Shapes and Translation Lesson Plan

One-sheets: Making a Robot

DESCRIPTION

Students will become familiar with the four basic 3D shapes of BlocksCAD: the **sphere**, **cylinder**, **cube**, and **torus**. Students will also practice using the **Translate** transformation, which is used to move shapes around the 3D grid. Translation is one of the most basic and fundamental transforms in BlocksCAD. Translation, combined with the four basic shapes, will give students enough tools to start making 3D models. Students will also learn how to label their code with **Comments** to keep code organized and readable, and will also learn to customize their model with the **Color** transform.

VIDEOS

- **BlocksCAD Quickstart** https://www.youtube.com/watch?v=5RNKVn7IijM
- **The Four Basic 3D Shapes** /www.youtube.com/watch?v=xs0a4hzd1Tk
- **The Translate Block** www.youtube.com/watch?v=6ulQa_sO8ms
- **Code Organization** https://www.youtube.com/watch?v=K-InjEWez8c

LEARNING OBJECTIVES

- Students will construct models using the four basic shapes of BlocksCAD: the sphere, cube, cylinder, and torus.
- Students will demonstrate understanding of 3D grid coordinates by translating objects along the X, Y, and Z axes.
- Students will demonstrate understanding of positive and negative numbers by positioning shapes at positive and negative coordinates on the 3D grid.
- Students will use comments to label their code, in order to explain code and make it easier to interpret.
- Students will practice debugging models, using the color transform to "tag" and locate shapes in the render window

REVIEW / PRIOR KNOWLEDGE

In the first lesson, no prior knowledge of BlocksCAD is presumed, but students should have a basic grasp of a few core math concepts. This includes basic 3D shapes, how to read and place points on a number line or grid, and what negative and positive numbers are.

One-sheets: *Robot Activity*

Skills and Knowledge
- Basic knowledge of the 3D shapes, including Cube, Sphere, Cylinder, Torus
- Knowledge of plotting points on an x-y grid, or a number-line.
- Emergent understanding of 3D space, including directions like forwards, backwards, sideways, and up and down.
- Knowledge of negative numbers, and plotting negative numbers on a grid or number line

TEACHER NOTES

Mini Lesson (I Do)

In this first set of lessons there will be several critical concepts to review with students. Depending on the age of your students, it may be appropriate to give them an overview of 3D modeling, and what exactly "CAD" can be used for. Topics could include 3D printing, video game graphics, CGI, architecture and design, art, mathematics, modeling, and more.

For younger students, it may be better to provide hands-on preparation. If you have toy blocks or building materials on hand, you may have students spend 5-10 minutes working with blocks to build a structure, identifying the shapes available (ideally cube, cylinder, sphere and torus or "doughnut"). You can tell them that after this, by the end of this lesson they will be able to do the exact same thing on a computer, with 3D modeling.

Guided Practice (We Do)

At first, students will need ample time to become comfortable navigating the BlocksCAD application. Have students follow along with you as you demonstrate the following actions in BlocksCAD. It will likely take several class periods to finish the Shapes + Translation onesheets, especially for younger students, and so it may be appropriate to review the actions below with each lesson, in order to ensure students grasp the basics.

Cube, Sphere, Cylinder, Torus (Basic 3D Shapes)
- Show students where to find the shapes (Cube, Sphere, Cylinder, and Torus) in the BlocksCAD editor, in 3D Shapes category on the left side. Demonstrate dragging these blocks into the code Workspace.
- Demonstrate one shape at a time. First render the default shape, and then make changes to values of each shape and render again, to show how the changed values affect the shape.
- Demonstrate how to render and re-render shapes. Emphasize that students should always re-render to see their newest code in action.
- Demonstrate how changing the numbers which define different shapes will change the final shape (after "render" is selected).
- You may also want to demonstrate what happens when a very large shape is rendered. In some cases, the shape may not appear because the camera is located inside of the shape. It is necessary to zoom out using the scroll wheel on the mouse, or using the "-" button in the render window.

Translate (Transform)
- Show students where to find the Translate block, in the "Transforms" category on the left side. Show students how to insert shape blocks into it by dragging towards the mouth until the green caret icon appears.
- Demonstrate how entering numbers in the translate block (including negative numbers) and clicking "render" will move shapes around the 3D grid. For beginners to 3D coordinates, demonstrate by only moving shapes along one axis at a time before demonstrating that you can translate along multiple axes with one block.
- Show students where the labels for the 3 axes can be found. X, Y, and Z labels are on the positive end of each axis.
- Another way to identify negative and positive directions on the axis is that the negative direction is a dashed line - which students may remember as looking like many "minus" signs in a line.
- For students comfortable with units and measurement, you may explain that the smallest grid interval is one millimeter, and the darker lines are at 10mm intervals.

Using BlocksCAD: Labeling, Color, Undo/Redo, Organization
- Show students how to make comments on their code, so they can begin organizing and labeling the different parts of their model. Either right-click a block and select "Add comment" then click the "?" icon on the block; or simply double-click a block. Comments can be hidden by clicking the "?" icon again to toggle.
- Show students how to use the **Color** transform block, which can be used to change the color of individual shapes. Students can also change the color of multiple shapes by clicking the "+" icon, which adds extra bays to the block.
- Show students the "undo" and "redo" buttons at the top of the page. It is common to accidentally delete code or change values, and so knowing how to undo is important.. The keyboard shortcut "ctrl" + "z" can also undo.
- To delete blocks, either drag the block into the left-side menu area (a red "x" will appear on the mouse icon), or select a piece of code and hit the "backspace" or "delete" key. If students accidentally delete something, they can alway undo it (see above).

Independent Practice (You Do)

Give students one of the onesheets for the Shapes and Translation set (Robot) and allow them to complete their own version of the project. Emphasize that students do not need to make their models exactly like the photo, and that you will not give them any number values for their shapes. Act as a mobile facilitator to answer students questions about how to change the dimensions of basic shapes, use the Translate block, and use Comments and Color blocks on their code. Students who finish early should try the addition models in the *Now Try This!* section, or can work on an additional One-sheet, or their own creations.
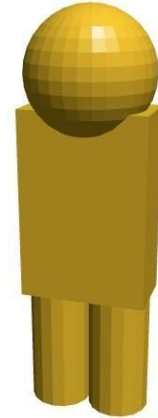
Translate basic 3D Shapes to make a Robot!

Getting Started:
Do you want your robot to have a body shaped like a sphere, a cylinder, a cube, or a torus? Start with that shape! (Hint: if you use a cube, select **centered**.)

Select other 3D Shapes for the head and legs.

Use the **translate** block to move the head to the top of the body and the legs to the right and left.

Use These Blocks!

Sphere radius 10   Cube X 10 Y 10 Z 10 not centered ▾

Cylinder radius1 10 🔒 radius2 10 height 10 not centered ▾

⊞ Translate X 0 Y 0 Z 0

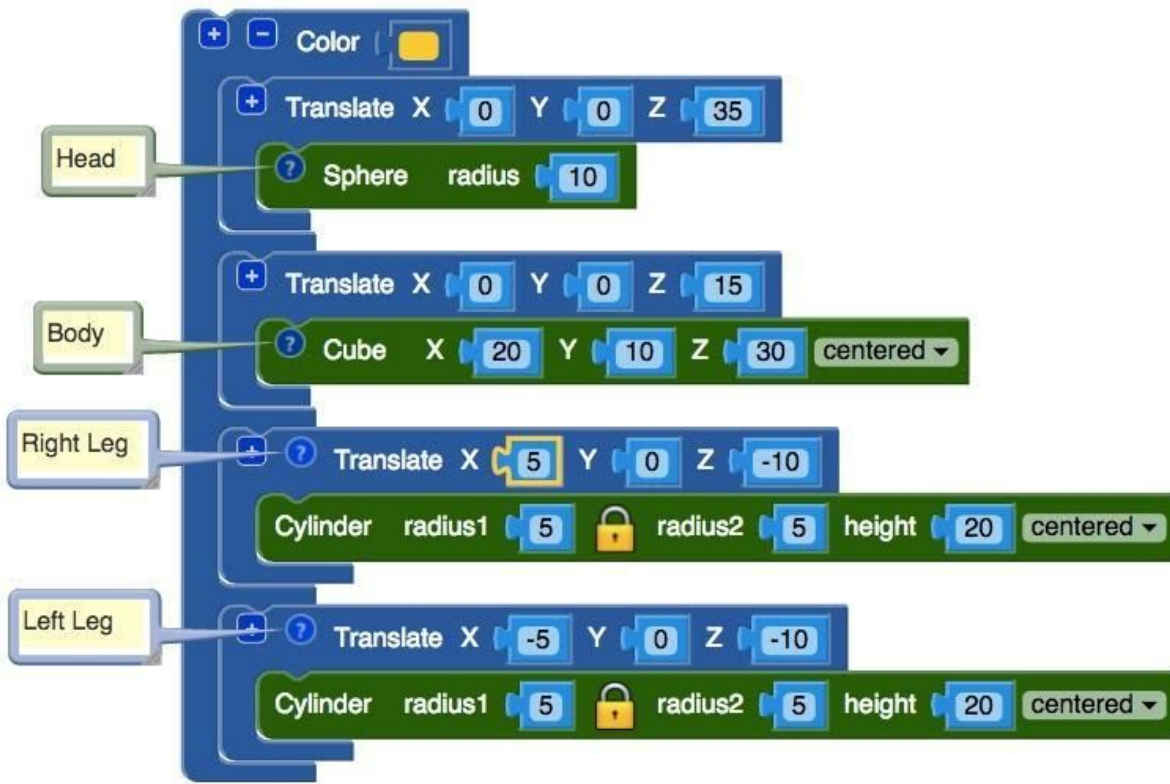## Think About It!

- What axis do we use to translate a shape up? How can we translate down?
- How would you add arms, or eyes, or a hat?

Now Try This!

Color [ ]

Head

Translate X [0] Y [0] Z [35]

Sphere radius [10]

Body

Translate X [0] Y [0] Z [15]

Cube X [20] Y [10] Z [30] centered ▾

Right Leg

Translate X [5] Y [0] Z [-10]

Cylinder radius1 [5] 🔒 radius2 [5] height [20] centered ▾

Left Leg

Translate X [-5] Y [0] Z [-10]

Cylinder radius1 [5] 🔒 radius2 [5] height [20] centered ▾

Color ▢

Translate X [0] Y [0] Z [30]

Head →
Sphere radius [10]

Body →
Cylinder radius1 [10] 🔒 radius2 [10] height [30] not centered ▾

Right Leg →
Translate X [10] Y [0] Z [10]
Cube X [5] Y [10] Z [40] centered ▾

Left Leg →
Translate X [-10] Y [0] Z [10]
Cube X [5] Y [10] Z [40] centered ▾