Course: Tennessee Computer Science Foundations | Module: Electrical Circuits

Lesson 3.4: Logic Gates and Chips

https://codehs.com/course/8902/lesson/3.4

Description	In this lesson, students will learn basic logical operators and how they can be implemented in an electrical circuit.
Objective	Students will be able to: • Explain logical operators and how they are implemented using logical gates • Use truth tables to solve logical equations and problems
Activities	3.4.1 Video: Logical Operators and Gates 3.4.2 Quiz: Quiz: Logical Operators and Gates 3.4.3 Connection: Exploration: AND and OR Gates
Prior Knowledge	Students should be able to use electrical circuits in Tinkercad and be able to connect different components.
Planning Notes	• This activity is designed to be completed on Tinkercad to use the electrical circuit simulator. You can choose to do this with actual electrical circuits if you have them available. • This lesson uses exploration worksheets saved as a Google Doc. You can choose to have students use these worksheets online, or print out copies for them to work from. • This lesson contains a challenge question at the end. This is different from the extension questions that were more of an option. All students should complete the challenge question.
Standards Addressed	
Teaching and Learning Strategies	**Lesson Opener:** • Have students brainstorm and write down answers to the discussion questions listed below. Students can work individually or in groups/pairs. Have them share their responses. [5 mins] **Activities:**

- Watch the *Logical Gates and Operators* video and complete the quiz. [7-9 mins]
- Complete the *Exploration: AND and OR Gates* activity [25-35 mins]
  - This can be completed on paper or online.
  - Students will be using ANDF and OR chips, which can be found by searching all components. Make sure they are not filtering when they look for the components.
  - If students need to see the wiring diagram for a particular circuit, they should google that chip number.
  - This activity contains a challenge at the end that will challenge students to create a more complicated circuit.
  - As an extension, ask students to explore some of the other logic gates such as NAND or NOR.

Lesson Closer:

- Have students reflect and discuss their responses to the end of class discussion questions. [5 mins]

Discussion Questions

Beginning of Class:

- What does it mean for a statement to be true?
  - *This is a complicated question, but for the sake of discussion, we can consider a statement to be true if it is factually correct, or if a general consensus determines that a particular statement is factual.*
- What does it mean for a statement to be false?
  - *This is also a complicated answer. The main idea here is that a statement is false if a statement is factually incorrect, or if societal consensus suggests that something is false.*
- List out some true / false questions.
  - *It is raining outside. I have three hands. The sun revolves around the Earth.*
- How might true and false values be useful in ciruits?
  - *We may want certain circuits to do specific things only if a condition is true. For example, turn on a light if the switch is on.*

End of Class:

- Why do we use truth tables?
  - *Truth tables help us break down more complex logical problems into smaller pieces to see where we have true and false values.*
- Give an example of where we may use AND and OR gate circuits in a real-life setting.
  - *Answers will vary, but any situation where you need two inputs is a good example. For example, lights on if switch is on AND motion sensor detects motion. Doorbell camera on if motion OR doorbell pressed.*
- Speculate why we need to connect each logic gate to both a positive and negative power source in addition to the two inputs

	and output. ◦ *This one may be challenging for students. The answer is that the positive and negative give the gate something to compare to so that the gate can recognize an on versus off value. You can prompt the students by asking them what makes a gate value true versus false.*
Resources/Handouts	

Vocabulary

Term	Definition
And operator	Logical operator that ANDs two boolean values. Written as `&&`. `a && b` will be true if both `a` and `b` are true.
Or operator	Logical operator that ORs two boolean values. Written as `||`. `a || b` will be true if `a` or `b` is true.
Logical Operator	Used to make logical associations between boolean values.
Logical Gates	Logical gates are physical circuits that implement logical operators.

Modification: Advanced	Modification: Special Education	Modification: English Language Learners