

Unit 1 Lesson 1

Personal Innovations

Resources

Name(s) _____ Period _____ Date _____

Activity Guide - Personal Innovations



Technological innovation is about recognizing a problem that needs to be solved, or recognizing something needs improving and then building a tool to solve it.

As a class we're going to see how innovative we can be, and we'll share our ideas through something called "rapid prototyping." (*Prototype is a fancy word that means a preliminary sketch of an idea or model for something new. It's the original drawing from which something real might be built or created.*)

First: Looking at the list of 4 interests at your table, let's **think about how technology is impacted by, or related to, those interests.**

How could **technology** improve your interest to make it **better, faster, or easier** to use?

What is a **problem**, or aspect of your interest, that a **creative or innovative technology** might **help solve**, or at least make better?

Interest	Improvements	Problems

Next: As a group, nominate the idea you've discussed that you think would be the *most interesting to everyone else* in the class.

Start to sketch it out on a poster. Make a visual representation of your ideas. Remember this is a rapid prototype, just something to quickly convey the idea. Feel free to jot down ideas or sketches in the space below:

Brainstorming and Notes

Name(s) _____ Period _____ Date _____

Rubric - Personal Innovations



Evaluate your group presentation according the following criteria. Justify each rating.

Criteria	Yes	Almost	No	Comments
What is the technological innovation? The report specifically identifies the innovation and explains the role computing plays in the innovation.				
What is the most important thing that it enables you to do? The report precisely describes the personal significant impacts experienced.				
How did people do this before the technology existed? The report fully identifies how people used to perform the identified task.				
What was a problem or issue with the way it was done before that this technology solved or made better? The report precisely describes significant impacts felt <u>before</u> the innovation became available and identifies how those impacts have been eliminated or reduced by the innovation.				
What new problems were created by the technology? The report presents a rich analysis of problems created by the innovation.				

Reflection: Reflect on the richness of technology in your life. Compare it with teenagers in other parts of the country or the world. How is your life “better” than theirs because of technology? Are there ways that their lives are better without certain technologies?

Unit 1 Lesson 2

Sending Binary Messages

Resources

Name(s) _____ Period _____ Date _____

Activity Guide - Binary Message Devices



Scenario: You are going to build a device out of classroom supplies to send information to a classmate on the other side of the room. There are some basic rules and constraints:

- **Stay on your side.** You may not walk to the other side of the room.
- **No language.** That means no writing or talking to communicate.
- **No projectiles!**

Challenge 1: Simple Binary Message (state A or B)

Time Limit: 5 mins

- Choose the **binary question** your device will be used to answer.
- **Create a device** using classroom items to send a simple binary message - state A or B.
- **Try to make it fail-proof.** Consider a few obstacles. Would it still work if...
 - There was something in between you and your partner?
 - You couldn't see your partner?
 - You were in a loud room?
 - Your partner wasn't paying attention?

Record how to use your device to send a state A / B in the table below

Your Binary Question: _____

Message	How to send with your device
A:	
B:	

Check-in with the Teacher

- Demonstrate the messaging systems
- Record this information about your device in your journal using a table similar to the example above.
- Your teacher may use the rubric to assess your device.

Challenge 2: Complex Messages (4 possible messages)

Time Limit: 5 mins

Not all questions have only two possible answers. Your new **challenge is to invent a way** to use your device to send an answer to a question that has **4 possible answers!** Think about these things:

- Should you modify your device?
- Should you use it in a different way?
- Should you make a new device entirely?

You've got 5 minutes! GO!

After you've done some testing, make a note below about how to use your device to send 4 possible messages. (enough that another person could pick up your device and use it).

Message	How to send with your device

Challenge 3: Complex Messages (8 possible messages)

Time Limit: 5 mins

What if you wanted to ask an even more complex question with **8 possible answers?**

Just as before update your device and test it out. Record how to use your device in the table below.

Message	How to send with your device

Challenge 4: Complex Messages (16 - n possible messages)

Time Limit: 5 mins

Could we keep increasing the number of messages forever? Could our devices be used for questions with 16, 32, or 1,000,000 possible responses? Some things to think about...

- Our alphabet only has 26-letters, yet we can spell many words
- Our number system only has 10 digits yet we can represent many numbers
- Think back to your simple two-state device. Could you simply use it differently, rather than modifying it?

Discuss with your partner

- How could you use your device to respond to much more complex questions (for example one with 1,000 possible responses).
- Use the space below to **describe the system you develop** in such a way that another group could pick up your device and use it to send messages this way.

Class Discussion

Follow your teacher's instructions for presenting your work to the class. You might need to:

- Describe how your system works
- Provide a simple example of your system
- Do a live demonstration of your system being used

Name(s) _____ Period _____ Date _____



Rubric - Binary Message Devices

Bit-Sending Device Rubric

If directed by your teacher, evaluate your efforts in working collaboratively with your team members to complete the project by completing the following rubric. Otherwise, move directly to the reflection questions.

Criteria	Yes	No	Comments
You and your partner(s) iteratively developed a bit-sending device that can be put into exactly two distinct states, and student could successfully send and receive a single binary message.			
You and your partner(s) modified or used the device differently to send/receive more than a single binary message (4, 8, 16...n possible messages).			
You and your partner(s) presented (written or spoken) the functionality of the device in a manner that allowed others to easily understand how to use it.			
You contributed meaningfully to the efforts of your group, were engaged in the activity, offered your own ideas, and responded to the ideas of your classmates.			

Unit 1 Lesson 3

Sending Binary Messages with the Internet Simulator

Resources

Name(s) _____ Period _____ Date _____

Activity Guide - Coordination and Binary Messages



Develop your Protocol: You and your partner will need to send a 2-bit message back and forth on the Internet Simulator. One partner will have a secret 2-bit message (for example BA). When your teacher says “Go” that partner will send the message using the Internet Simulator. The second partner will then send the same message back. At the end you’ll check that the correct secret message was successfully sent back and forth.

Your Protocol: You will need to agree on rules, or a “protocol” to make this message exchange work. Develop your protocol in the space below. Make sure you consider:

- How will you know when the exchange is supposed to begin?
- How will you know whose turn it is to send or receive the message?
- How will you coordinate your actions?

Practice: Practice sending a 2-bit message back and forth (4 bits sent in total). Try to get your time as low as possible without making mistakes. Record your fastest time in the space below.

Bits Transmitted: 4 Time in Seconds: _____

Challenge: Extend your protocol so that it can send more bits. Can you make it work for 4-bit messages or 8-bit messages? Keep improving your protocol so that you can send more bits as quickly as possible without making mistakes.

Bit Rate: A bit rate is a measure of how fast a system transmits bits. You can calculate your protocol’s bit rate by dividing the number of bits sent by the amount of time it takes. Calculate your bit rate for one of your fastest runs of your protocol. Note: If you send 4 bits back and forth, you’ve actually transmitted 8 bits.

Bits Transmitted: _____ Time in Seconds: _____ Bit rate: _____ bits/sec

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Worksheet - Video Guide for “Wires, Cables & WiFi”



Vocabulary

Bit: _____

Bandwidth: _____

Bit Rate: _____

Latency: _____

Why is it important to communicate a timing protocol prior to sending messages?

	Pros	Cons
Electricity		
Light		
Radio Waves		

Where is copper wire most commonly used? Why don't we use it everywhere?

Where is fiber-optic cable most commonly used? Why don't we use it everywhere?

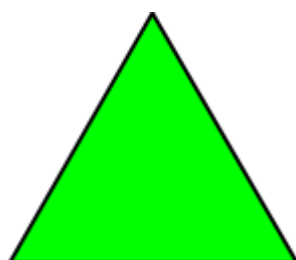
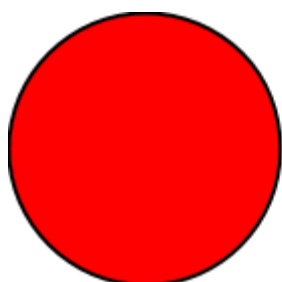
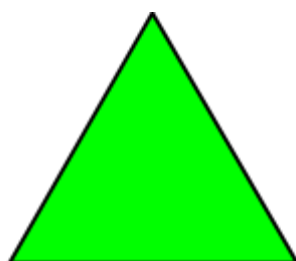
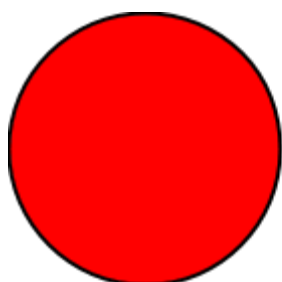
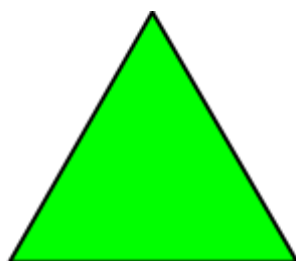
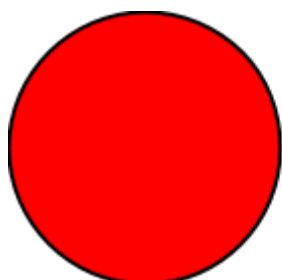
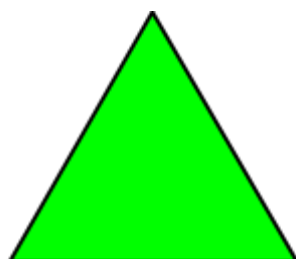
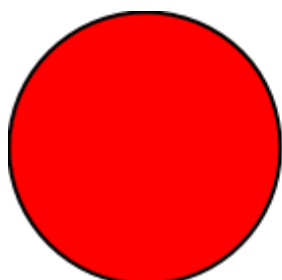
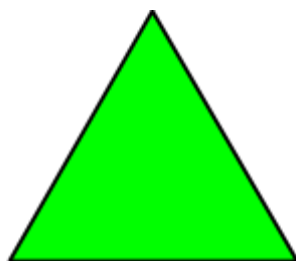
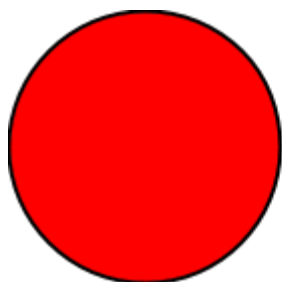
Where are radio waves most commonly used? Why don't we use them everywhere?

Unit 1 Lesson 4

Number Systems

Resources

Teacher Resource - Number Systems: Circle-Triangle-Square



Name(s) _____ Period _____ Date _____

Activity Guide: Circle-Triangle-Square

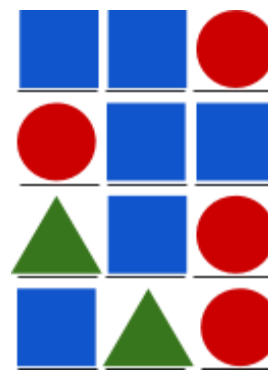


Instructions

Given 3 places to work with, make as many *unique* patterns as you can using only circles, triangles and squares.

The diagram on the right shows a few examples of some 3-place patterns.

NOTE: Order matters, so, for example: Circle-Triangle-Square is a different pattern than Square-Circle-Triangle, even though both have one of each shape.



Challenge 1 - Find all of the 3-place patterns

Record all of the unique 3-place patterns you can find in the template started below.

How many are there? Number each one you find to keep track. (Note there may be more or fewer total patterns than spaces provided)

Suggestion: *think about trying to find the patterns in an organized or systematic way, rather than just randomly.*

...

(keep going)

Challenge 2 - make a system for generating all the patterns

Now that you've listed out all of the 3-place patterns of circles, triangles, and squares, let's put them in a systematic order. You can use any system you like, as long as you create and follow a clear set of rules for getting from one line to the next.

Jot down the rules of your system below.

Suggestion: to test your rules, have someone follow them to see if they can recreate your organized list above.

Unit 1 Lesson 5

Binary Numbers

Resources

Name(s) _____ Period _____ Date _____

How to Make a Flippy Do



Instructions for how to make the Flippy Do

BEFORE →
Blank Template

Flippy Do

Fold along the bold line. Cut on the dotted lines

Name: _____

AFTER



Flippy Do

Fold along the bold line. Cut on the dotted lines

Name: _____

1. Write in the powers of 2

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
-------	-------	-------	-------	-------	-------	-------	-------

2. Write in the whole number equivalents

128	64	32	16	8	4	2	1
-----	----	----	----	---	---	---	---

3. Write a row of 0s

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

4. Write a "1" on the **back** of each flap.
(Careful about upside-down)

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

5. Cut on dotted lines



Flip it up!

Name(s) _____ Period _____ Date _____

Activity Guide - Binary Practice



Directions

Using your Flippy Do or the binary odometer widget fill in the following charts and answer the following questions.

All 4-bit numbers

It's useful and handy to have a sense of the sixteen 4-bit numbers. Fill in all of the 4-bit numbers in the table below along with their decimal equivalents, in order. We've started the first three for you.

Binary: 4-bit number	Decimal
0000	0
0001	1
0010	2

Binary: 4-bit number	Decimal

8-bit numbers with exactly one 1

The table below contains every 8-bit number that has exactly one 1 in it. Write down the decimal equivalent next to each one. Do you notice a pattern?

Binary: 8-bit number (with exactly one 1)	Decimal
0000 0001	1
0000 0010	2
0000 0100	
0000 1000	

Binary: 8-bit number (with exactly one 1)	Decimal
0001 0000	
0010 0000	
0100 0000	
1000 0000	

Conversion Practice!

Using your own binary skills (aided by the flippy do or binary odometer) fill in the decimal and binary equivalents below.

What's the Decimal Number?

Binary	Decimal
100	
101	
1101	
0001 1111	
0010 0000	
1010 1010	
1111 1111	

NOTE: a short binary number like **101** is assumed to have leading 0s for all the other bits, like: **0000101**. Typically large binary numbers are grouped in 4-bit chunks to improve readability, for example: 0110 0101 1010

What's the Binary Number?

Binary	Decimal
	5
	17
	63
	64
	127
	256*
	513*

***NOTE:** 256 and 513 exceed the capacity of the flippy-do but you can work it logically following what you know about patterns with binary numbers.

Questions:

1. There is a simple pattern for determining if a binary number is odd. What is it and why does this pattern occur?
2. How many bits would you need if you wanted to have the ability to count up to 1000?
3. How high could you count in binary if you used all 10 of your fingers as bits? (finger up means 1, finger down means 0)

Unit 1 Lesson 6

Sending Numbers

Resources

Name(s) _____ Period _____ Date _____

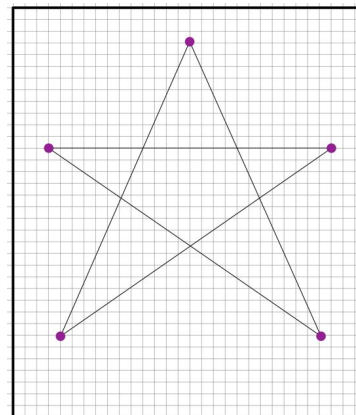
Activity Guide - Sending Numbers



Challenge: Develop a protocol or set of rules for communicating a drawing to your partners using only numbers

Challenge Rules:

- The image will be a line drawing created by connecting points on a grid, like the one seen here.
- You can discuss and agree on a protocol ahead of time, but the image exchange must happen without communication between the two parties other than through using the Internet Simulator.
- You can only send **a single message - a single list of numbers** - through the Internet Simulator to describe the whole image.



Things to Consider:

- How will your points be formatted?
- How does the recipient know when one number ends and the next begins?

Your Protocol: Write the steps of your protocol below.

Self-assess with the *Number-Sending Protocol* rubric on the next page.

Rubric - Sending Numbers



Protocol Rubric

Use the following criteria to evaluate your success in creating a protocol for sending the coordinates to draw an image described in the Sending Numbers activity. Justify your score for each rating.

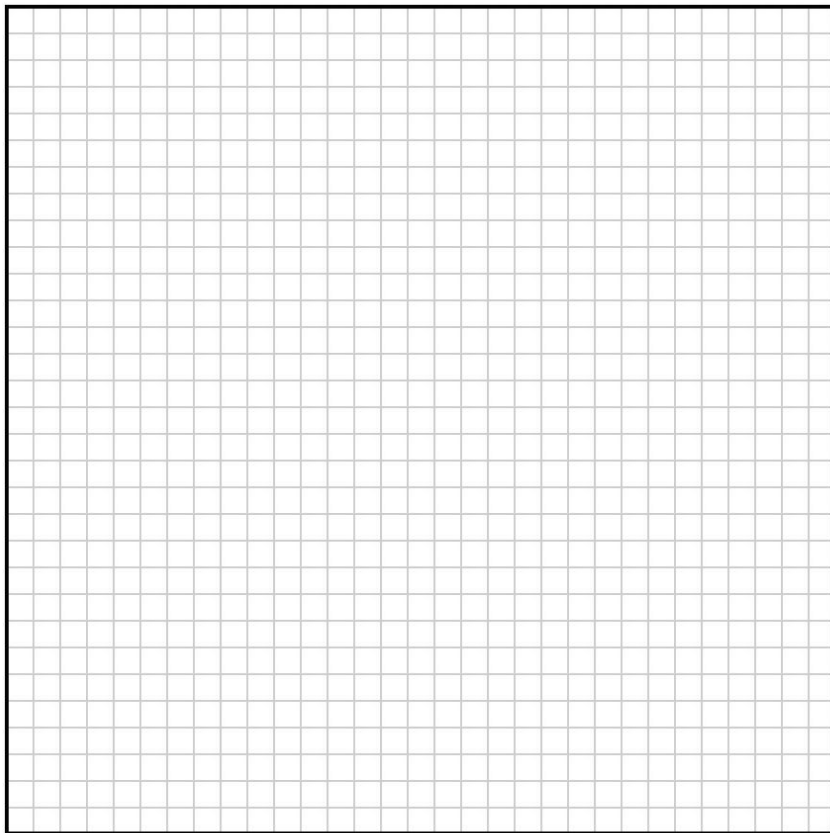
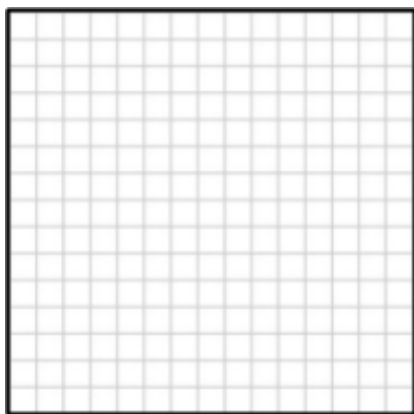
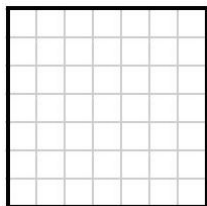
Criteria	Yes	No	Comments
The team successfully collaborated to create a workable protocol for sending numbers.			
<ul style="list-style-type: none">• The order of values is defined.			
<ul style="list-style-type: none">• The recipient can distinguish when one number ends and another starts.			
The numbers were successfully translated, sent, and received.			
The receiving team member was able to translate the numbers and re-create the drawing on the other end.			

Name(s) _____ Period _____ Date _____

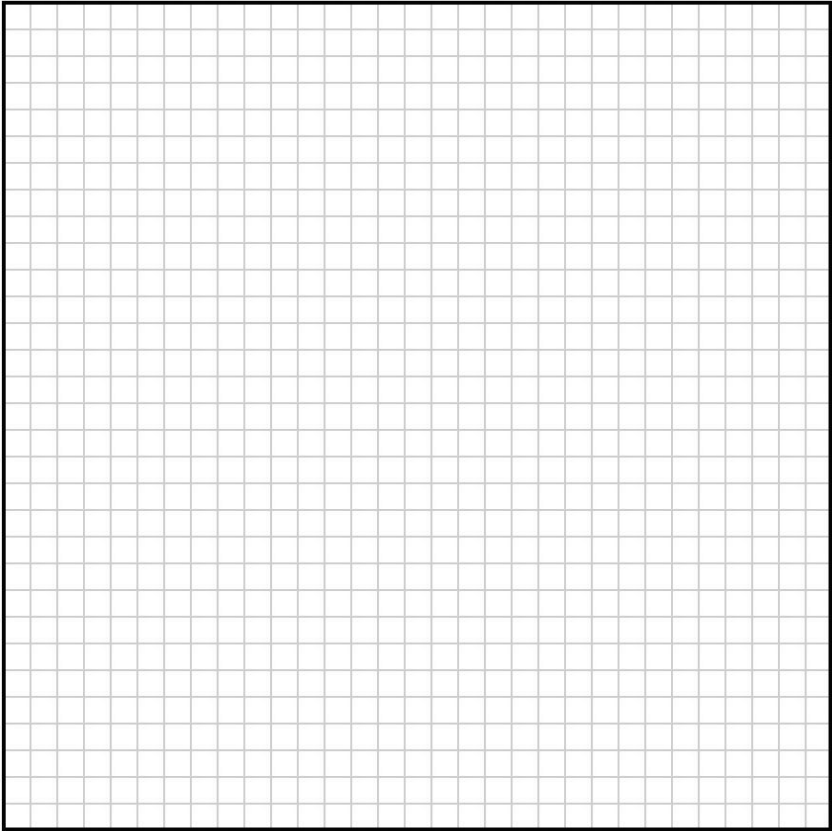
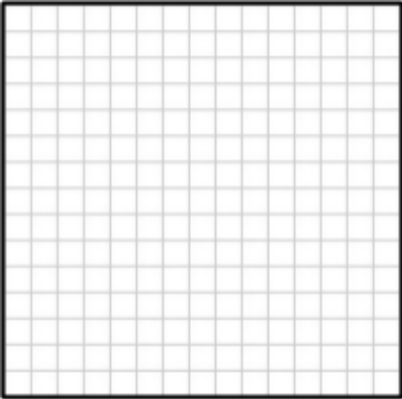
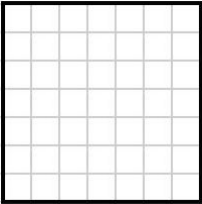


Worksheet - Sending Numbers for Graphing

Outgoing Graph: Create your drawing on the left, translate the coordinates to binary, and log the bits on the right. (This is the message you will send to your partner.)



Incoming Graph: *Log your partner's binary message below, translate it into coordinates, and plot on the graph to the right.*



Unit 1 Lesson 7

Sending Text

Resources

ASCII Reference Sheet



What is ASCII?

ASCII (American Standard Code for Information Interchange) is a widely used system for character encoding. It was originally developed in 1963 as a 7-bit system allowing for 128 characters. Symbols 0-31 and 127 were reserved for control characters (e.g. “Backspace” or “Delete”) with the numbers 32-126 being used for printable characters. As the 8-bit “byte” became standardized, ASCII was extended to the 8-bit format you see below.

Num.	Bits	Char.
32	00100000	Space
33	00100001	!
34	00100010	"
35	00100011	#
36	00100100	\$
37	00100101	%
38	00100110	&
39	00100111	'
40	00101000	(
41	00101001)
42	00101010	*
43	00101011	+
44	00101100	,
45	00101101	-
46	00101110	.
47	00101111	/
48	00110000	0
49	00110001	1
50	00110010	2
51	00110011	3
52	00110100	4
53	00110101	5
54	00110110	6
55	00110111	7
56	00111000	8
57	00111001	9
58	00111010	:
59	00111011	;
60	00111100	<
61	00111101	=
62	00111110	>
63	00111111	?

Num.	Bits	Char.
64	01000000	@
65	01000001	A
66	01000010	B
67	01000011	C
68	01000100	D
69	01000101	E
70	01000110	F
71	01000111	G
72	01001000	H
73	01001001	I
74	01001010	J
75	01001011	K
76	01001100	L
77	01001101	M
78	01001110	N
79	01001111	O
80	01010000	P
81	01010001	Q
82	01010010	R
83	01010011	S
84	01010100	T
85	01010101	U
86	01010110	V
87	01010111	W
88	01011000	X
89	01011001	Y
90	01011010	Z
91	01011011	[
92	01011100	\
93	01011101]
94	01011110	^
95	01011111	_

Num.	Bits	Char.
96	01100000	`
97	01100001	a
98	01100010	b
99	01100011	c
100	01100100	d
101	01100101	e
102	01100110	f
103	01100111	g
104	01101000	h
105	01101001	i
106	01101010	j
107	01101011	k
108	01101100	l
109	01101101	m
110	01101110	n
111	01101111	o
112	01110000	p
113	01110001	q
114	01110010	r
115	01110011	s
116	01110100	t
117	01110101	u
118	01110110	v
119	01110111	w
120	01111000	x
121	01111001	y
122	01111010	z
123	01111011	{
124	01111100	
125	01111101	}
126	01111110	~

Unit 1 Lesson 8

The Internet Is for Everyone

Resources

Name(s) _____ Period _____ Date _____

Activity Guide - Primary Source: "The Internet is for Everyone"



Introduction

"The Internet is for Everyone" is a memo written by Vint Cerf as a plea to the the people who write and define standards to make sure the way the Internet is engineered maintains the philosophy that the Internet should be available and useable by everyone in the world, regardless of race, gender, creed, location, or wealth.

Clearly, Vint Cerf thought that the prospect of "The Internet is for Everyone" might be threatened in early 2002, shortly after the terrorist attacks of Sept. 11, 2001. In the memo, he lays out the state of the Internet and its usage in 2002, predicts the future, and then presents a series of nine challenges or threats to the idea that the Internet is for everyone. The last several paragraphs begin with the phrase: "Internet is for everyone - but it won't be if..."

The document is reproduced below in its entirety. ([Here's the original RFC 3271](#) if you want to see it.)

Commentary is provided on the side to help explain some of the technical details and contextualize some of the statements.

Primary Source Document	Commentary
<p>Network Working Group Request for Comments: 3271 Category: Informational</p> <p style="text-align: right;">V. Cerf Internet Society April 2002</p> <p style="text-align: center;">The Internet is for Everyone</p> <p>Status of this Memo</p> <p>This memo provides information for the Internet community. It does not specify an Internet standard of any kind. Distribution of this memo is unlimited.</p> <p>Copyright Notice</p> <p>Copyright (C) The Internet Society (2002). All Rights Reserved.</p> <p>Abstract</p> <p>This document expresses the Internet Society's ideology that the Internet really is for everyone. However, it will only be such if we make it so.</p> <p>1. The Internet is for everyone</p> <p>How easy to say - how hard to achieve!</p> <p>How have we progressed towards this noble goal?</p> <p>The Internet is in its 14th year of annual doubling since 1988. There are over 150 million hosts on the Internet and an estimated 513 million users, worldwide.</p>	<p>Here is Vint's challenge: it's easy to say that the Internet should be for everyone, but what will it take to actually make it be so?</p> <p>This is the state of the Internet in 2002.</p>

By 2006, the global Internet is likely to exceed the size of the global telephone network, if it has not already become the telephone network by virtue of IP telephony. Moreover, as many as 1.5 billion Internet-enabled appliances will have joined traditional servers, desktops and laptops as part of the Internet family. Pagers, cell phones and personal digital assistants may well have merged to become the new telecommunications tools of the next decade. But even at the scale of the telephone system, it is sobering to realize that only half of the Earth's population has ever made a telephone call.

It is estimated that commerce on the network will reach somewhere between \$1.8T and \$3.2T by 2003. That is only two years from now (but a long career in Internet years).

The number of Internet users will likely reach over 1000 million by the end of the year 2005, but that is only about 16% of the world's population. By 2047 the world's population may reach about 11 billion. If only 25% of the then world's population is on the Internet, that will be nearly 3 billion users.

As high bandwidth access becomes the norm through digital subscriber loops, cable modems and digital terrestrial and satellite radio links, the convergence of media available on the Internet will become obvious. Television, radio, telephony and the traditional print media will find counterparts on the Internet - and will be changed in profound ways by the presence of software that transforms the one-way media into interactive resources, shareable by many.

The Internet is proving to be one of the most powerful amplifiers of speech ever invented. It offers a global megaphone for voices that might otherwise be heard only feebly, if at all. It invites and facilitates multiple points of view and dialog in ways unimplementable by the traditional, one-way, mass media.

The Internet can facilitate democratic practices in unexpected ways. Did you know that proxy voting for stock shareholders is now commonly supported on the Internet? Perhaps we can find additional ways in which to simplify and expand the voting franchise in other domains, including the political, as access to Internet increases.

The Internet is becoming the repository of all we have accomplished as a society. It has become a kind of disorganized "Boswell" of the human spirit. Be thoughtful in what you commit to email, news groups, and other Internet communication channels - it may well turn up in a web search some day. Thanks to online access to common repositories, shared databases on the Internet are acting to accelerate the pace of research progress.

The Internet is moving off the planet! Already, interplanetary Internet is part of the NASA Mars mission program now underway at the Jet Propulsion Laboratory. By 2008 we should have a well-functioning Earth-Mars network that serves as a nascent backbone of an interplanetary system of Internets - InterPlaNet is a network of Internets! Ultimately, we will have interplanetary Internet relays in polar solar orbit so that they can see most of the planets and their associated interplanetary gateways for most, if not all of the time.

This is Vint's prediction in 2002 for what would be true in 2006.

Keep in mind that this was written 5 years *before* the first iPhone existed. Many people still did not have cell phones.

"Personal digital assistants" at the time were devices for keeping people's address books and calendars, but they could not be used as phones and did not connect to the Internet. Oh yeah, WiFi was kind of new.

It turns out Vint was exactly right about 2005, but things got better faster than he predicted. By the end of 2014 it was estimated that over 40% of the world's population was on the Internet. Still...less than half the world.

Things that did not exist when Vint wrote this paragraph: YouTube, streaming video, streaming music, HD television, smart phones, or really even phones that took pictures.

One of the greatest amplifiers, Twitter, was still 4 years away, and it was really 6 years before anyone had heard of it.

Voting for public office is still done in person.

"Boswell" means a constant companion, someone who is always there. In 2015, it's estimated that 90% of the world's Internet data was created within the previous 2 years.

This project was cancelled by NASA in 2005. But we get the point: the Internet is big, always growing, and there's nothing stopping it from being even bigger.

The Internet Society is launching a new campaign to facilitate access to and use of Internet everywhere. The campaign slogan is "Internet is for everyone," but there is much work needed to accomplish this objective.

Internet is for everyone - but it won't be if it isn't affordable by all that wish to partake of its services, so we must dedicate ourselves to making the Internet as affordable as other infrastructures so critical to our well-being. While we follow Moore's Law¹ to reduce the cost of Internet-enabling equipment, let us also seek to stimulate regulatory policies that take advantage of the power of competition to reduce costs.

Internet is for everyone - but it won't be if Governments restrict access to it, so we must dedicate ourselves to keeping the network unrestricted, unfettered and unregulated. We must have the freedom to speak and the freedom to hear.

Internet is for everyone - but it won't be if it cannot keep up with the explosive demand for its services, so we must dedicate ourselves to continuing its technological evolution and development of the technical standards the lie at the heart of the Internet revolution. Let us dedicate ourselves to the support of the Internet Architecture Board, the Internet Engineering Steering Group, the Internet Research Task Force, the Internet Engineering Task Force and other organizations dedicated to developing Internet technology as they drive us forward into an unbounded future. Let us also commit ourselves to support the work of the Internet Corporation for Assigned Names and Numbers - a key function for the Internet's operation.

Internet is for everyone - but it won't be until in every home, in every business, in every school, in every library, in every hospital in every town and in every country on the Globe, the Internet can be accessed without limitation, at any time and in every language.

Internet is for everyone - but it won't be if it is too complex to be used easily by everyone. Let us dedicate ourselves to the task of simplifying the Internet's interfaces and to educating all that are interested in its use.

Internet is for everyone - but it won't be if legislation around the world creates a thicket of incompatible laws that hinder the growth of electronic commerce, stymie the protection of intellectual property, and stifle freedom of expression and the development of market economies. Let us dedicate ourselves to the creation of a global legal framework in which laws work across national boundaries to reinforce the upward spiral of value that the Internet is capable of creating.

Here come the challenges or threats to the idea that the Internet is for everyone....

Challenge 1

Challenge 2

Challenge 3

Challenge 4

Challenge 5

Challenge 6

¹ "[Moore's Law](#)" is not a law of nature. It's just an observation that so far has been true since the early 1970s. Moore's law states that every 18 months or so, computers and digital technology will double in speed and capacity while the costs get cut in half. So, for example: If something costs \$200 now, in about a year you can have the same thing for \$100, or something twice as good for \$200.

Internet is for everyone - but it won't be if its users cannot protect their privacy and the confidentiality of transactions conducted on the network. Let us dedicate ourselves to the proposition that cryptographic technology sufficient to protect privacy from unauthorized disclosure should be freely available, applicable and exportable. Moreover, as authenticity lies at the heart of trust in networked environments, let us dedicate ourselves to work towards the development of authentication methods and systems capable of supporting electronic commerce through the Internet.

Challenge 7

Internet is for everyone - but it won't be if parents and teachers cannot voluntarily create protected spaces for our young people for whom the full range of Internet content still may be inappropriate. Let us dedicate ourselves to the development of technologies and practices that offer this protective flexibility to those who accept responsibility for providing it.

Challenge 8

Internet is for everyone - but it won't be if we are not responsible in its use and mindful of the rights of others who share its wealth. Let us dedicate ourselves to the responsible use of this new medium and to the proposition that with the freedoms the Internet enables comes a commensurate responsibility to use these powerful enablers with care and consideration. For those who choose to abuse these privileges, let us dedicate ourselves to developing the necessary tools to combat the abuse and punish the abuser.

Challenge 9

Internet is for everyone - even Martians!

I hope Internauts everywhere will join with the Internet Society and like-minded organizations to achieve this, easily stated but hard to attain goal. As we pass the milestone of the beginning of the third millennium, what better theme could we possibly ask for than making the Internet the medium of this new millennium?

Vint repeating what he said at the beginning...it's easy to say "the Internet should be for everyone," but actually achieving that is pretty hard.

Internet IS for everyone - but it won't be unless WE make it so.

The "WE" Vint is referring to here is not just the IETF, but citizens in general, like you.

Name(s) _____ Period _____ Date _____



The Internet is for Everyone - Abbreviated Version

Introduction

["The Internet is for Everyone"](#) is a memo written by Vint Cerf as a plea to the the people who write and define standards to make sure the way the Internet is engineered maintains the philosophy that the Internet should be available and useable by everyone in the world, regardless of race, gender, creed, location, or wealth. (The full document with sidebar commentary can be found here: [Primary Source: "The Internet is for Everyone"](#))

Clearly, Vint Cerf thought that the prospect of "The Internet is for Everyone" might be threatened in early 2002, shortly after the terrorist attacks of Sept. 11, 2001. In the memo, he lays out the state of the Internet and its usage in 2002, predicts the future, and then presents a series of nine challenges or threats to the idea that the Internet is for everyone.

The last several paragraphs of the memo all begin with the phrase: "Internet is for everyone - but it won't be if..." Here is the first sentence from each of those paragraphs

1. **Internet is for everyone - but it won't be if** it isn't affordable by all that wish to partake of its services, so we must dedicate ourselves to making the Internet as affordable as other infrastructures so critical to our well-being.
2. **Internet is for everyone - but it won't be if** Governments restrict access to it, so we must dedicate ourselves to keeping the network unrestricted, unfettered and unregulated. We must have the freedom to speak and the freedom to hear.
3. **Internet is for everyone - but it won't be if** it cannot keep up with the explosive demand for its services, so we must dedicate ourselves to continuing its technological evolution and development of the technical standards the lie at the heart of the Internet revolution.
4. **Internet is for everyone - but it won't be** until in every home, in every business, in every school, in every library, in every hospital in every town and in every country on the Globe, the Internet can be accessed without limitation, at any time and in every language.
5. **Internet is for everyone - but it won't be** if it is too complex to be used easily by everyone. Let us dedicate ourselves to the task of simplifying the Internet's interfaces and to educating all that are interested in its use.
6. **Internet is for everyone - but it won't be if** legislation around the world creates a thicket of incompatible laws that hinder the growth of electronic commerce, stymie the protection of intellectual property, and stifle freedom of expression and the development of market economies.
7. **Internet is for everyone - but it won't be if** its users cannot protect their privacy and the confidentiality of transactions conducted on the network.
8. **Internet is for everyone - but it won't be if** parents and teachers cannot voluntarily create protected spaces for our young people for whom the full range of Internet content still may be inappropriate.
9. **Internet is for everyone - but it won't be if** we are not responsible in its use and mindful of the rights of others who share its wealth.



KWL Chart

This KWL Chart tracks what you **Know (K)**, **Want to know (W)**, and **Learned (L)** about a topic. Complete the **K** and **W** before beginning your project and add to the **W** and **L** sections as you work. At the end, reflect on where you began and all that you have learned at each point during the project.

Topic:

(K)now

(W)ant To Know

(L)earned

Reflections and Other Thoughts

Unit 1 Lesson 9

The Need for Addressing Resources

Activity Guide - Broadcast Battleship Game Board



Battleship Directions:

1. Write in the names of your partners on the lines below.
2. Shade in boxes for your ships' locations in the "My board" sections. Ships are 2 units long and are either horizontal/vertical, no diagonals.
3. You can have a different ship placement for each opponent.
4. Don't show your board to your opponents! Record each hit with an "X" and miss with an "O."

Partner #1: _____				Partner #2: _____				Partner #3: _____			
My board				My board				My board			
	A	B	C		A	B	C		A	B	C
1				1				1			
2				2				2			
3				3				3			
Their board				Their board				Their board			
	A	B	C		A	B	C		A	B	C
1				1				1			
2				2				2			
3				3				3			

Activity Guide - Broadcast Battleship Rules



Overview

Today you'll be playing a crazy version of the classic board game, Battleship. In the classic game, the board is 10x10, but here we play with a 3x3 board. The classic game is a guessing game for two people. Here are the rules for our multi-person version of the game.

Goal: Win the most games!

Game Objective

- The object of Battleship is to try and sink another player's ship before they sink yours.
- The other player's ship is somewhere on his/her board
- Each turn, you try to guess your opponent's ship location by calling out a coordinate on the grid.
- The other player also tries to hit your ship by calling out coordinates.
- You maintain and mark two grids:
 1. Your *Ship Boards* - where you record shots fired against you.
 2. Your *Target Boards* - where you record the shots you fired against others.

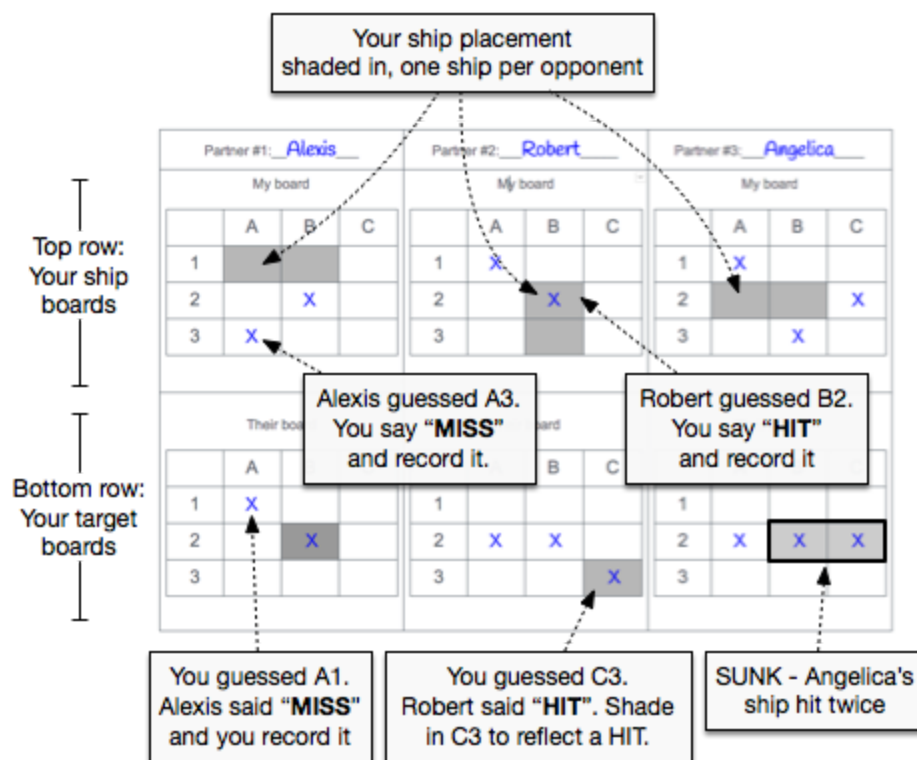
Starting a New Game

- Each player places a ship on their board - one ship for each opponent
- A ship occupies two contiguous squares on the grid - vertically or horizontally. NO Diagonal placement.
- Once the guessing begins, the players may not move the ships.

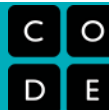
Playing the Game

The diagram shows an example of a game in progress between 4 players - you, Alexis, Robert and Angelica. You can see how you might mark the board.

- Players try to guess their opponent's ship locations by calling out coordinates.
- The opponent responds with "HIT" or "MISS" as appropriate.
- Both players should mark their grid with separate markings for hit or miss.
- When both of the squares that represent one ship have been hit, that should be announced as "HIT AND SUNK!". As soon as all of one player's ships have been sunk, the game ends.



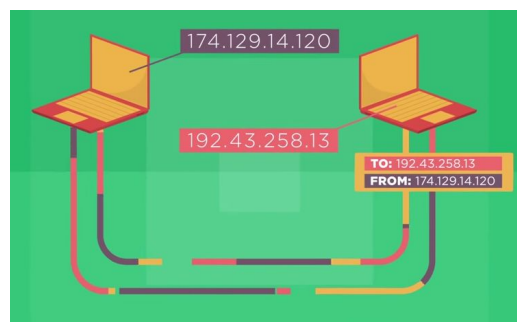
Name(s) _____ Period _____ Date _____



Worksheet - Video Guide for “IP Addresses and DNS”

Overview

This video features the father of the Internet, Vint Cerf, and Microsoft engineer, Paolo Mejia, addressing the question, “How does data know where to go on the Internet?” They introduce the concepts of Internet Protocol (IP) addresses and the Domain Name System (DNS). In this worksheet, you will use ideas covered in the video as well as search for information on the Internet to answer questions... about the Internet!



Directions

1. Watch the video, “IP Addresses and DNS.”
2. Research any additional information required using an Internet search engine.

Questions

1. What is a protocol?
2. What is an Internet Protocol (IP) address? How is it organized hierarchically?
3. How many bits are in an IPv4 address? How many IPv4 addresses does that mean there are?

4. What is the difference between IPv6 and IPv4. Why do we need IPv6?
5. What is an IP packet?
6. What is the difference between an IP address and an IP Packet?
7. What is the purpose of the Domain Name System (DNS)?
8. Optional: What is the IP address of the computer you're sitting at right now?

Name(s) _____ Period _____ Date _____

Activity Guide: Invent a Binary Protocol for Battleship



Overview

Previously you came up with a method for exchanging messages on an open broadcast channel to play multiple games of Battleship at once. Now that you've played Battleship this way, with your group or with a partner, **describe an efficient binary protocol for playing a 3-person game of Battleship that can be played accurately over the Internet Simulator.**

Let "efficient" mean that your protocol uses the smallest reasonable number of bits (0s and 1s) to make messages for Battleship that still contain all of the necessary information for playing the game.

Directions

- List all of the information (data) that you will need to communicate in order to play Battleship. *You will need to express all of this with your protocol, so think about how you can express each piece of data in binary.*

Example Grids for Player A

Player A's ship on the board

	A	B	C
1			
2		X	
3	X		

Player A's guesses

	A	B	C
1			X
2	X		
3	X		

- Make a diagram or chart that explains the protocol, what the bits represent, and how to use the protocol to play Battleship. Don't worry about coming up with a "correct" protocol -- just one that works! Make sure that the diagram shows some example encodings of things that can happen during play.

While developing your protocol here are some **questions and suggestions** to think about:

- Remember that ultimately you are making a communication protocol for a computer to read, so if it's hard for a human to decipher, but would be easy to describe for a computer, that's fine.
- A message you send over the Internet is just a string of 0s and 1s -- so your protocol should indicate how the bits work (i.e. what is the binary representation?)
- You can also invent other rules or standards of play that would help make the protocol work well.
- Think about using numeric addresses rather than people's names.
- Think about what else you can communicate with binary to reduce the total number of bits. How "efficient" can you make your message? How small can you make the size of a message?
- You might consider testing out your protocol with the Internet Simulator to see if it's viable.

Rubric

Criteria	Yes	No	Comments
All data required for a Battleship message is represented as a binary protocol.			
An example of a Battleship message is given and explained.			
All data required for a Battleship response is represented as a binary protocol.			
An example of a Battleship response is given and explained.			
The overall protocol is explained clearly.			

Unit 1 Lesson 10

Routers and Redundancy

Resources

Name(s) _____ Period _____ Date _____

Activity Guide - Routers and Redundancy



Getting Started

Go to the Internet Simulator: Log into Code Studio and find today's lesson.

Choose a Router: Add a router if you need more space. Then join a router with a few of the people sitting closest to you. Ideally, you'll have 3-4 classmates with you on your router.

Activity

Find Your Classmate's IP Address: To begin today's activity, explore the new version of the Internet Simulator. You've likely noticed that the structure of the messages has changed a little bit to include IP addresses both for you and for the person you are sending the messages to. If you look at the network visualization, you can find the IP addresses of your friends on the router. Use the new tool and get comfortable with the updated message format.

	To	From	Message
ASCII	13.2	13.8	Hey there!
Binary	1101 0010	1101 1000	01001000 01100101

96/Infinity bits

Have a Conversation: Choose two classmates on your router and exchange a short conversation with one another. Make sure your messages are getting through and that you're not sharing any secrets. You'll see why in a second!

Read the Traffic: Move to the router tab and click the "Log Browser" button to see the network traffic for your router. Then respond to the questions below.

- How many total messages passed over your router?
- About what percent of those messages did you actually receive?
- Did all the messages get through? Why might a message have been "Dropped"?
- Can you trace a full conversation between two of your classmates? What types of things are people talking about?

Instructions

My Device

Router

Stats

Uptime	0:10:14
Queued Packets	0
Memory Use	0b / Unlimited
Throughput	0bps / Unlimited
Routed Packets	1 / 1 (100%)
Routed Data	8B / 8B (100%)

Logs

Log Browser

My Router Logs					
Time	Logged By	Status	From	To	Message
4:54:37.640 PM	Router 2	Success	2.9	2.14	Hello!

show all routers

Close

Find a Classmate on a Different Router: You can actually send a message to classmates on different routers if you like; you just need to know their IP addresses. Ask two classmates from different routers to share their IP addresses with you.

Have a Conversation: Once again have a short conversation with each of your classmates.

Read the Traffic: In the same tab as before, click on the “Log Browser” button again, and then the “Show all routers” button. Then respond to the questions below.

- How many total messages were sent?
- Can you trace the full conversation between two of your classmates? What are they talking about?
- Is there anything different about the way messages are being sent this time? Why might that be the case?
- Send multiple messages to the same person on a different router. Do your messages always take the same path? What do you think this is simulating?



Reflect: Based on your experience with the Internet Simulator today, respond to the questions below (also on Code Studio).

- Describe the relative benefits of routing over a broadcast style of communication. Is routing traffic more secure than broadcasting? Justify your answer.
- Can you know in advance the path a message will take between you and another computer on the Internet? Justify your answer

Additional Reflection and Discussion

- An Internet service provider (ISP) just purchased all the routers in your area. What types of things is this ISP capable of doing? Are you comfortable with this arrangement?

Unit 1 Lesson 11

Packets and Making a Reliable Internet

Resources

Name(s) _____ Period _____ Date _____

Activity Guide - Packets and Making a Reliable Internet



Background

Packets: Information travelling across the Internet is not sent all at once. Instead, it is broken into smaller chunks of data called packets. There are many reasons this is done:

- **Limit Data Loss:** The Internet is not actually perfectly reliable. Even in the modern day a small percentage of packets (2% is quite common) are lost on transmission. We would prefer to only have to resend small chunks of data rather than the entire message.
- **Improve Speed:** Once a message is broken into packets, those packets do not have to travel from sender to receiver over the same path. If a faster route opens up mid-transmission, the next packets can switch paths.
- **Efficient Network Usage:** The total traffic across the network can be more easily balanced across routers if messages have been divided into smaller, more manageable chunks.

An Updated Internet Simulator: For today's activity you will be using an updated version of the Internet Simulator which is designed to present some of the challenges associated with sending a large message across the Internet. You will notice the following changes:

- **Packets:** You must now split messages into packets, which have been limited in size to ***no more than 8 characters***. You may add a packet by clicking the "Add Packet" button.
- **Unpredictable Order:** Messages travelling over the Internet take longer if they travel longer distances or visit more routers. When sending multiple packets, you have no guarantee of the order in which they will arrive.
- **Unreliable Network:** A small percentage of all packets will be randomly dropped. This is done to simulate both the unreliability of the physical infrastructure of the Internet and the fact that routers can become overwhelmed with traffic and drop packets.

	To	From	Message
ASCII	1.9	1.2	pkt#1
Binary	0001 1001	0001 0010	01110000 01100011 01101011

	To	From	Message
ASCII	1.9	1.2	pkt#2
Binary	0001 1001	0001 0010	01110000 01100011 01101011

64/64 bits

Add Packet Send

Goal: Given these constraints, develop a protocol for reliably sending a message across the Internet.

Getting Started

Join a Group: This activity is ideally completed in groups of two or three.

Go to the Internet Simulator: You will need to log into Code Studio and find the version of the Internet Simulator included in today's lesson.

Join a Router: Add a router if you need more space. Each member of the group should join a **DIFFERENT** router from the other members of the group.

Develop Your Protocol

Guidelines: Make sure your protocol meets the following criteria:

- All communication must be done through the Internet Simulator.
- You must send a message that uses at least 10 packets (i.e. minimum 80 total ASCII characters).
- The protocol should account for the possibility that the characters might be entirely random (i.e. not necessarily English - do not count on human intuition to reconstruct the message).
- Do not assume the message is known beforehand.
- The sender and receiver must be confident the full message was successfully transmitted and reconstructed.

The Problem to Solve

The real problem to solve is to think about what the recipient of the messages should do to inform the sender of what's missing and needs to be re-sent.

It's tricky because any message the recipient sends back to the sender also stands a chance of being dropped or lost. Your protocol needs to overcome this unreliability for both the sender or receiver.

Protocol: Use the space below to list the steps or components of your protocol. Make sure you test it to ensure it works as you expect.

U1L11 - Packets Unplugged Activity

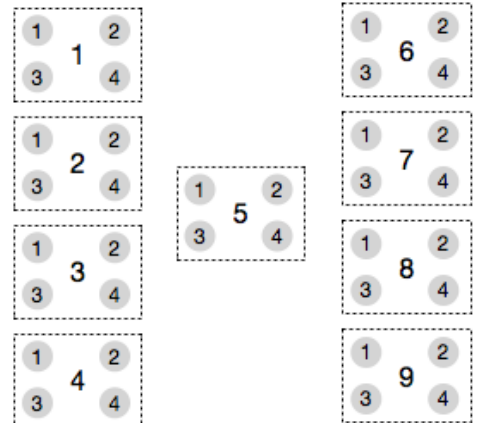
Synopsis

This activity simulates issues of packets traveling on the internet with a paper-passing activity:

- Students pass pieces of paper (post its?) with writing on them to another student in the class
- Students cannot move from their seat - they only pass to someone within reach
- Teacher might provide some “interference” by grabbing post-its in transit and delaying or destroying them.

Setup

- **Arm’s Length** - Students cannot move during this, so each student needs to be within an arm’s length of at least one or two other students.
- **Make an “H”** - Cluster students in an “H”-like configuration - create two large groupings on different sides of the room. Place only a few students between the groupings that can “connect” one side of the room to the other.
- **Addresses** - Each student needs to have an “address” - the diagram at right shows students sitting at numbered tables, with each position at the table numbered as well. A student’s address can be [table number].[other number]. For example a student sitting at Table 1 might have the address 1.4. (It doesn’t matter what the other number is - you don’t have to use numbered positions as in the diagram - as long as it’s a number)
 - **NON-TABLE ALTERNATIVES:** if you don’t have tables to use, you can simply have students stand in this configuration. Drop pieces of paper on the ground with numbers and have students cluster around them.



Running the activity

Getting Started

- Ask students to make a simple drawing, or write a handwritten message on a piece of paper.
- Say: “You have just made a message that you are going to send to someone else on the other side of the room. However, we’re going to imagine that it’s too big to send all at once. So tear it into a few pieces (4 is fine)”
- Ask students to look across the room to find a partner - they can point at or make eye contact with someone. (Students in the middle should find partners who aren’t at the middle table)
- Once each student has a partner, ask students to tell their partner their IP address.
- Students should write their partner’s IP address on each piece of paper that makes up their drawing, clearly indicating that it is going to that address. For example “To: 4.2”.



Explain the Rules:

Goal: You are going to try to send your drawing to your partner across the room, and also to receive and re-construct your partner’s drawing.

- **No moving** - You may not move from your current position.
- **Only one piece at a time** - You may hand one (and only one) piece of paper at a time to any person who is within arm’s reach. You can’t pass a handful of paper to anyone.

- **Forward messages to destination** - If you receive a piece of paper that is not for you, you should hand it to someone who can get it closer to its intended destination. (This should be possible since the address has a table number on it. You may want to re-establish where each table is).
- **Collect all your pieces and reconstruct the drawing** - You are looking for pieces of paper with your address on it, and once you have them all to reconstruct the drawing your partner sent you.
- **Start and stop on my command** - When I say "GO" everyone start passing pieces of paper. And stop when I call "STOP"

Ready, Set, GO!

Call "GO"

There will probably be enough "traffic" going around for issues of delayed packets and dropped packets to emerge. But if you want to force the issue you can try a few of the following:

- As students are passing paper, teacher can participate or try to interfere by delaying and occasionally destroying pieces of paper.
- Teacher may also prepare a different drawing to send to one student, just to introduce some confusion.

Calling "STOP"

- You should ensure that at least one student was able to receive and reconstruct the image before calling STOP
- 5 minutes is probably more than enough time for this paper-passing portion.

Debrief

Have brief discussion to bring out some of the things that happened during the activity especially to make connections to using the internet simulator.

Questions:

- *For a student who was able to get the whole drawing - did the pieces of paper come to you in order? (Probably not) Why not?*
- *How did you know how to reconstruct the message or image? (if it was a drawing, the correct order was probably pretty obvious, but what if your message was a word like "dear", which could also be reconstructed as "read"? How do you know which word the sender intended?)*
- *Did anyone not get all the pieces intended for them? What happened?*
 - *Note: the internet can be unreliable this way - packets may get dropped because of over-congestion, nature (power outage, squirrel eats wire), or even malicious acts.*
- *What happened at the table in the middle - what was that like? (lots of congestion?)*
- *What do you think this has to do with the internet and how it works?*

Foreshadow problem for internet simulator:

- *The interesting question is: if you receive some but not all of the pieces of a message, what can you as the recipient do to fix it? What should the protocol be?*

Connections when you "plug it in"

- You can set up the internet simulator with the same router numbers as in the unplugged activity
- Students can use the same partner on the simulator as they did in the unplugged activity.

Unit 1 Lesson 12

The Need for DNS

Resources

Teacher Resource - IP Address Labels



Directions

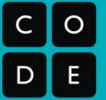
Below is a set of imaginary IP addresses. For today's warm up, you will be handing out IP addresses to students. To prepare, print and cut out the squares below. It is helpful to have more IP addresses than you have students.

90.124	8.71	43.255	9.154	80.211
6.34	76.3	29.121	9.80	14.62
101.3	94.5	97.13	88.97	105.53
82.32	9.167	4.30	5.29	67.39
44.32	192.168	43.76	185.32	122.7

7.15	78.19	39.30	10.29	43.55
12.231	8.149	29.267	3.11	31.48
56.27	33.92	150.29	205.22	72.88
41.60	82.52	173.185	208.30	42.237
193.42	120.5	253.75	213.8	99.50
11.24	82.76	79.81	32.75	40.58

Name(s) _____ Period _____ Date _____

Worksheet - Names and Addresses



Use the table below to create a list linking the names and IP addresses of each of your classmates.

[illegible]

[illegible]

Name(s) _____ Period _____ Date _____

Activity Guide - DNS Partner Questionnaire



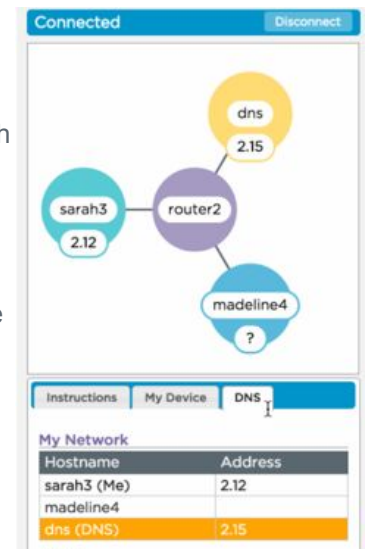
Directions

Log on to Code Studio and join the Internet Simulator. You are going to interview/have a conversation with a classmate using only the Internet Simulator. We've created a list of interview questions (on the next page) and you should both jot down each other's responses.

HOWEVER....As you're working, if your teacher taps you and your partner, you both **MUST** disconnect and reconnect from the simulation. This is to simulate changing IP addresses. Even though your IP address will change, your hostname will stay the same, so you'll need to re-join a router and ask the DNS for your partner's new IP address in order to continue having your conversation!

Communicating with the DNS

To begin, click over to the "DNS" tab to see all the hostnames of people on the router. You will see the address of the DNS (always 15) but will not see an address for anyone else on the router.



The DNS server responds to a text protocol that will give you someone's IP address. Type the IP address of the DNS into the "To" field, then use the following protocol to retrieve the IP address.

The protocol is: GET <hostnameOfPerson>

For example: GET baker3

	To	From	Packet	Message
ASCII	2.15	2.6	1 of 1	GET baker3
Binary	0010 1111	0010 0110	0001 0001	01000111 01000101 01010100 00100000 01100010 01100001 01101011 01100101 01110010 00110011

You can request the IP address of anyone in your class, even if they're connected to a different router!

	To	From	Packet	Message
ASCII	2.5	2.15	1 of 1	baker3:2.6
Binary	0010 0101	0010 1111	0001 0001	01100010 01100001 01101011 01100101 01110010 00110011 00111010 00110010 00101110 00110110

Once you've sent your request for the IP Address, the DNS will respond with the hostname and the IP address (shown on the left)

After the DNS has returned your partner's IP, you may contact them directly by typing the IP address into the "To" field, entering a message, and then pressing "send."

Send a Message				
	To	From	Packet	Message
ASCII	2.6	2.5	1 of 1	HI!
Binary	0010 0110	0010 0101	0001 of 0001	01001000 01001001 48/8192 bits

Send

Interview questions

Partner's name: _____

1. Are you a morning person or a night person?
2. If you could have any superpower, what would it be and why?
3. If you won the lottery, what is the first thing you'd do with the money?
4. Which TV program would you never miss?
5. Do you like animals or have any pets?

Name(s) _____ Period _____ Date _____



Activity Guide - Research: DNS in the Real World¹

Directions

Carefully read and analyze your resource with your group. After you have finished you will share your analysis with other members of the class as directed by your teacher.

Resource: _____

Summary:

Key Points:

-
-
-
-

Other Facts:

¹ Adapted from: <http://www.adlit.org/pdfs/strategy-library/jigsaw.pdf>

Jigsaw

Join a new group as directed by your teacher and share what you each learned. Record the name of the topic and the key points of interest shared with you in the space below.

Name:	Name:	Name:
Key Points:	Key Points:	Key Points:

Name:	Name:	Name:
Key Points:	Key Points:	Key Points:

Articles List

Growing Threat of DDoS on DNS

<http://www.information-age.com/technology/security/123459033/growing-threat-ddos-attacks-dns>

The Details Behind a Denial of Service Attack: What it is, Why it Matters, and What You can do to Stop it

<http://www.business2community.com/tech-gadgets/the-details-behind-a-denial-of-service-attack-what-it-is-why-it-matters-and-what-you-can-do-to-stop-it-01241089>

How to Launch a 65Gbps DDoS, and How to Stop One

<https://blog.cloudflare.com/65gbps-ddos-no-problem/>

How DNS Works

<http://www.pcworld.com/article/2889392/like-google-in-vietnam-lenovo-tripped-up-by-a-dns-attack.html>

DDoS Attacks Against NATO Likely DNS Amplification or NTP Reflection, Expert Suggests

<https://www.scmagazine.com/home/news/ddos-attacks-against-nato-likely-dns-amplification-or-ntp-reflection-expert-suggests/>

DNS Flood DDoS Attack Hit Video Gaming Industry with 90 Million Requests per Second

<http://thehackernews.com/2014/06/dns-flood-ddos-attack-hit-video-gaming.html>

St. Louis Federal Reserve Suffers DNS Breach

<http://krebsonsecurity.com/2015/05/st-louis-federal-reserve-suffers-dns-breach/>

China Great Firewall Causing DDoS Attacks

<http://www.forbes.com/sites/thomasbrewster/2015/01/26/china-great-firewall-causing-ddos-attacks/>

Turkish ISPs Intercept Google DNS Service to Spy on Internet Users

<http://www.techtimes.com/articles/4998/20140331/turkish-isps-intercept-google-dns-services-to-spy-on-internet-users.htm>

DDoS Attacks Double But Could go Bigger Still With IPv6

<http://www.scmagazineuk.com/ddos-attacks-double-but-could-go-bigger-still-with-ipv6/article/415736/>

New Zealand Internet Providers Threatened with Legal Action for Providing Access to US Netflix

<http://thenextweb.com/insider/2015/04/10/new-zealand-internet-providers-threatened-with-legal-action-for-providing-access-to-us-netflix/>

Unit 1 Lesson 13

HTTP and Abstraction on the Internet

Resources

Name(s) _____ Period _____ Date _____

Resource - HTTP and Abstraction on the Internet

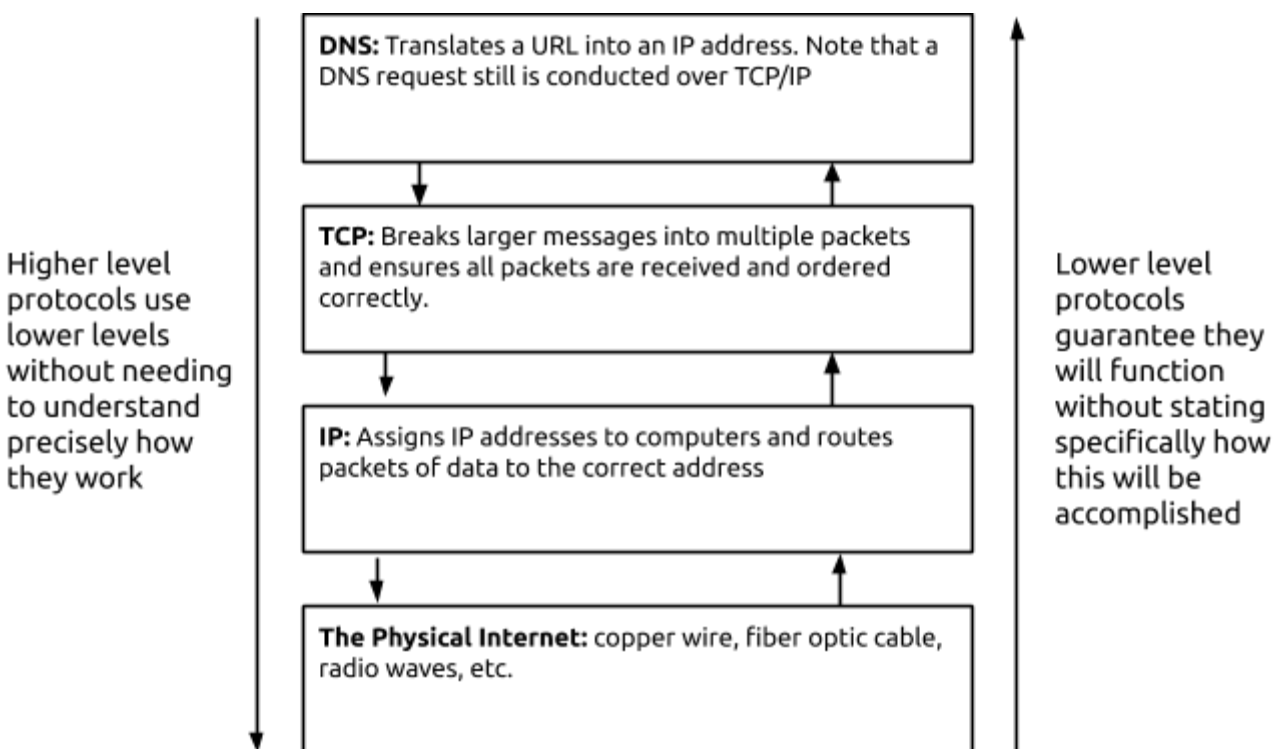


Vocabulary

- **Abstraction:** Reducing information and detail to focus on essential characteristics. It is typically possible to look at a system at many levels of abstraction, depending on how much detail is necessary to approach the challenge at hand.
- **Server:** A computer that awaits and responds to requests for data
Example: a DNS server awaits and responds to requests for URLs to be translated to IP addresses.
- **Client:** A computer that requests data stored on a server
Example: When you type an address into your browser, your computer is the client and it sends the request to the DNS server.

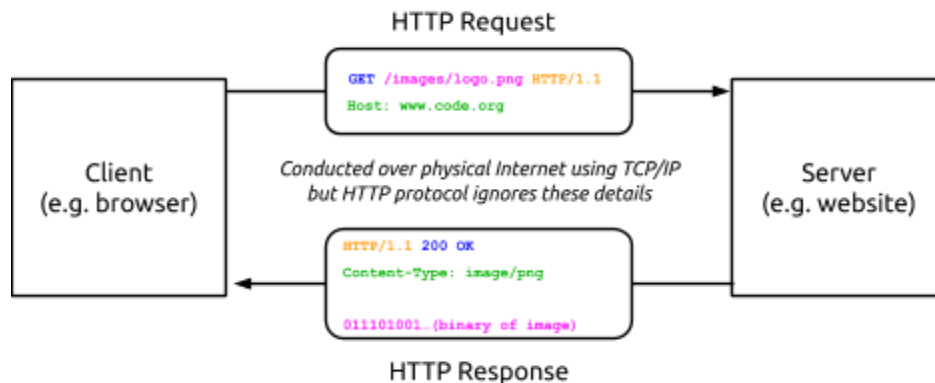
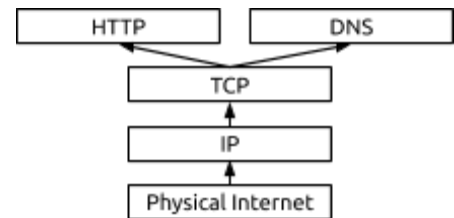
Abstraction on the Internet

Abstraction plays a key role in the relationship between the layers of the Internet, as higher levels make use of the functionality provided by lower levels, without worrying about how they function.



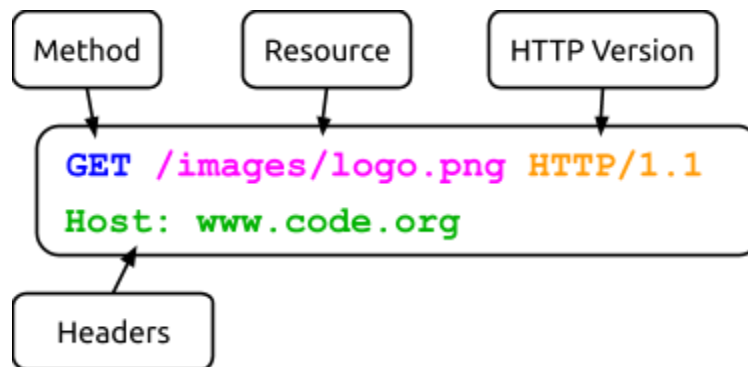
HTTP (HyperText Transfer Protocol)

HTTP is a high level protocol, that defines how users of the Internet (clients) request and receive data like web pages, images, video, audio, and files from the servers containing them. A client will send a request to the server with an identifier for a desired piece of data, and the server will attempt to respond to the request, typically by returning the information requested.



HTTP Requests

When you type a URL in your browser, your computer (the client) needs to “ask” the server that is storing the data and images for the web page to return its contents so your browser can display it. To do so, your computer will send an ASCII-text message called an HTTP request. Here’s what a simple HTTP request for the data of an image might look like:



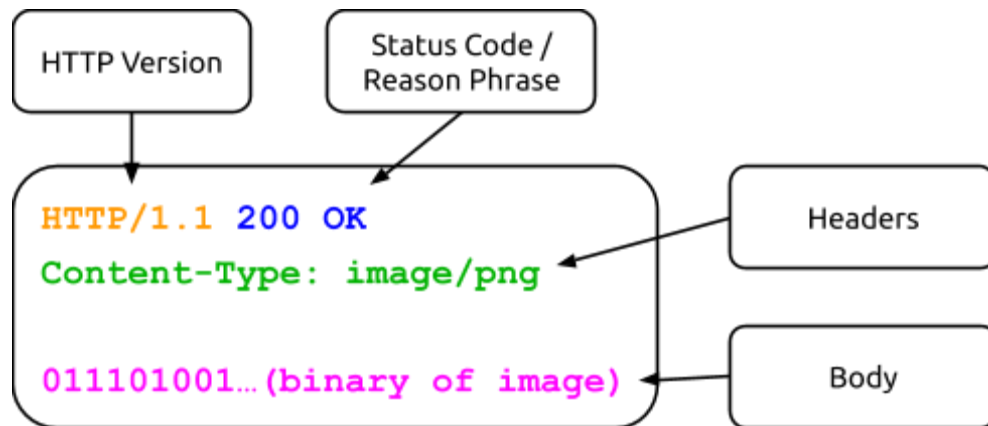
- **Method:** An HTTP request will begin with a method, which indicates what the client wants the server to do. The two most common methods are:

Method	Description
GET	Requests a specified web page or other data
POST	Submits some data for the server to accept or process

- **Resource:** The name of the resource you wish to access. In the example above, the request is for a .png image called “logo” located in the folder “images.”
- **HTTP Version:** An indication of the version of HTTP being used; in this example it is HTTP 1.1.
- **Headers:** Additional information included to help the server interpret the request. In the above example, “Host” is included, but many more can be added by placing them on additional lines.

HTTP Response

When a server receives an HTTP request it will respond with a message of its own. Once again, the response will be sent entirely in ASCII-text and must be correctly formatted. Here's a sample HTTP Response:



An HTTP Response has multiple components:

- **HTTP Version:** An indication of the version of HTTP being used; in this example it is HTTP 1.1.
- **Status Code and Reason Phrase:** A number and phrase indicating how the server responded to the request. Some common Status Codes / Reason Phrases are:

Status Code / Reason Phrase	Meaning
200 Ok	Request was handled successfully
404 Not Found	Server could not find anything matching request
301 Moved Permanently	Requested data was permanently moved
302 Moved Temporarily	Requested data was temporarily moved
500 Internal Server Error	Error by the server prevented fulfilling request

- **Headers:** Additional information about the response. The example above includes the header “Content-Type,” indicating the type of content included in the response.
- **Body:** Following the headers, the response may include some data that was requested. In this example the actual binary representation of the image would be included in the response, so this response could be quite long.

HTTP as Abstraction

HTTP specifies how requests and responses should be formatted but does not mention how this text will actually be sent. You could conduct an HTTP exchange with a friend by writing hand-written letters and mailing them to one another, so long as your letters were formatted according to HTTP. In the real world, HTTP exchanges are conducted over TCP/IP, but this is not the concern of HTTP. It simply requires that some system be in place for these messages to be sent back and forth. In this way, HTTP uses lower-level systems abstractly, relying on their functionality without concern for the details of how that functionality is achieved.

Name(s) _____ Period _____ Date _____

Worksheet - HTTP in Action



Using the Developer Tools

Most modern browsers include a set of Developer Tools designed to provide a detailed look into your browser's activity. It is possible to monitor the traffic of HTTP requests and responses associated with a web page in real time.

Name	Method	Status	Type	Initiator	Size	Time	Timeline	
code.org	GET	200	document	Other	17.8 KB	242 ms		
400912536.js	GET	304	script	(index):23	427 B	13 ms		
style.css	GET	200	stylesheet	(index):32	135 KB	120 ms		
user-menu.css	GET	200	stylesheet	(index):33	1.4 KB	44 ms		
jquery.min.js	GET	304	script	(index):24	10.7 KB	30 ms		

63 requests | 1.7 MB transferred | Finish: 1.90 s | DOMContentLoaded: 893 ms | Load: 1.80 s

Use the links below to help you navigate to the Developer Tools of your browser. In Chrome, Internet Explorer and Firefox you'll need to **open the "Network" tab**.

Chrome: <https://developers.google.com/web/tools/chrome-devtools/>

Internet Explorer: [https://msdn.microsoft.com/library/bg182326\(v=vs.85\)](https://msdn.microsoft.com/library/bg182326(v=vs.85))

Firefox: https://developer.mozilla.org/en-US/docs/Tools/Network_Monitor

Safari: <https://developer.apple.com/safari/tools/> (look at the "Network Requests" in the "Timelines" tab.)

Seeing HTTP in Action

You will use your browser's developer tools to discover what kind of HTTP traffic is associated with visiting different types of websites. You and your partner are going to look at least 5 different types of websites:

1. <http://example.com> -- a very simple web page. Use this first to investigate developer tools.
2. A **"static" website** like: Wikipedia
3. A **news website** like: ESPN.com, BuzzFeed, the New York Times, etc.
4. A **streaming site** like: YouTube, or Spotify
5. A **site that accepts user input** like: twitter, facebook, email, google docs.

For each type of website below, follow these steps:

1. Monitor the HTTP traffic generated by loading the page.
2. Once the page has loaded, poke around with the other information the developer tools let you see about the data coming in. What about the protocols can you see?
3. Interact with the website by clicking links or using other functionality on the site, noting how this affects the HTTP traffic.
4. Observe other things like:
 - o Total amount of data received
 - o Number of HTTP requests actually generated by loading one page
 - o Total time to load the page.
 - o Types of data received through HTTP (it's more than just HTML)

Make notes about any questions you have or things that are interesting and worth sharing with other groups.

Unit 1 Lesson 14

Practice PT - The Internet and Society

Resources

Description

For this project you will **prepare a 2-minute “flash talk”** related to one of the major issues listed below about **the Internet and its effects on people and society**. A flash talk is a brief speech or presentation, intended to grab the attention of the audience and convey key information in a quick, insightful, and clear manner.

Purpose

The purpose of this flash talk is for you to demonstrate your knowledge (thus far) of the Internet and how it works, and to connect that to a relevant topic that has an impact on people and society that you care about.

Who is your audience? Not everyone knows as much about the Internet and how it works as you do now. Your speech should be directed at a person (or people) you care about and who you want to inform about this issue. You should provide them with enough technical detail that they can understand why and how it affects them, and the benefits and drawbacks of responses to the issue.

The Issues

There are several issues facing society right now for which it really helps to understand how the Internet functions in order to have an informed opinion.

Pick one of the three issues below to research and prepare your flash talk on.

Issue	Things to look for
1. Net Neutrality Net Neutrality is the principle that all Internet traffic should be treated equally by Internet Service Providers. However, there are legitimate reasons to treat certain kinds of traffic differently. https://en.wikipedia.org/wiki/Net_neutrality	Packets, TCP, IP Address, Protocols
2. Internet Censorship Censorship is the control of what can be accessed, published, or viewed on the Internet. It may be carried out by governments or by private organizations or individuals. Most people believe in having some amount of both freedom of speech and censorship at the same time. https://en.wikipedia.org/wiki/Internet_censorship	TCP, IP, DNS, URL, HTTP
3. Advanced option: Protocol Vulnerabilities and/or Hacks The most common Internet protocols have certain vulnerabilities that attackers can take advantage of. For this option you should pick one of the common protocols: HTTP, DNS, TCP, IP (or TCP/IP) and do a web search for that protocol + “vulnerability” or “hack”. For example you might search for “TCP vulnerability”.	HTTP, DNS, TCP, IP + Vulnerability or Hack

This is an advanced option because some of the articles you find might be fairly technical. Your task will be to research one of these and be able to explain it in your flash talk in terms your classmates will understand.

Part 1: Pick and Research your Issue

- **Your selected issue:** Pick one of the issues listed above that interests you the most or that you'd like to know more about.
- **Reference 1:** Start by looking at the wikipedia article and scan the article for content related to Internet topics covered in class.
- **The focus of your speech:** Find an item or element of the article that interests you on which to base your 2-minute flash talk.
- **Reference: 2 and beyond:** Read further about the issue. Find *at least two* other articles (outside of Wikipedia) that relates to the issue.

Record your research in the organizer provided here:

My Selected issue:
Focus of my flash talk:
The position I will take in my talk:

What is the reference? What did I learn from this reference?	What are the positive (+) and negative (-) impacts on society, economy, or culture? What do I want people to know about this?	What connections can I make to what I've learned about the Internet so far?	What details have I learned that support the position I have taken on this issue?
Reference 1 (wikipedia)			
Reference 2:			
Reference 3:			

Part 2. Write the Flash Talk

You will need to submit a written copy of what will be said in your flash talk.

Your 2-minute flash talk **must**:

1. **Explain the topic or issue**, including technical details of the Internet and how it works in the context of the issue you've chosen to investigate.
2. **Explain the societal impacts** (both positive and negative) related to the issue
3. **Give an informed opinion**, position, or call-to-action on the issue

That's a lot to pack into 2 minutes! So your script for the talk needs to be tight and you need to choose your words well. (NOTE: 2 minutes of speech is about 300 words of text.) Use your research organizer to help you focus on what's most important. You should probably also practice reading it out loud.

Part 3. Presentation and Evaluation

Your flash talk should be tight, coherent, and convey a point of view. It should also clearly demonstrate your knowledge of the Internet and how it works. Below are the primary criteria on which your talk will be evaluated.

The flash talk...	1 does not	2 almost	3 does a good job
Clearly explains the broad issue and what must be considered.			
Clearly focuses on one important aspect of the broader issue.			
Appropriately connects knowledge of the Internet to the area of focus.			
Adequately presents beneficial/positive impacts, as well as the harmful/negative impacts.			
States a position on the issue and makes a convincing argument supported by facts/details.			
Research organizer chart is complete/thorough and lists at least 3 resources. Only 1 can be wikipedia.			