PROJECT ONE

CLOUD TYPES AND DISPLAY STANDS

LINK: *thingiverse.com/thing:1699444* for access to handouts, videos and other materials associated with this project.

PROJECT INFO

AUTHOR
Danielle Evansic,
@devansic

SUBJECT
Science

AUDIENCE
Grade Levels 1–4

DIFFICULTY
Beginner

SKILLS NEEDED
Basic Tinkercad™ software experience

DURATION
3–4 Class Periods

GROUPS
8 Groups
3–4 Students / Group

MATERIALS
10 No.2 Pencils
Paper and Markers
Index Cards
Camera or Scanner

SOFTWARE
Tinkercad (**web app**)

PRINTERS
Works with all MakerBot® Replicator® 3D printers

PRINT TIME
Prep: 5 hrs / Cloud Base
Lesson: 1–3 hrs / Cloud

FILAMENT USED
1–1 ½ Large Spools

"This project enables kids to do more than design something on the computer. They get to take something they've drawn by hand and turn it into a 3D object. Then, as a bonus, they use their 3D-printed object to show what they know! It's a great, un-scary way of getting kids to make in the classroom."

– **Danielle Evansic**

LESSON SUMMARY

Cloud types differ not only in appearance, but in water content, altitude, and as signals for future weather conditions. Learning about the clouds helps students understand the atmosphere and the interconnectedness between the systems of the planet.

This project prompts students to work in groups to design and print models for each of the ten different cloud formations. The cloud prints are designed to fit on the end of a standard pencil, which can sit in a base that has the name of the cloud formation. The base also has space for flash cards, pictures of clouds, or additional study aids. This is a great science project and can be used to create a display area for teachers who like to use learning stations.

LEARNING OBJECTIVES

After completing this project, students will be able to:

› **Identify** cloud types based on characteristics, appearance, and altitude.

› **Convert** a hand drawing to a 3D model using Tinkercad software.

› **Manipulate** models in Tinkercad using the group, hole, and ruler tools.

NGSS STANDARDS

3-ESS2-1 Earth's Systems Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.

5-ESS2-1 Earth's Systems Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

MS-ESS2-4 Earth's Systems Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

3-5-ETS1-1 Engineering Design Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

This project can be extended to meet the following Standards:

5-PS1-1 Matter and Its Interactions Develop a model to describe that matter is made of particles too small to be seen.

5-ESS2-2 Earth's Systems Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

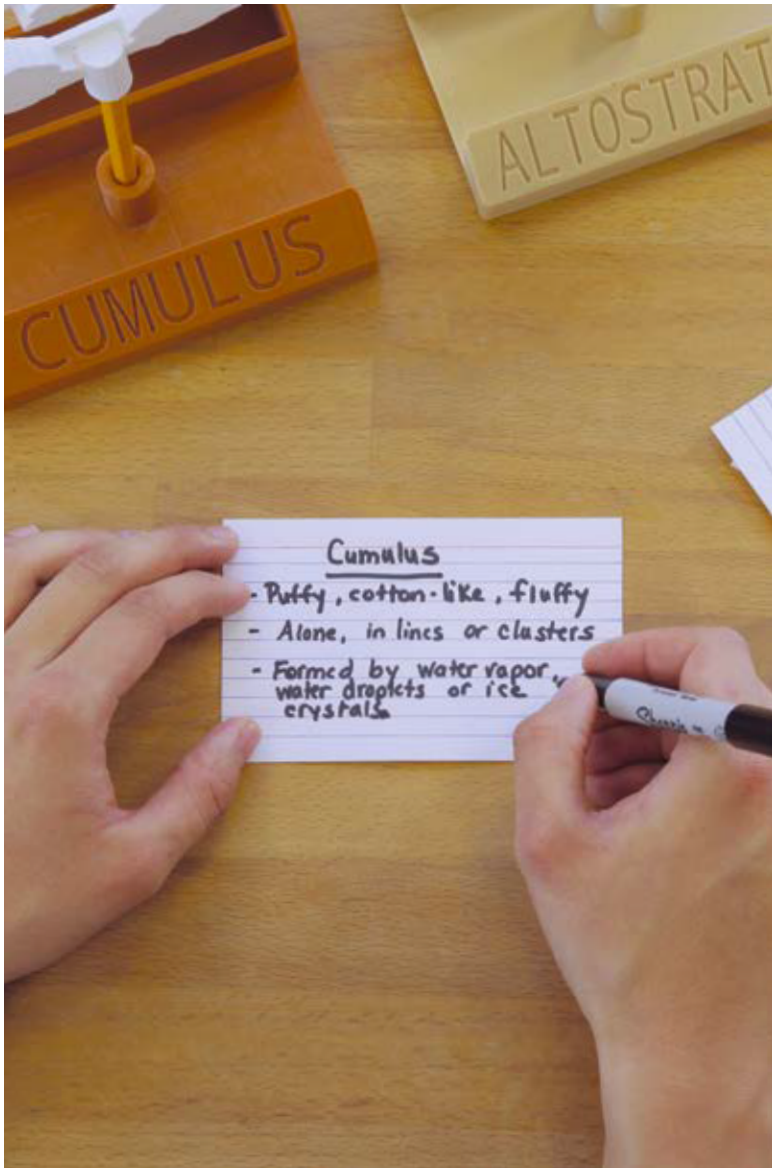
MS-ESS2-5 Earth's Systems Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.

MS-LS2-3 Ecosystems: Interactions, Energy, and Dynamics Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

TEACHER PREPARATION

A. Print cloud bases: 3D print each of the cloud bases included in the Thingiverse Education™ post (*thingiverse.com/thing:1699444*). Leave yourself some time for this, as each cloud base will take 4-5 hours to print.

B. Research cloud formations: Have students research and discuss different cloud formations. *NOVA*, *NASA*, and *ABCTeach* offer great resources. You can find these links in the Thingiverse Education post.



C. Make index cards: Have students make index cards for each of the following types of clouds:

› **High-Level Clouds** - Cirrus, Cirrostratus, Cirrocumulus
› **Mid-Level Clouds** - Altostratus, Altocumulus
› **Low-Level Clouds** - Stratus, Stratocumulus
› **Multi-Level/Vertical Clouds** - Cumulus, Cumulonimbus, Nimbostratus

STUDENT ACTIVITY

STEP 01:
DRAW CLOUDS

It's pretty easy to go from a simple drawing to a 3D printed part.

In this project, your group will create a 3D printed model based on your drawing of one cloud type.

A. Choose one of the cloud types (make sure each group selects a different cloud type to work on).

B. Draw and color your clouds. Use dark colors so they show up as solid when designing in Tinkercad software. If you're crafty, leave some blank spots for detail.

TIP: Make sure the cloud names are spaced far enough away from the cloud drawings to allow for easier removal in the Tinkercad software.

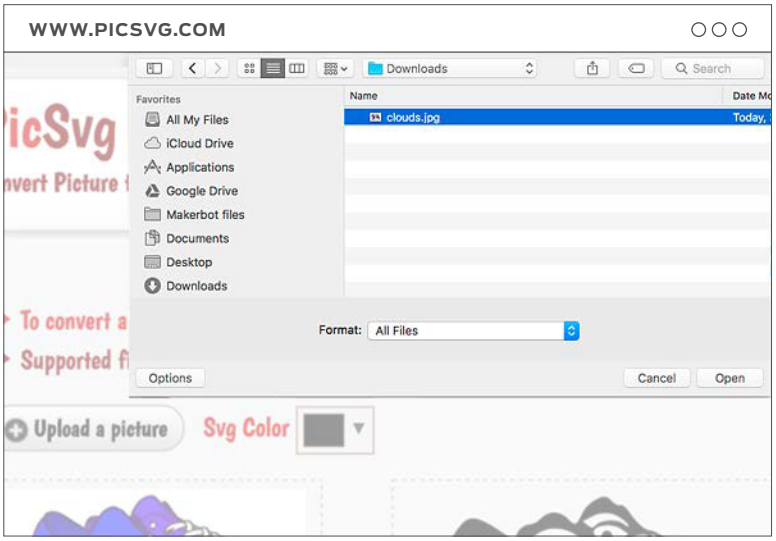
STEP 02:
CONVERT DRAWING TO .SVG FILE

A. Take clear, well-lit photos of your drawings.

B. Import the photos to your computer by either emailing them or uploading the photos to a cloud drive like Dropbox®, and save them to your computer.

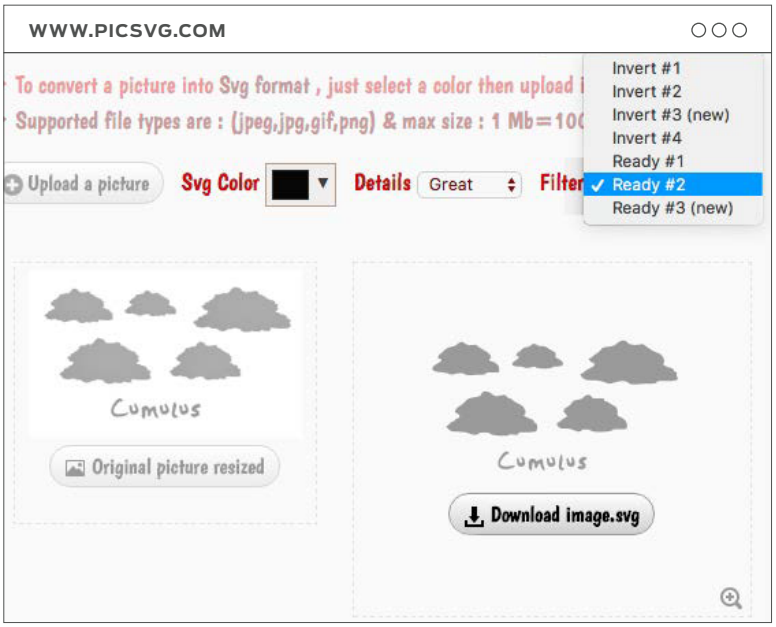
TIP: Establishing a method to transfer files back and forth between teacher and students (i.e. USB drives, Google Classroom™, etc.) will save you a lot of time.

C. Go to *picsvg.com* and click **upload picture**.



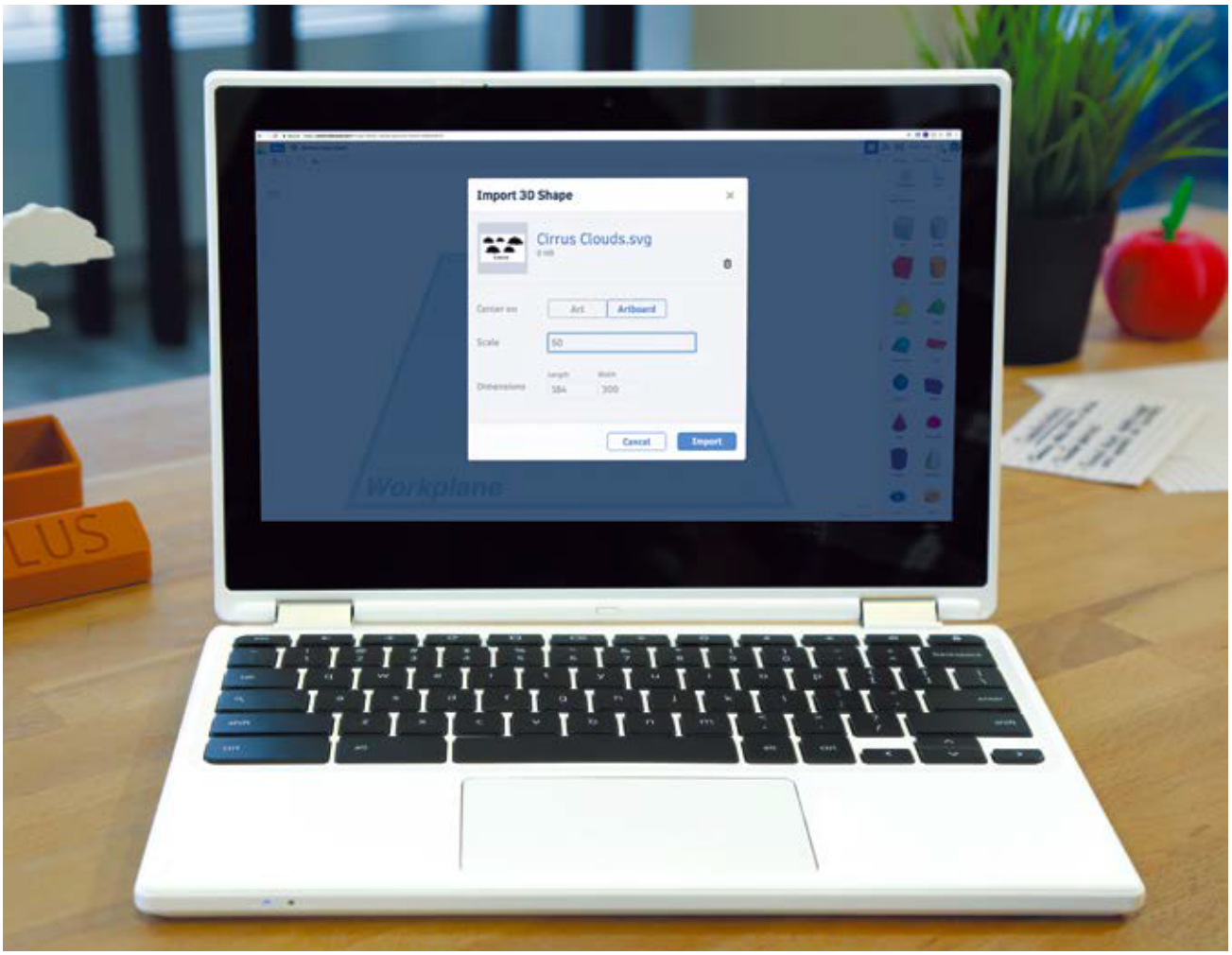
D. Navigate to where the picture is stored on your computer and click **open**.

TIP: Use the filter drop down menu to ensure your cloud is filled in.



E. Click download image. svg. If the image appears in your browser, right-click the image and select **save as** to save the new .SVG file. Do this for each cloud.

STEP 03:
IMPORT .SVG FILE INTO TINKERCAD

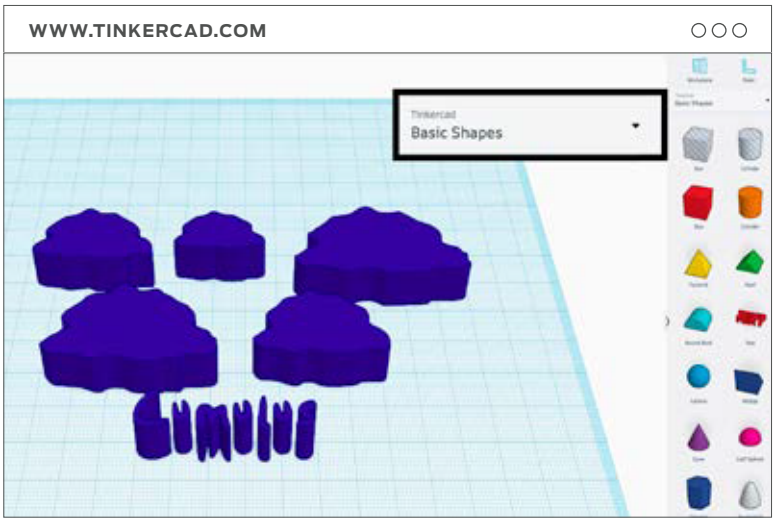


A. Open a browser and navigate to *Tinkercad.com*. Click **create a new design**, and click **import** in the top right of your screen.

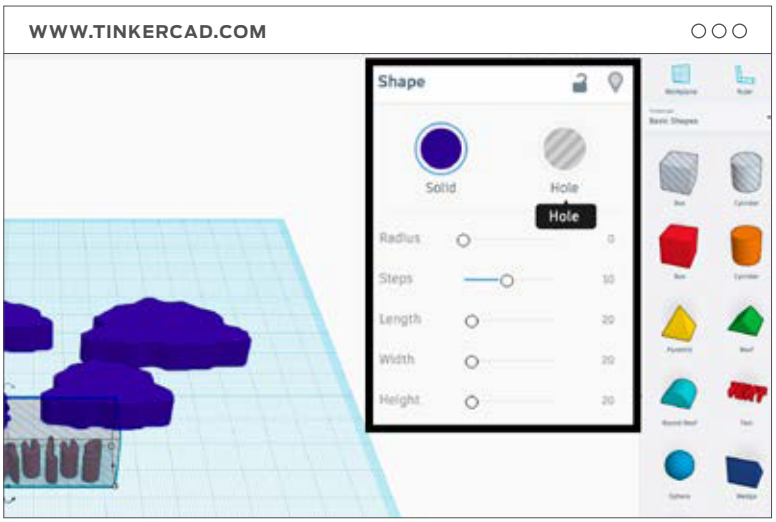
B. Select the correct .SVG file, you'll need to choose the scale (size) or dimensions (length, width, height) of the 3D model. Because they can be pretty large, Tinkercad software will give you a suggested size reduction to make your drawing manageable. The cloud files shown in this example were imported at 50% scale.

TIPS: If your import is too big, don't worry, just delete the one you imported, change the numbers, and click **import** again. When re-sizing, be mindful of your build plate size.

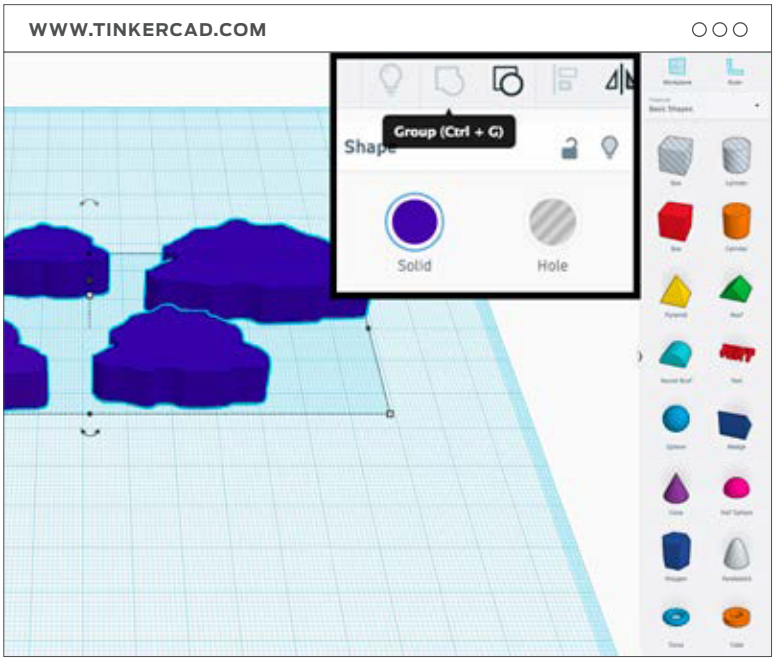
When your drawing is imported, only dark colored parts will be visible. If they aren't connected, they will be separate parts when printed. We will have to put in connectors later so that they stay together when printed.



C. Remove anything extra that came in from the drawing (names, extra lines, etc.) To do this, go to the **basic shapes** menu, select a **box** and make sure it's big enough to cover.



D. Turn the box into a hole by selecting the box, then clicking **hole** in the dialogue window near the top right corner.

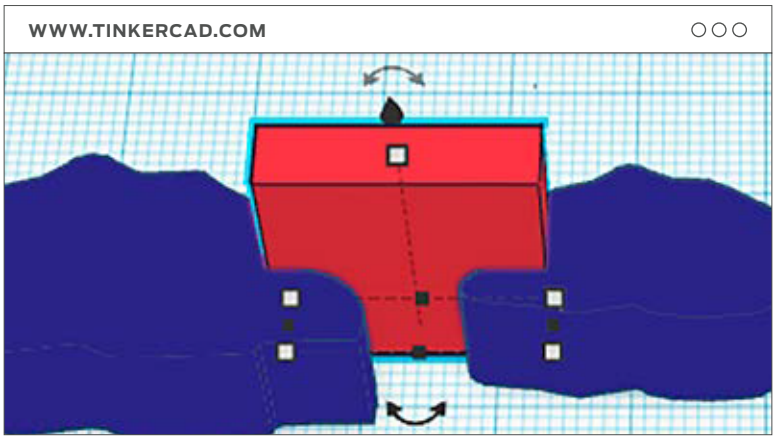


E. Select the cloud and hole by holding **shift** while clicking on both, and use **group** to combine them. This will remove both the box and everything it covers.

STEP 04:
ADD CLOUD CONNECTORS

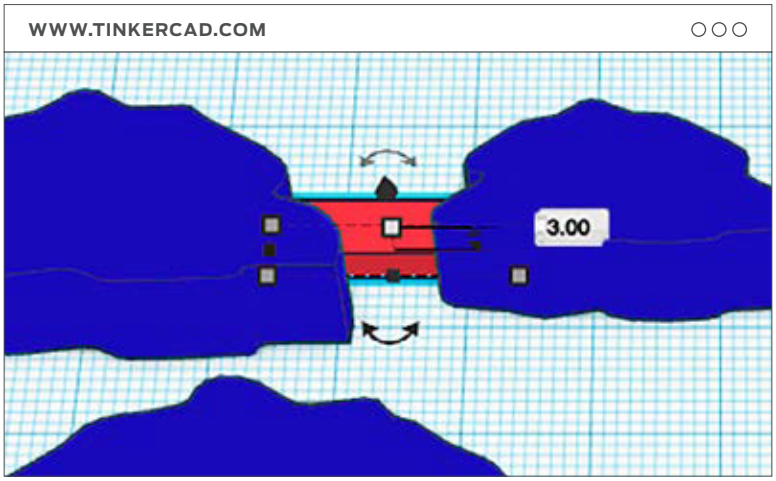
Now that all that clutter is hidden, add some connectors to the clouds. You might be able to skip this step if your cloud is already one single part.

A. Drag a new box onto your workplane and position it between two cloud pieces.

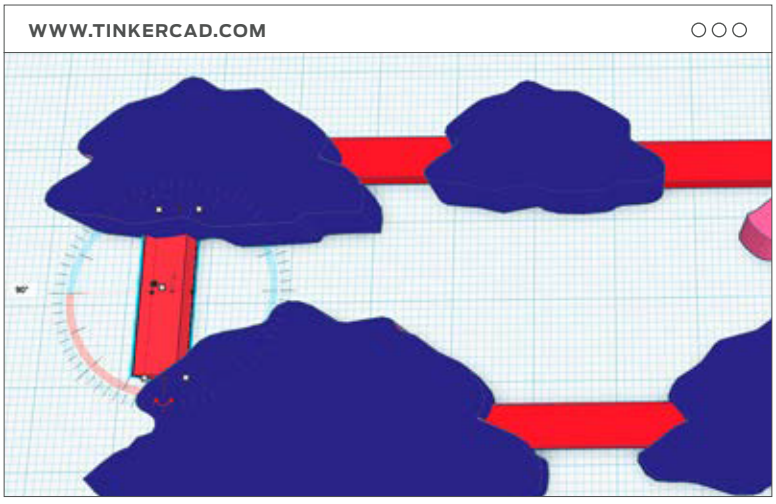


TIP: Use the **right click** on your mouse to orbit your view to make sure everything is in the correct place.

B. Click and drag the white corner handles to change the size and shape of the box. Then click and drag the central white handle to change the height down to 2 mm (just enough to hold the clouds together). Make sure all of the connectors are at least 1 mm thick so they won't break after printing.



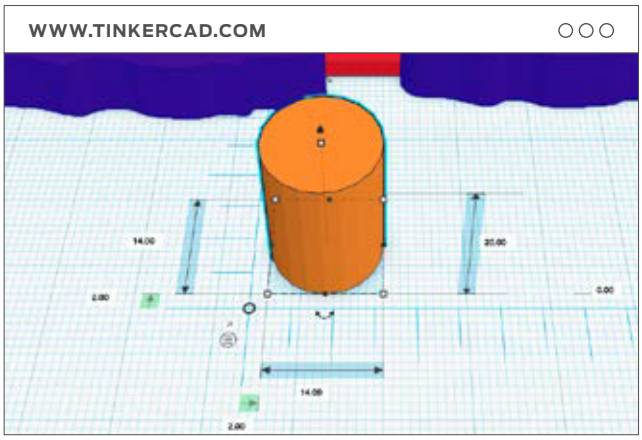
C. Repeat this process to make as many connectors as you need. For some connectors, you'll need to use the **rotate** handles to get them into the correct position.



TIP: Make sure all connectors lay flat on the workplane and are not floating in the air. They should share the same bottom surface as the clouds. Use the hotkey **D** to drop a selected item to the workplane.

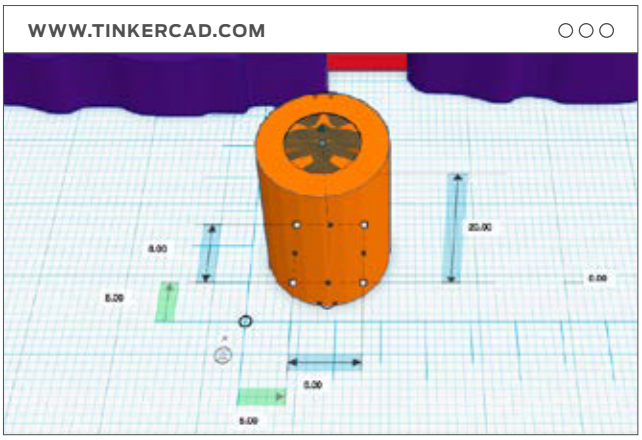
STEP 05:
MAKE PENCIL TOPPER

Most pencils are a little less than 8 mm in diameter. Add a couple of cylinders to make the topper for the pencil.

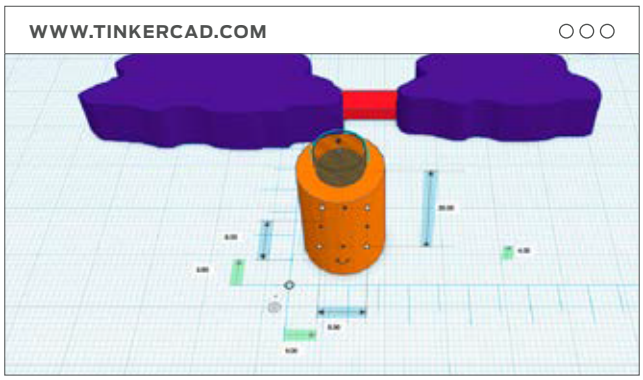


A. Drag a new box over from the **basic shapes** menu, then drag a **ruler** to help you out. Click on the cylinder to apply the ruler to it. Change the diameter of the cylinder to 14 mm.

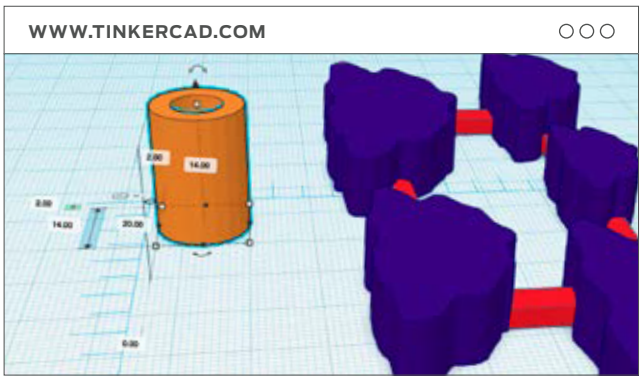
TIP: With the ruler, you don't need to drag the corners of your object to resize. You can just click on the dimensions you want to change and type in the measurements you want.



B. Make a cylinder hole for the pencil to fit into. Select the first cylinder and duplicate it by pressing **ctrl-C then ctrl-V (cmd-C, cmd-V on Mac)**. Change the size of the second cylinder to 8 mm in diameter and select hole. This will be the cutout for the pencil to fit into.



C. Change the elevation of the hole so that it sits 3 mm above the workplane. You do this by clicking on the black cone at the top center of the cylinder and dragging it up 3 mm.



D. Group the cylinders once you're done moving and resizing them. To do this, select both cylinders and click on the **group** icon at the top of the page.

STEP 06:
PRINT

Now it's time to export the model so you can print it.

A. Click export in the upper right side of the Tinkercad software window. Select the format that your printer uses. (MakerBot Print imports .STL files.) The download will start once you click on the desired file format.

B. Import the files into MakerBot Print™, select your print settings, and start printing.

Print Settings:

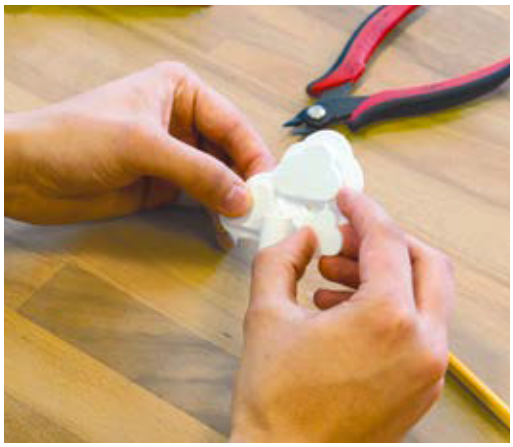
Rafts	Yes
Supports	No
Resolution	0.2 mm
Infill	10%

TIPS: The export window in the Tinkercad software window doesn't disappear until you close it, so be sure to check your downloads folder before you click export again (or you may end up with some extra copies).

You can also name your file in the Tinkercad software, unless you like those way-cool file names the program randomly assigns you. While they are entertaining, they're not always descriptive enough.

PROJECT COMPLETE:
REACH FOR THE SKY!

Once printed, assemble the clouds onto the pencils and put them onto their respective bases. If you want, you can cut the pencils to different lengths to match the altitudes of the clouds (low, medium, high). Nice job! You're ready to go!



GOING FURTHER

A. After the project, the cloud models and bases can be used as a learning station that students will cycle through over a series of days. As they start the activities, students can be given puzzles and worksheets that encourage them to explore the models on their own, gathering information while they complete their assignments.

B. Consider scaffolding activities, where students can match clouds with the bases where the pencils are attached, or sort the note cards into the bases with the clouds. Additionally, a summative activity could include having the models, pencils, and bases disassembled and asking the students to work together to place the components in the correct positions.

C. Assess students with quizzes or performance tasks based on recall of the cloud names and characteristics. Or have them perform a puppet show with the clouds, where the characters in the show talk about what clouds they see and how those reflect the weather or anticipated weather changes.

TRADEMARKS

SCREENSHOTS

LEGAL