

# Lesson 2: Building a Network

## Overview

In this lesson, students are formed into groups of 5-7 and given string so they can connect themselves together to form a computer network. Students are given several specific networks to form, along with several guidelines for how to best form computer networks. Students are also forced to wrestle with conflicting guidelines in determining the 'best' way to connect together to form a network, and will need to justify why they chose the networks that they did.

## Purpose

The physical activity in this lesson helps provide a memorable experience and personal anchor for the rest of the unit - we can refer to the networks created in this activity to help motivate concepts in later lessons. In the final challenge for this lesson, it is important to let students wrestle with how to best balance the 3 network guidelines and refine their reasoning & explanation for decisions they made when creating their network. This is important in setting up later lessons in this unit - in this lesson, the guidelines are based on the physical impacts of creating a network but towards the end of the unit students will examine the societal and economical impacts for creating computer networks and will again think critically about how to balance several factors from a societal and economic lens.

## Standards

Full Course Alignment

### CSP Conceptual Framework

- **CSN-1** - Computer systems and networks facilitate how data is transferred.

### CSTA K-12 Computer Science Standards (2017)

- **NI** - Networks & the Internet

## Agenda

### Lesson Modifications

**Warm Up (5 minutes)**

**Activity (35 minutes)**

**Wrap Up (5 minutes)**

## Objectives

Students will be able to:

- Explain how computing devices can be connected to form a network
- Identify the path(s) connecting two devices in a simulated network

## Preparation

- Cut strings between 1.5 and 3 feet long. Each student will need 2 of these strings. A ball of yarn can work really well here.
- Decide how you would like students to physically form their networks - standing, in seats, etc.

## Links

**Heads Up!** Please make a copy of any documents you plan to share with students.

For the teachers

- **CSP Unit 2 - The Internet** - Slides

# Teaching Guide

## Lesson Modifications



**Attention, teachers!** If you are teaching virtually or in a socially-distanced classroom, please read the full lesson plan below, then click **here** to access the modifications.

## Warm Up (5 minutes)

**Discuss:** *In the previous lesson, we explored the Internet Simulator, where each of you were connected to one other person by a single wire. What are the potential problems with this setup?*

**Discussion Goal:** Direct the conversation towards the need to be able to talk to multiple people and the need to have a backup if that wire is damaged or unable to transmit information.

### Remarks

Today we are going to build a physical representation of a computer network to address some of these very concerns!

## Activity (35 minutes)

**Group:** Place students in groups of 5-7. Give each group string according to the following chart:

- Groups of 5: 10 strings
- Groups of 6: 15 strings
- Groups of 7: 21 strings

### Teaching Tip

**Strings Per Group:** The number of strings per group is calculated by adding up all of the numbers less than the group size. For example, a group of 5 needs  $4+3+2+1 = 10$  strings. A group of 8 would need  $7+6+5+4+3+2+1 = 28$  strings.

### Remarks

We are going to build a computer network that will let us communicate with multiple people. We will be using strings to represent our connections - if two people are connected with a string, then they are allowed to speak to each other. Only two people can be connected by a single string, but you can be connected to multiple people at the same time via multiple strings.

**Do This:** The next activity is guided by the lesson slides. Display the challenge for students and give them a few minutes to form their network using the provided strings. Each new challenge introduces a new guideline they need to follow. These challenges progress in a specific way, with each guideline helping to motivate the next challenge.

-  As a class, read through the rules for all challenges.

- **Challenge #1 (3 mins):** Students work in groups to create a network where everyone can speak directly to everyone else.
- **Challenge #2 (3 mins):** As a class, read through Guideline A before having students work through the challenge.
- **Challenge #3 (8 mins):** As a class, read through Guideline B before having students start work on the challenge.
- **Challenge #4 (10 mins):** As a class, read through Guideline C before having students start work on the challenge. Let students know there are many possible answers to this as long as they have a reason for why they created the network that they did.

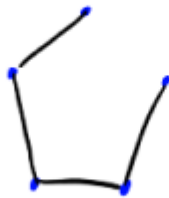
#### Teaching Tip

The first 3 challenges have very direct solutions with most networks in the class looking nearly identical:

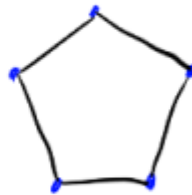
Challenge 1



Challenge 2



Challenge 3



**Discuss:** Thinking about our 3 guidelines, what is a strength of the network your group created? What is a weakness for the network your group created?

**Discussion Goal:** There are many possible answers to Challenge 4 so its important for students to think critically about why they made the choices that they did. They can think of Challenge 1 and Challenge 2 as the two extremes - too well connected and not connected enough - and their network finds a balance somewhere in the middle.

You may choose to have groups draw their networks on a sheet of paper and write their responses along with their network drawing. This can help students process their thinking, and can act as an artifact for reference throughout the unit.

#### Remarks

You've built some interesting networks today. Let's talk a little more about how data moves in these networks.

Routing is the process of finding a path from the sender to the receiver. As we have seen, there are many different paths a message might take.

How fast that message arrives is determined by bandwidth. In a computing network, the bandwidth is the maximum amount of data that can be sent in a fixed amount of time, usually measured in bits per second. If a message arrives quickly, that may be because of high bandwidth - many bits can be sent per second. If the message arrives slowly, it could be due to low bandwidth.

## Wrap Up (5 minutes)

**Display:** Vocabulary words with their definitions (students do not write these down yet):

- Computing Device
- Computing System
- Computing Network
- Path
- Bandwidth

**Discuss:** *How would you use these words to describe today's activity?*

**Discussion Goal:** Students should discuss in pairs how to describe today's activity using the new vocabulary from this unit. They should make the following connections between these words and this activity:

- Each individual person was acting as a computing device
- The strings were the paths between devices. If two people aren't directly connected, then a path may require multiple strings to communicate
- The entire system - devices and paths - make up a computer network
- A computing network is a type of a computing system.

### Remarks

These are the same components that make up our modern Internet! In fact, the challenges we worked with today are the same challenges that the founders of the Internet faced. In the following lessons, we will take a closer look at how the Internet was created.

**Journal:** Record the following words and definitions in your journal: Computing Device, Computing System, Computing Network, Path, Bandwidth.

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## Assessment: Check For Understanding

*Check For Understanding Question(s) and solutions can be found in each lesson on Code Studio. These questions can be used for an exit ticket.*

**Question:** Describe two different paths that a message could take from Person A to Person D:

