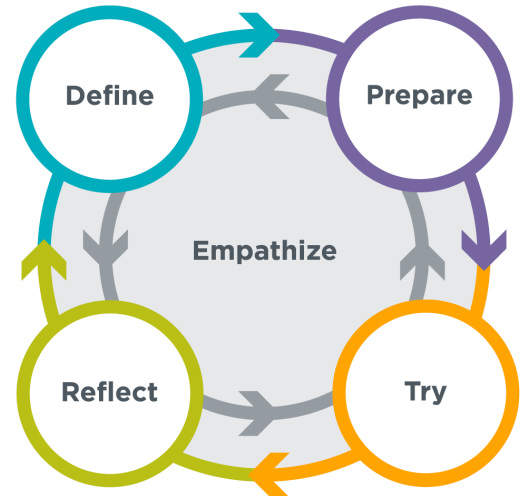
Define

- Decide what problem you are trying to solve or what question you are trying to answer
- Make sure you understand your target audience (it could be you!) and what specifically it needs
- Identify the parts of your problem you could address with data, and how more information could help

Prepare

- Decide what kinds of data you will collect
- Decide how you will collect the data and in which format you will collect it
- Anticipate possible challenges in data collection and change your plan to account for them
- Develop a plan for how you will analyze your data and make sure your data will be useful for that kind of analysis

Try

- Collect your data using the plan you created
- Clean your data by removing errors, unexpected values, and inconsistencies
- Visualize the data by creating tables, graphs, or charts that help you see broad trends in your data
- Interpret the trends and patterns in your visualizations based on your knowledge of the problem

Reflect

- Review what you've learned about your question or problem
- Decide if what you've learned has solved your problem and allows you to make a decision, or if you'll need to go back to one of the previous steps
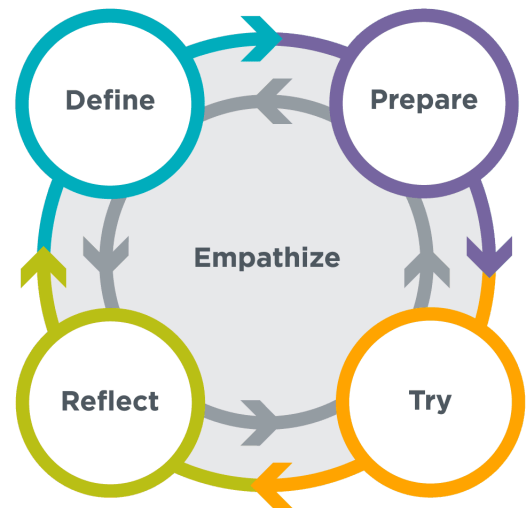
Unit 2 Lesson 13

Automating Data Decisions

Resources

Name(s)_____ Period _____ Date _____

Resource - Automating Data Decisions

Making Rules from Data

Someone has given a survey and put the results in the following tables. Use the information to decide what rules you want for your algorithm.

Vacation and Food

	Beach	Amusement Park	Big City	National Park
Ice Cream	5	2	1	-
Pizza	1	2	2	1
Salad	-	-	1	5
Sandwiches	2	-	-	3

Vacation and Superpower

	Beach	Amusement Park	Big City	National Park
Flying	3	1	-	4
Invisibility	-	-	3	3
Super Strength	-	1	-	2
Teleport	5	2	1	-

Vacation and Animal

	Beach	Amusement Park	Big City	National Park
Wolf	2	1	-	3
Whale	2	-	-	2
Mouse	-	3	2	-
Dog	4	-	2	4

Name(s)_____ Period _____ Date _____

Activity Guide - Automating Data Decisions

Choosing a Vacation

You're going to create an algorithm that will help your classmates choose a good vacation spot based on data that you collect about their preferences. You can suggest the **beach**, an **amusement park**, a **national park**, or a **big city**. After you create your algorithm, you'll try it out on three of your classmates.

Your Algorithm

Your algorithm will use the answers that a user gives to assign points to different types of vacation. For each possible answer to the question, decide how many points each location will get. The location with the most points after asking the three questions will be where your user should go on vacation.

The first one is done for you, but you can change it if you disagree.

	Answer	Instructions
What is your favorite food?		
	Ice cream	Add 2 points to beach. Add 1 point to amusement park.
	Pizza	
	Salad	
	Sandwiches	
Which is the best superpower?		
	Flying	
	Invisibility	
	Super Strength	
	Teleport	
Which animal do you like the best?		
	Wolf	
	Whale	
	Mouse	
	Dog	

Testing Your Algorithm

Now, try your algorithm by asking two of your classmates to answer the questions and adding up the points to find the suggested vacation spot.

Classmate 1

Answer 1:_____ Answer 2:_____ Answer 3: _____

Beach Points	Amusement Park Points	National Park Points	Big City Points

What is the recommended spot? _____

Classmate 2

Answer 1:_____ Answer 2:_____ Answer 3: _____

Beach Points	Amusement Park Points	National Park Points	Big City Points

What is the recommended spot? _____

Reflection

Did you agree with the suggestions that your algorithm made? _____

Why or why not? _____

_____

How could you improve this algorithm so that it could make better recommendations? _____

_____

What is a disadvantage of a computer making a decision automatically? _____

_____

What's a type of decision that you do not want a computer to make automatically? _____

Why? _____

_____

Unit 2 Lesson 14

Problem Solving with Big Data

Resources

Activity Guide - Data in the Real World

Web Pix

Web Pix is a website where users can watch television and movies on demand. It has thousands of movies and shows and is always adding new ones.

Web Pix recommends a Top Video to each of its users every day. Your job is to collect information about your users and your videos to make the best recommendation you can for each user's Top Video.

1. What kinds of information should you collect about users or videos to improve your recommendations?

_____

_____

2. How could you get this information?

_____

_____

🎥 **3. Watch the video about Netflix, and explain how it solves this problem.**

_____

_____

Routz

Routz is a company that helps people navigate traffic. It has maps of locations all around the world and knows real-time information about traffic conditions. When you type in a destination you want to go, it will give you the best route it can find.

Routz wants to improve its data to provide even better directions. Your job is to help the company decide what data it could collect to improve those directions.

1. What data should you collect to improve its recommendations?

_____

_____

2. Where could you get that data?

_____

_____

🎥 **3. Watch the video about Waze, and explain how it solves this problem.**

_____

_____

Nyle

Nyle is a company that sells all kinds of products online. Users on the site can search for and order products that are interesting to them.

Advertisers are working with you to advertise their products on Nyle to increase sales. Ideally they would only show ads to people who are likely to buy their products.

1. What kind of information should you collect about its users to make sure ads are relevant to their customers?

_____

_____

2. How might you collect this information?

_____

_____

◼◀ **3. Watch the video about Amazon and explain how it solves this problem.**

_____

_____

Reflection

There are many ways that data can be collected to solve problems. Fill in as many examples from your discussions today that fall into each of the categories below.

User Actively Provided The user actively provides data and understands that their actions are providing data to the company	User Passively Provided The user might not know that their behavior on the website is generating data to solve a problem.	Sensor Data Sensors automatically collect data about the world. Usually this is not measuring anything about people.

Sometimes people do not realize that they are providing data when they use technology.

What's one example of data from above that a user may not want to share? _____

Why might a user want to keep this data private? _____

_____

Unit 2 Lesson 15

Data and Machine Learning

Resources

Unit 2 Lesson 16

Project - Make a Recommendation

Resources

Peer Review - Make a Recommendation

Pre-Review
Creator's Name: _____

One thing I want feedback on is…_____

_____

Reviewer Section
Reviewer's Name: _____

Types of Evidence	Evidence I Found	Ideas for More
The problem is well-defined, including a question that the recommender will answer. Steps of the process clearly relate back to the problem.		
The data is analyzed using the cross tabulation tables, and at least five relevant conclusions are drawn from each relationship between the types of data.		
The algorithm includes at least five rules that clearly relate back to the results and conclusions drawn from the cross tabulation tables.		
At least four types of data to be collected are clearly identified, a survey is designed to collect the needed data, and choices around the data collection process are explained in the presentation.		
The algorithm is tested at least three times, and any feedback from the users is taken into consideration, with an explanation of why it should or should not result in changes to the algorithm.		

Free Response Feedback

I like… _____

_____

I wish… _____

_____

What if… _____

_____

Creator's Reflection

1. What piece of feedback was most helpful to you? Why?

2. What piece of feedback surprised you the most? Why?

3. Based on feedback, what changes will you make to your app proposal?

Unit 5 Chapter 2 Project Rubric

Key Concept	Extensive Evidence	Convincing Evidence	Limited Evidence	No Evidence
Modeling and Problem Solving with Data: Data-based Problem Solving	The problem is well-defined, including a question that the recommender will answer. Steps of the process clearly and consistently relate back to the problem.	The problem is defined, including a question that the recommender will answer. Steps or the process relate back to the problem.	The problem is described, but may not have enough detail to understand the particular question that the recommender will answer.	The problem is not defined.
Modeling and Problem Solving with Data: Draw Conclusions with Data	The data is analyzed using cross tabulation, and at least five relevant conclusions are drawn from each relationship between the types of data.	Most of the data is analyzed using cross tabulation, and at least three relevant conclusions are draw from relationships between the types of data.	Some of the data is analyzed using cross tabulation, and at least one relevant conclusion is drawn from the relationships between the types of data.	Relationships between the data are not analyzed or no relevant conclusions are drawn from them.
Modeling and Problem Solving with Data: Automated Decision Making	The algorithm includes at least five rules that clearly and consistently relate back to the results and conclusions drawn from the cross tabulation.	The algorithm includes at least five rules that relate back to the conclusions drawn from the cross tabulation.	The algorithm includes multiple rules, but their relationship to the conclusions drawn from cross tabulation may be unclear or inconsistent.	There are no rules, or the rules do not relate to any conclusions from the data.
Data	At least four types of data to be collected are clearly identified, a survey is designed to collect the needed data, and choices around the data collection process are justified in the presentation.	At least four types of data to be collected are clearly identified, and a survey is designed to collect the needed data.	Some types data needed to solve the problem are identified, and a survey is designed to collect data.	Data was not identified or a survey was not designed.
Modeling and Problem Solving with Data: Develop a Data-based Model	The algorithm is tested at least three times, and any feedback from the users is taken into consideration, with an explanation of why it should or should not result in changes to the algorithm.	The algorithm is tested multiple times, and feedback is recorded and taken into consideration when listing potential revision to the algorithm.	The algorithm is tested, but feedback may not be recorded or taken into consideration when listing potential revisions to the algorithm.	There is no testing.

Project Guide - Solve a Data Problem
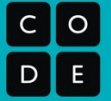
Overview

In this unit you've seen how data can be used to solve all kinds of problems. Now it's your turn to use data to help someone.   In this project, you will use data to make a recommendation to a classmate.

You will...
- Work with a partner
- Define a problem that could be addressed by a recommendation
- Identify the data you need and create a survey to collect it
- Interpret the data to find relationships between survey answers
- Create an algorithm to make a prediction based on data
- Test your algorithm
- Present your work to your classmates

You will submit...
- Completed Project Guide (this document)
- Completed Peer Review
- Any materials used to present your work

Starting Off

Before you start your project, look at the example recommendation app online.

What choice does the app help the user to make?

_____

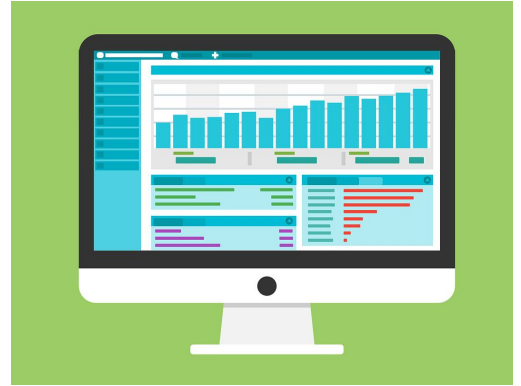_____

What data does it use to make that recommendation?

_____

_____

How do you think the creators of the app decided on the algorithm that they used to make the choice?

_____
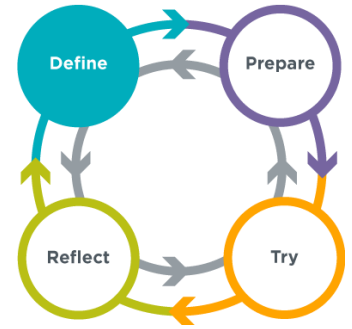
_____

Project Steps

Step 1 - Define Your Problem

In the sample app, the recommender helped the user to decide where to go on vacation. With your partner, decide what type of problem your recommender will solve.

What question will your recommender answer for the user?

_____

_____

What possible recommendations should it choose from?

1. _____   3. _____

2. _____   4. _____

Step 2 - Decide What Data You Need

In the sample app, the recommender used data about a user's food, superpower and animal preferences to decide what to recommend.

What data might help you make a recommendation?

Type of Data _Describe the kind of information you want to collect_	Possible Questions and Answers _Describe the questions and answer choices you might put in a survey_

Step 3 - Create Your Survey

Look at the kinds of data you've decided you need to collect. Use them to create survey questions

Question 1

_____

Answer Choices

1.	3.
2.	4.

Question 2

_____

Answer Choices

1.	3.
2.	4.

Question 3

_____

Answer Choices

1.	3.
2.	4.

To figure out how these answers relate to the recommendation you want to make, you'll also need to ask everyone their preference for what you want to recommend.

Preference Question

_____

Answer Choices

1.	3.
2.	4.

Step 4 - Collect Your Survey Data

Now that you have a survey, you're ready to collect your data. Give your survey to at least twenty different people, and record their answers here. You'll use this data to figure out how the answers to the first three questions can predict a person's preference.

#	Answer 1	Answer 2	Answer 3	Preference
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

Step 5 - Interpret your Data

Use cross tabulation to find out how the answers to each of the three questions relate to the preference that you want to recommend. Label each chart with the question you asked, then fill it in with the answers in with the answers from the survey. Once you've put your data into the table, try to find some relationships that will help you make your recommendation algorithm.

Question 1

_____

What relationships could help you make a rule?

1. _____

_____

2. _____

_____

Question 2

_____

What relationships could help you make a rule?

1. _____

_____

2. _____

_____

Question 3

_____

What relationships could help you make a rule?

1. _____

_____

2. _____

_____

Step 6 - Define your Algorithm

Now that you've found some interesting relationships between the answers to the
questions and user preferences, you can use them to make your algorithm. For each
question, list the possible answer choices and explain the instructions for adding points to
the relevant recommendation choices.

	Answer	Instructions
Question 1		
Question 2		
Question 3		

Step 7: Try out your Algorithm

Test your algorithm by trying to make a recommendation for three classmates who did not take your original survey.   For each classmate, list the four possible recommendations in the first row of the table, then use the second row to tally the points each recommendation gets from that classmate's survey answers.
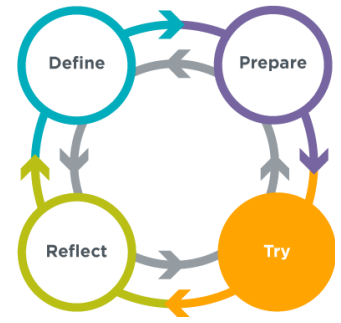
Classmate 1

Answer 1:_____   Answer 2:_____   Answer 3: _____

Recommendation				
Points				

What is the recommendation?   _____

Classmate 2

Answer 1:_____   Answer 2:_____   Answer 3: _____

Recommendation				
Points				

What is the recommendation? _____

Classmate 3

Answer 1:_____   Answer 2:_____   Answer 3: _____

Recommendation				
Points				

What is the recommendation? _____

Did your users agree with the recommendations that you made? Explain.

_____

_____

Are there any changes that you think you should make to your algorithm?

_____

_____

Step 8: Peer Review

Your teacher will provide you with a Peer Review sheet. Trade projects with another group and complete the peer review. As part of this process you should develop new ideas for how you can improve your recommendation.

Step 9: Finalize and Present

Based on the results of your peer feedback make any additions or changes you need to make to how you defined your problem, the data you want to collect, or the way it will be analyzed. Then prepare a presentation of your solution to share with your peers. It should include:

- What choice you are helping the user to make
- The types of data you collect to help the user make that choice
- The relationships that you found when interpreting your survey data
- The way you used this information to create your recommendation algorithm
- The results of testing the algorithm on users

You should be able to find all this information inside your project guide.