

Boolean Operators

Overview

In this PDF, you will find instructions for the **Boolean Operators** activity.

In a separate file (**BooleanOperators-Templates PDF**) you will find templates, cutting guides, and cards that you can either print off, or use as a reference (i.e. you can easily copy the information for the cards onto paper or index cards, and cut shapes from different colors of paper using a ruler or approximation).

Find a space, preferably on the floor or a table that is the appropriate height for the child. This should be a space where you can easily lay out all of the materials in a orderly way, without immediate clutter or distraction.

This activity is intended for children ages 3 - 9; we encourage you to adapt to your child(ren) and circumstances as you see fit.

Boolean Operators

Key Concepts and Connections

Boolean logic is based on statements that are either TRUE or FALSE. Boolean logic uses operators such as **AND**, **OR**, **NOT** to process information as TRUE or FALSE.

For this activity, we will create statements using Boolean Operators in order to differentiate items based on shape and color. One example of how we use Boolean operators in computer science is with search algorithms. Suppose you are at the library; you might search for items in the following ways:

1. Search for content about architecture **AND** published after 1950.

This will return content about architecture, but only the content that is published after 1950.

- If the content is 'about architecture' (TRUE); 'published after 1950' (TRUE), then it will be returned in the search.
- If the content is 'about architecture' (TRUE); 'published after 1950' (FALSE), then it will not be returned in the search.

2. Search for books about cats or about dogs.

This will return all books that are about cats or dogs.

- If the book is about cats (TRUE), then it will be returned in the search
- If the book is about dogs (TRUE), then it will be returned in the search
- If the book is about cats (TRUE) and dogs (TRUE), it will also be returned in the search.

3. Search for books about architecture that are **NOT** published in the United States.

This will return all books about architecture from all over the world, except those published in the United States.

*Note that OR in the Boolean context is different than how we often use "or" conversationally. Oftentimes, in conversation, we use OR exclusively, meaning one or the other. For example: For dessert, you may have cake OR ice cream. But in computer science, OR means that you get to have both!

Boolean Operators

Activity 1: Colors, Shapes

Materials

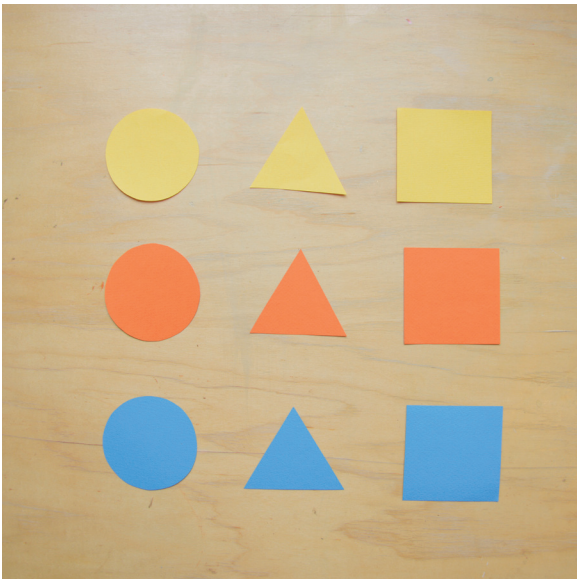
- assorted paper: 3 different colors
- ruler
- pencil / marker
- scissors

Preparation

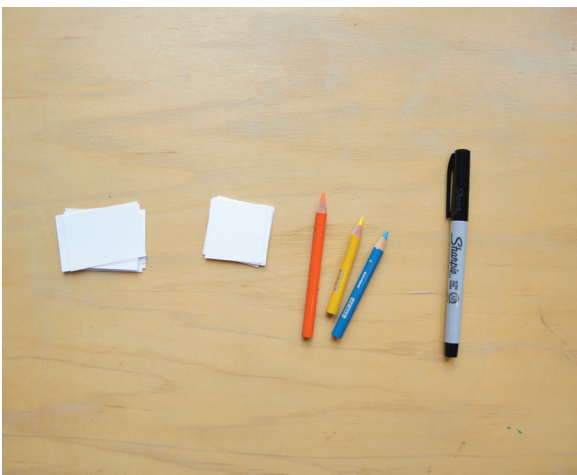
1. Print out the templates (if you do not have access to a printer, you can cut the shapes out by hand)
2. Cut out one set of shapes (circle, square, triangle) from 3 different colors of paper. If you do not have construction paper/colored paper, you can create your own by coloring it with crayons, colored pencils, or paint.
3. Cut out the AND, OR, NOT cards from the template; or create your own by simply writing AND, OR, NOT on separate cards. Create at least 4 sets.

What if I don't have access to a printer right now?

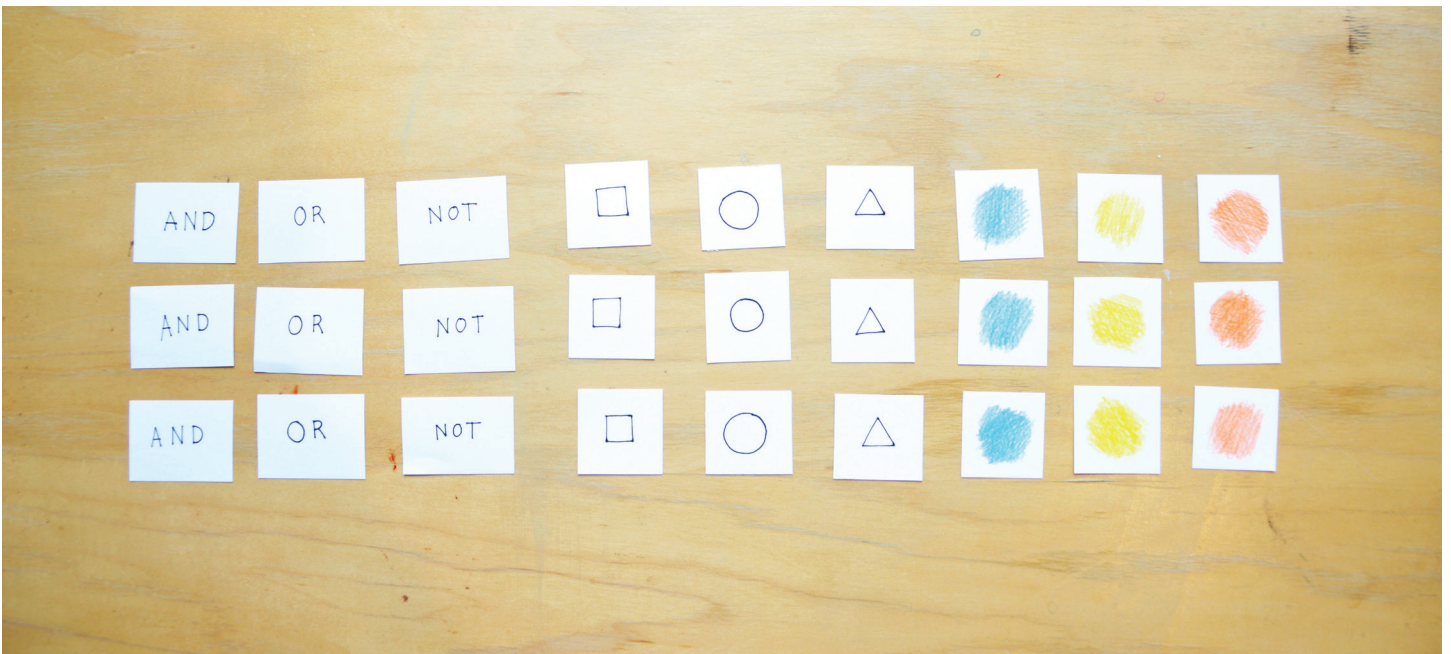
No problem! We have included measurements here, so that you can use a ruler (or approximation) and simple letter-size paper (or any size paper for that matter) to cut out exactly what you will need. Just follow the guides in the [BooleanOperators-Templates PDF](#).



Cut out shapes



Cut out / make operator, shape, and color cards



Boolean Operators

Activity 1: Colors, Shapes

Objective

Children will demonstrate an understanding of the meaning of AND, OR, and NOT as Boolean operators, by isolating the pieces that correspond to the logical statements.

Setting Up

1. Lay out all of the cut out shapes randomly, and no particular order (there should be nine total: 3 squares in 3 different colors; 3 triangles in 3 different colors, and 3 circles in 3 different colors).

What do you notice about these? In what ways are they similar? In what ways are they different? If you were to sort them, how might you do that?

2. Take one AND card and set it in front of the child. Pointing to the card, say *AND*. *What does AND mean? Can you use it in a sentence?* Discuss.

3. Take one OR card and set it in front of the child. Pointing to the card, say *OR*. *What does OR mean? Can you use it in a sentence?* Discuss.

What is the difference between AND and OR?

4. Take one NOT card and set it in front of the child. Pointing to the card, say *NOT*. *What does NOT mean? Can you use it in a sentence?* Discuss.

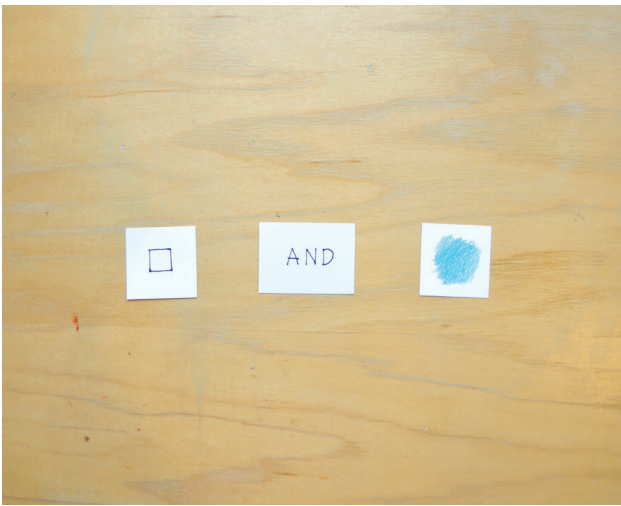
Using these three words, we can create statements that instruct us how to separate the pieces into different groups. Let me show you what we mean:



*Note that OR in the Boolean context is different than how we often use “or” conversationally. Oftentimes, in conversation, we use OR exclusively, meaning one or the other. For example: For dessert, you may have cake OR ice cream. But in computer science, OR means that you get to have both!

5. Take the shape / color cards. Using the cards, set up a single statement. A good way to start is with one shape card and one color card.

Here is an example:



Pointing to the cards, read this statement aloud:

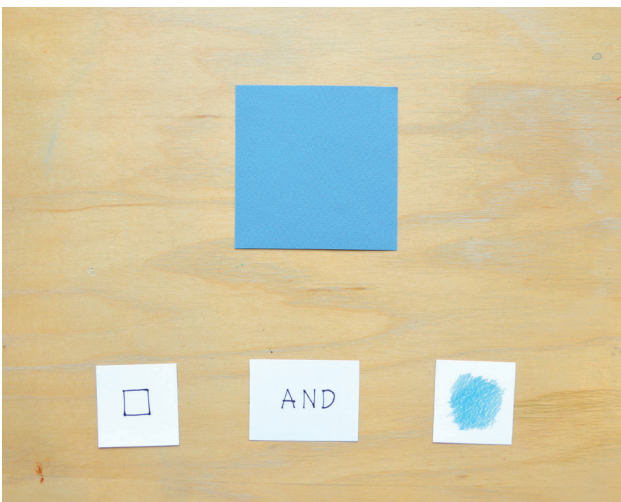
square AND blue

Point to the assortment of shapes, and ask: *Can you find any shape or shapes that are square AND blue?*

For younger ones, you can break this down into two steps. *Can you find all of the shapes that are square?*

And from there: *Can you find any of these squares that are blue?*

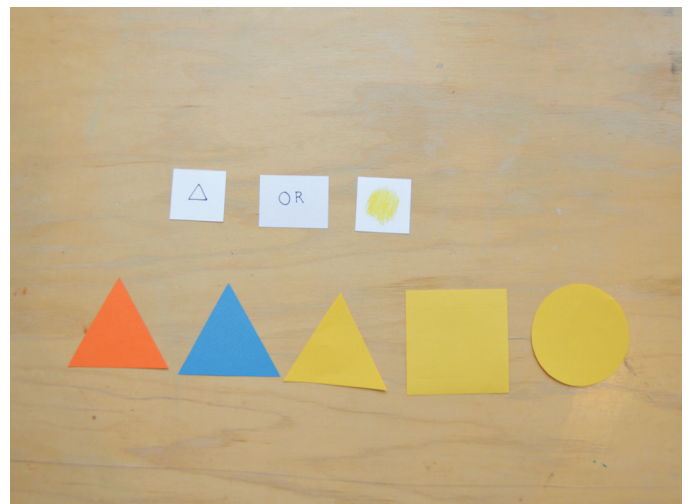
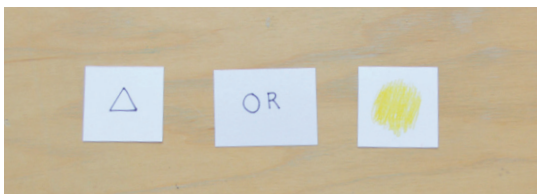
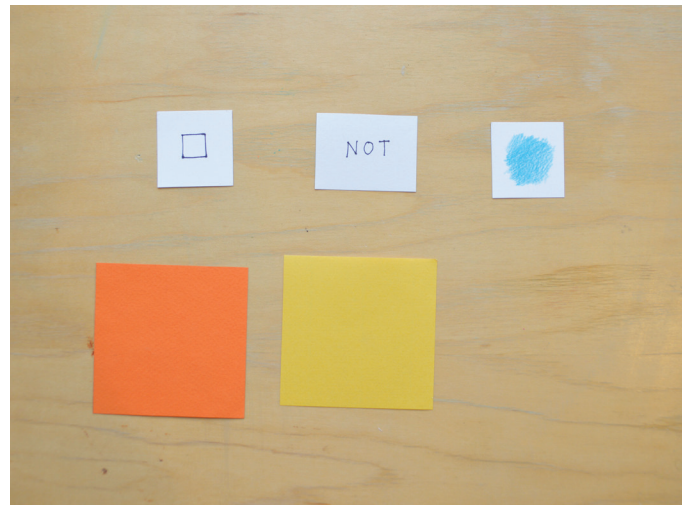
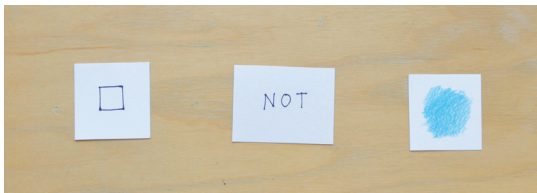
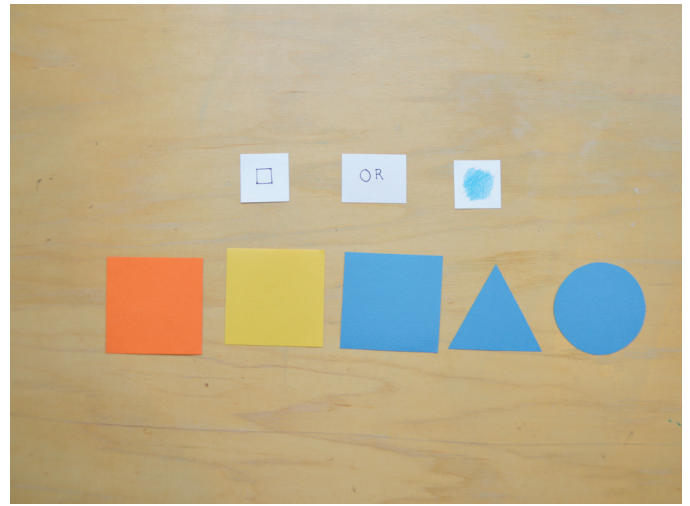
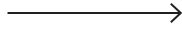
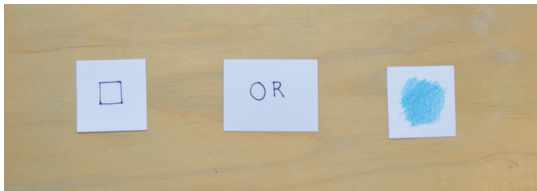
After the child has correctly identified the shapes, together you can say the statement again - so that the child is learning the significance of AND, OR, NOT through repetition.

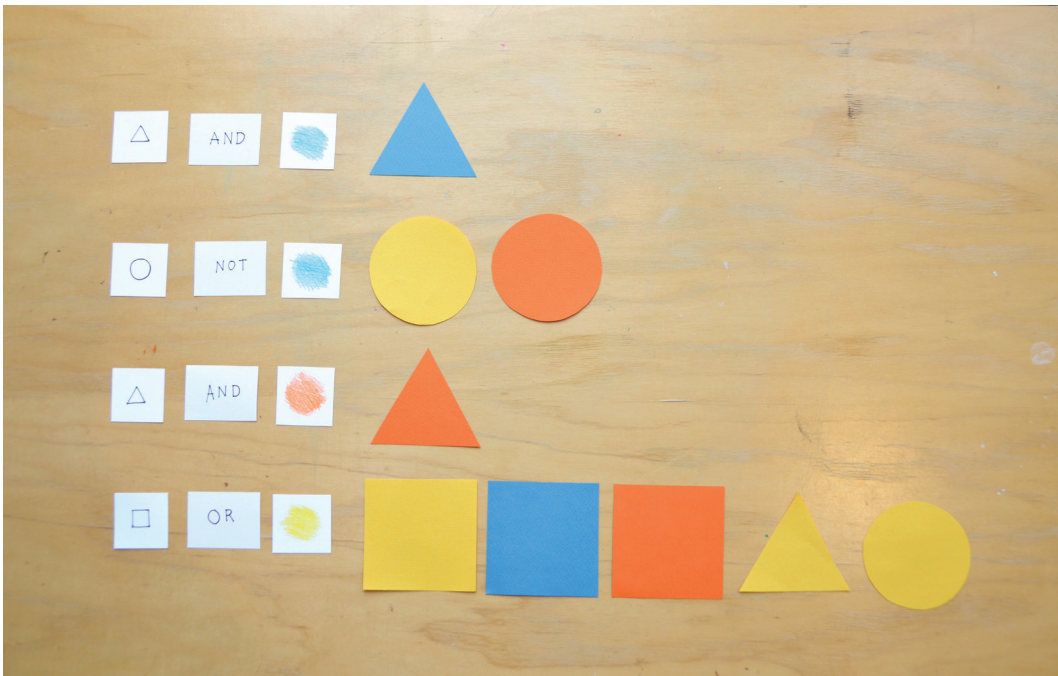


Set up additional statements, using this pattern: shape - operator - color

Using this pattern, you can create many statements. And ask the child to select the pieces that correspond to the statements.

Examples:





Boolean Operators

Activity 2: Working Backward

This activity works well with older children, as it can be a bit challenging. Try it after completing Activity 1 and the child has demonstrated a solid understanding of AND, OR, NOT through successfully matching the correct shapes to the corresponding statements.

Setting Up

1. Now I am going to present a shape or group of shapes to you. Can you tell me what the corresponding statement would be?

2. Set up a shape or group of shapes. Here are some examples that work well:

blue triangle

orange square

yellow circle, blue circle, orange circle

yellow square, blue square

You can come up with many more - just make sure to try them out in your head or before you set up to make sure that the statement will be straightforward.

Answers to the above examples:

blue triangle - **triangle AND blue**

orange square - **square AND orange**

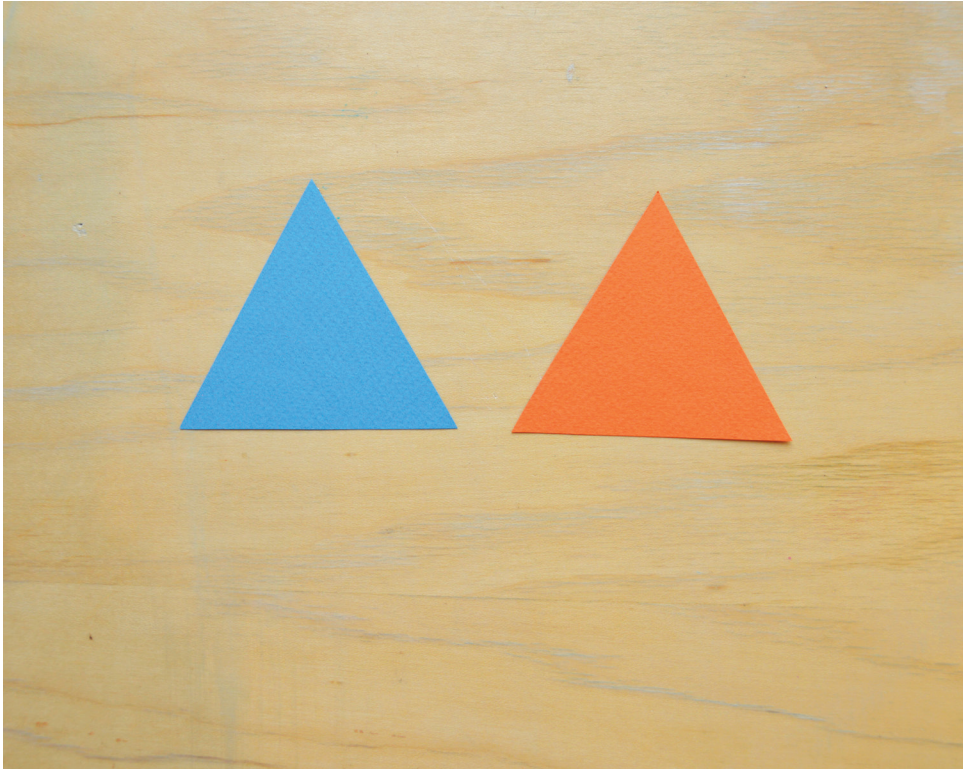
yellow circle, blue circle, orange circle, blue triangle, blue square - **circle OR blue**

yellow square, blue square - **square NOT orange**

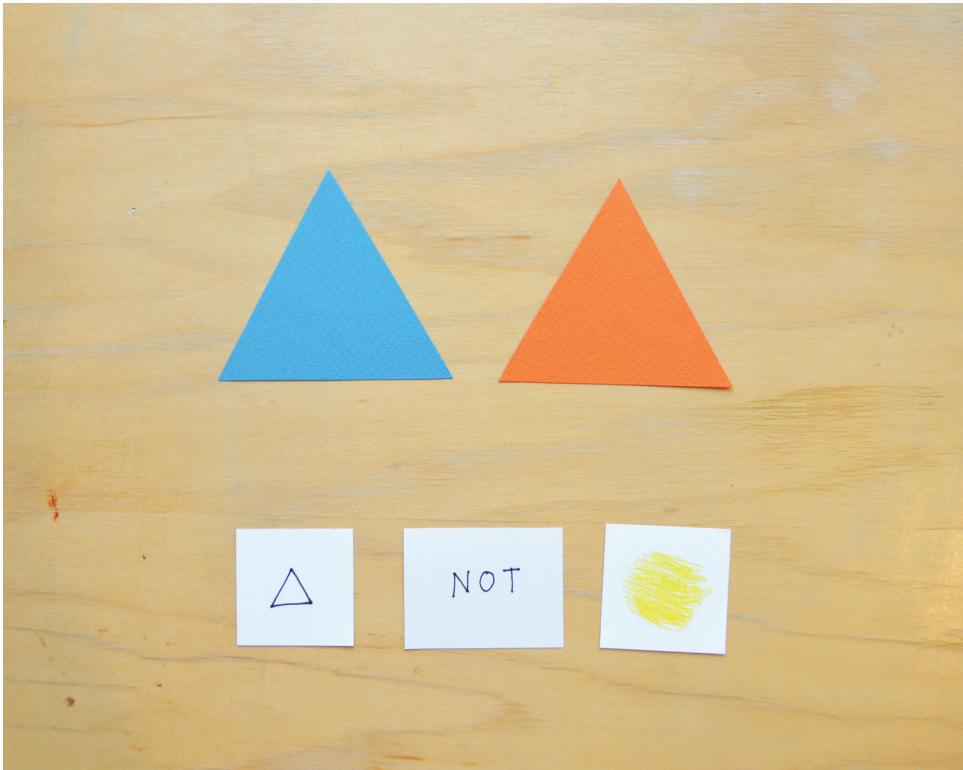
Which operator(s) give us more shapes? Which operator(s) give us fewer shapes?

Example:

1



2



Boolean Operators

Activity 3: Found Objects

Setting Up

Find objects around the house, or nature objects from outside. You could even do this together - go for a walk and collect things from outside such as flowers, leaves, seeds, sticks, and rocks.

Add them to small-ish objects from around the house - small toys, scraps of fabric or paper, pantry items, nick-nacks, etc.

With your group of objects, ask: In what ways are any of these objects similar? In what ways are any of these objects different?

Depending on your selection of objects, identify (either on your own or with your child) characteristics that you can use to describe some of them. Could be shapes, colors, textures, characteristics such as natural/not natural, etc.

Write down these characteristics on blank cards. You may use words, or depictions (such as color or shape) as before.

Use these new cards with the operator cards to create statements, as with Activity 1. Try a few together.



