



Welcome to the Boole2School Worksheet- 3rd and 4th Years

Section 1 - George Boole

1. Who is George Boole?

2. Where did he teach in Ireland?

3. Why are we celebrating him this year?

Section 2 - Logic

4. Give an example of a logic argument using assumptions and conclusions:

5. Decide which of the following is a proposition and which is not:

- (1) What time is it?
- (2) It's time to have some fun.
- (3) This statement you're reading just now is false.

Section 3 - How do we use Boolean Logic?

6. Give an example of the way Boolean logic is used in your everyday life:

Section 4 - Truth Tables

7. For every statement P , one can find an opposite $\text{NOT}(P)$ by the following rules: whenever P is TRUE, then $\text{NOT}(P)$ is FALSE. Whenever P is FALSE, then $\text{NOT}(P)$ is TRUE.

Let P be the statement: "Anna **AND** Brian are happy."

Then $\text{NOT}(P)$ is: _____

Fill out the table with true or false depending on what you see you classmates do

| Stages | Statements | |
|---------------------|----------------------------------|---|
| | Anna AND Brian are happy. | Anna is NOT happy OR Brian is NOT happy. |
| 1) Anna 😊, Brian 😞. | | |
| 2) Anna 😊, Brian 😊. | | |
| 3) Anna 😞, Brian 😊. | | |
| 3) Anna 😞, Brian 😞. | | |

8. One day the famous scientist Dr. Doom makes a public announcement:
 "IF there will be an earthquake tomorrow, THEN this entire building will fall down."
 The next day, everybody talks about how Dr. Doom was so wrong. What happened in the meanwhile?

9. The president of the school Bridge club is very good at cheating. Just before the last game, Justine told the president "IF you cheat, THEN you'll have to quit!"
 The president does his best – and succeeds – to prove Justine's statement wrong.
 Try using Boolean operators like AND, OR or NOT in answering the questions below:

a) In your opinion, what did the president do during the game to prove Justine wrong?

b) The club members decided to send a last warning to their president. They staged a protest with the message "IF you cheat, THEN you'll have to quit!" Find a way to chant this message which is shorter, catchier, and doesn't use IF...THEN but rather some of the Boolean operators like AND, OR or NOT.

Hint: It is the opposite statement to what the president did.

| | Justine: | What the president did to prove Justine wrong: | Club members chant: |
|----------------|-----------------------------------|--|---------------------|
| English: | "IF you Cheat, THEN you'll Quit!" | | |
| Boolean Logic: | IF C THEN Q | | |

Section 5 – Puzzles

10. Bushfires and Whitewaters

During a recent reality TV game show the 6 contestants were faced with a novel challenge. The contestants from both camps (3 Whitewaters and 3 Bushfires) met on the river bank where they were given the following instructions.



The Whitewater contestants have been faced with the challenge of moving all of the contestants across the river. There is only one boat that can hold a maximum of 2 people.

IF at any stage the Bushfire contestants outnumber the Whitewaters on a riverbank, THEN Bushfire win the challenge. Otherwise the Whitewater Camp wins.

Help the contestants from Whitewater Camp to solve and win the challenge.

11. The Knight and Knave Problem



You are in a strange land. John and Bill are standing at a fork in the road. John is standing in front of the left road, and Bill is standing in front of the right road. One of them is a knight who always tells the truth and the other a knave who always lies, but you don't know which. You also know that one road leads to Death, and the other leads to Freedom.

By asking one yes–no question, can you determine the road to Freedom?



Hint: When the options are only TRUE or FALSE, a double lie can also lead to the truth:

NOT(NOT(P))=P. So try to force the knave to tell such a double lie.

12. The Stolen Envelope:

Chief police inspector S. Mart interrogates the three suspects of the robbery of the famous Blue Eye paper envelope. All three suspects are well known criminals, and he knows that none of them can utter two consecutive sentences without lying at least once.

Mr Black: "I am innocent, inspector. It was White who stole the envelope."

Mr Green: "Black is innocent, inspector. Black is lying when he says White is guilty." Mr White:

"Black is innocent. Green is innocent."

Who did Smart arrest?

Hint: Consider assuming the guilt of a suspect and then evaluating the truth of all statements based on this assumption. You might find it helpful to fill out part of this table with TRUE or FALSE.

| | Black is Guilty | Green is Guilty | White is Guilty |
|---|-----------------|-----------------|-----------------|
| Black: "I am innocent". | | | |
| Black: "White stole it". | | | |
| Green: "Black is innocent". | | | |
| Green: "Black is lying when he says White is guilty". | | | |
| White: "Black is innocent". | | | |
| White: "Green is innocent." | | | |

Section 6 – Follow-up

If you found this lesson particularly enjoyable, you might wish to try out one of the mathematics enrichment programmes which are run in 5 centres across Ireland. More info at <http://www.irmo.ie/>