

# Celebrate the Hour of Code with //CODE Online Game

*Robot Repair: Can You Fix the Robot Brain?*

## **Lesson Overview and Preparation**

### **Overview**

The online //CODE Robot Repair game teaches the logic and problem solving skills coders need. This game is a great way to introduce and practice computer science topics. We'll take you through the process of fixing a Robot's brain, step by step! Along the way you'll solve puzzles based on the famous 'Boolean Satisfiability Problem,' and within an hour you'll be a Boolean Master and have an understanding of advanced programming concepts! All instruction is contained on one screen, and volume is optional.

For this Hour of Code activity, you will spend a short amount of time preparing students by introducing a computer science concept with an unplugged activity. Students will then learn how to play the online game. At the end of the lesson, students will reflect and you will guide a wrap-up discussion.

### **Time:**

60 - 90 minutes

*Note: Most of the time should be spent on students playing the game.*

### **Materials:**

- Computer devices (one per student, or one for every two students)
- Robot Repair Online Game: <http://www.thinkfun.com/hourofcode/>

### **Suggested Grade Levels:**

This Robot Repair game is appropriate for grades 3 and up. The early challenges will be very easy for secondary students and the later challenges will be very difficult for elementary students. No prior math skills are needed for playing. English language learners may need extra support understanding the instructions especially when content specifics are used (e.g. nodes, logic, power cell). The challenges will stretch students' logical thinking and problem solving abilities.

### **Managing Game Play:**

Students can work individually or in pairs for the online game. Feel free to structure the student game time however works best for your classroom.

**Option 1:** Students will be working on their own device or working in pairs with a device. The whole class is playing the Robot Repair game simultaneously.



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**Option 2:** Implement the Robot Repair game as a center-based activity. After completing the lesson introduction, have students rotate through the //CODE Robot Repair while the rest of the class works in other centers or on another project. Note: this option is preferable if you have a limited number of devices.

## Lesson Plan

### Topic

Today, we have a very special lesson. We will be learning about computer science by playing a game!

### Objective

Students will be able to explain and use Boolean logic to solve puzzles.

### CSTA National Computer Science Standards

#### *Grades 3-5*

AP-11 Decompose (break down) problems into smaller, manageable subproblems to facilitate the program development process.

AP-15 Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended.

#### *Grades 6-8*

AP-13 Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs.

#### *Grades 9-12*

AP-17 Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.

### Vocabulary

- **Boolean Logic:** problems that evaluate to True or False
- **Boolean Expression:** a statement that is either True or False
- **Logic Gate:** an operation on inputs that are True or False

### Agenda

- Vocabulary - 5 minutes
- Stand If... - 10-15 minutes
- Play Robot Repair game - 30+ minutes
- Reflect on what we learned - 10 minutes

### Stand If...

A big part of coding and computer science is called **Boolean Logic**. Boolean Logic includes problems that evaluate to True or False. In Boolean Logic, we use Boolean expressions and logic gates.



A **Boolean Expression** is a statement that is either True or False. For example, “The lights are on” is a Boolean expression, it’s either true or false (ask the students if it is true or false, then turn the lights off and ask again). Ask the students if the following statements are Boolean expressions:

- “The lights are NOT off.” (*yes, it is, because it evaluates to True or False*)
- “Your dog’s name.” (*no, it is not, because it does not evaluate to True or False*)
- “How old are you?” (*no, it is not, because it evaluates to your age, not True or False*)

Let’s play the Stand If game to demonstrate **Boolean Logic**. To play, we will take turns telling the class to “Stand up if you...” and add a Boolean expression. Then, anyone that the Boolean expression is true for will stand up. For example, you could say, “Stand up if... **you are wearing red.**” Anyone wearing red would then stand up.

Have the students play for a few rounds and then tell them that you want to add a twist. You are going to add a logic gate, or an operation on inputs that are True or False. In other words, we are going to add operations to our Boolean Expressions. In algebra, we use + - \* / and other operators to manipulate numbers. In Boolean Logic we use AND OR XOR NOT NAND NOR and IFF to manipulate Boolean Expressions. If it sounds complicated, don’t worry, we will start simple.

Let’s start with the AND operator by asking two students to suggest different Boolean expressions. Students will only stand if BOTH Boolean expressions are true for them. For example: “Stand up if you are **left handed AND if you like to run**” would result in only students who are left-handed and like to run standing up.

After play for a few rounds, tell the students that you are going to change the rules again. This time, two students will say Stand Up phrases but this time they will stand if one OR the other is true about them. This is an OR logic gate. For example: “Stand up if you are wearing shoes or you like kittens” would result in all students who are wearing shoes or who like kittens to stand up.

*Extension:* with older students you could keep complicating the game by using two Boolean expressions with other logic gates found in the game. Here are the logic gates and how they could be used in the Stand if game:



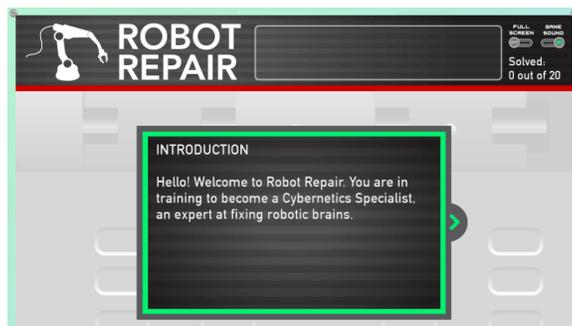
Logic Gate	Stand if...
AND	All Boolean Expressions are TRUE
OR	At least one Boolean Expression is TRUE
IFF	Either both Boolean Expressions are TRUE or both Boolean Expressions are FALSE
XOR	One Boolean Expression is True and one Boolean Expression is False
NOR	All of the Boolean Expressions are False
NAND	At least one of the Boolean Expressions is False

Next, students will play the Robot Repair: Can You Fix the Robot Brain? Challenge where they will be using Boolean Logic just like they did in the Stand Up activity.

### Play Robot Repair Game

The Robot Repair game is non-competitive and can be collaborative if played in pairs. This is an interactive lesson with an emphasis on strategic problem solving. Tell students that it is important to read the explanations thoroughly as this will help them learn the concepts, complete the puzzles, and apply strategic thinking.

Depending on the age and level of your students, you may choose to walk through the online opening slides together as a class (working through the first two challenges) using a projection device, reading the directions, completing the tasks together, and discussing. When students understand how the game works, have students start working independently or in pairs. Emphasize the importance of collaborative problem solving and classroom discourse around problem solving.



If your students are going to be working in pairs, introduce Pair Programming. Explain that pair programming is when two students use one computer to write a program together. Two heads together are better than one! Explain to students in pair programming there is a DRIVER and a NAVIGATOR. Recommend that they switch roles with each robot challenge.

### DRIVER

The driver focuses on the DETAILS

- Control the main actions (mouse, touchscreen, keyboard)
- Explain what you are doing

### NAVIGATOR

The navigator focuses on the BIG PICTURE

- Helps the driver
- Points out potential problems or mistakes
- Thinks ahead and makes suggestions for what to do next

As students are completing the game challenges look for these skills and strategies:

- How students decompose the problem (break it into smaller pieces to solve).
- How students communicate with each other about their logic and reasoning.
- Aspects of Boolean logic where they are more emergent in their thinking.
- Aspects of Boolean logic where they are most fluent and flexible in their thinking.
- Strategies they use for testing and refining their solutions.

While your students are playing share these tips with them:

- Determine what kind of logic statements are presented.
- Once you have solved on clue, or a part of one clue, you will want to see what you can learn about the other clues based on what you already know.
- Work through statements one at a time and then go back and check each statement.

### **Reflection and Discussion:**

- Wrap up the lesson by asking students to reflect and discuss what they learned.
- Ask students to share the most difficulty they had with Boolean Logic and what steps they used to get through the difficulty or challenge.
- How did they go about decomposing the problems or breaking the problem into smaller pieces to solve? When else do you use decomposition to solve a problem outside this game?
- Encourage students to use the vocabulary from the lesson in the discussion.



## **EXTENSION**

This lesson was a great introduction to Boolean Logic. But don't let one hour of code be the only time your students study this important 21st century skill! Take your students' learning deeper with one (or all) of the [ThinkFun //CODE Programming Series](#) and other board games, sold online:

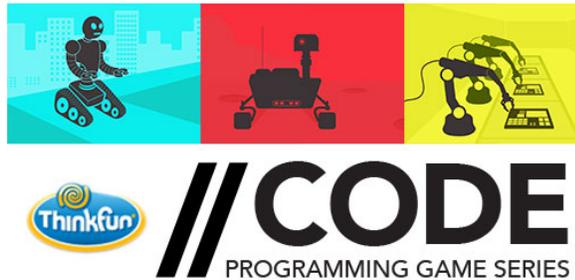
[//CODE On the Brink](#)

[//CODE Robot Repair](#)

[//CODE Rover Control](#)

[Code Master](#)

[Robot Turtles](#)



These board games are a perfect way to introduce your students to complex computer science topics without devices! Each game has challenges and are labeled by difficulty making it easy for you to differentiate instruction in your classroom.

The ThinkFun //CODE Programming Game Series is quickly becoming the preferred unplugged activity for K-12 teachers everywhere.