

## PROJECT SEVEN

# WEATHER SURVIVAL CHALLENGE



## PROJECT INFO

### AUTHOR

Nichole Thomas,  
@liberty3D

### SUBJECT

Science

### AUDIENCE

Grade Levels 2–6

### DIFFICULTY

Intermediate

### SKILLS NEEDED

Basic Tinkercad™  
software experience

### DURATION

2-3 Class Periods

### GROUPS

10 Groups  
2-3 Students / Group

### MATERIALS

Plastic tub  
Sand or stones  
Water

Sketchbook

### SOFTWARE

Tinkercad (**web app**)

### PRINTERS

Works with all  
MakerBot® Replicator®  
3D printers

### PRINT TIME

**Prep:** None  
**Lesson:** 5-10 hrs / Group

### FILAMENT USED

1-2 Large Spools

“I love this project because it covers so many different lessons and strategies. When testing their designs, the students not only engage in the basics of STEM education, but also learn how to design (and redesign) and make the best model for the job. They get a chance to try, fail, redesign and try again – something that many students don’t get the opportunity to do. It’s awesome seeing all of the different solutions that the students create to solve the same problem!”



– Nichole Thomas

## LESSON SUMMARY

This project is a great expansion for any class unit discussing weather patterns and how they affect us. Students are challenged to create a structure that will withstand extreme weather or flooding, then print and test their models.

## LEARNING OBJECTIVES

After completing this project, students will be able to:

- › Create objects in Tinkercad using the **group, hole, and transformation tools**.
- › Understand basic types and patterns of weather.
- › Understand conceptual methods of creating structures impervious to flooding.

## VIRGINIA STANDARDS

**SOL: SCI 2.6** The student will investigate and understand basic types, changes, and patterns of weather. Key concepts include

- › Temperature, wind, precipitation, drought, flood, storms
- › The uses and importance of measuring and recording weather data

## NGSS STANDARDS

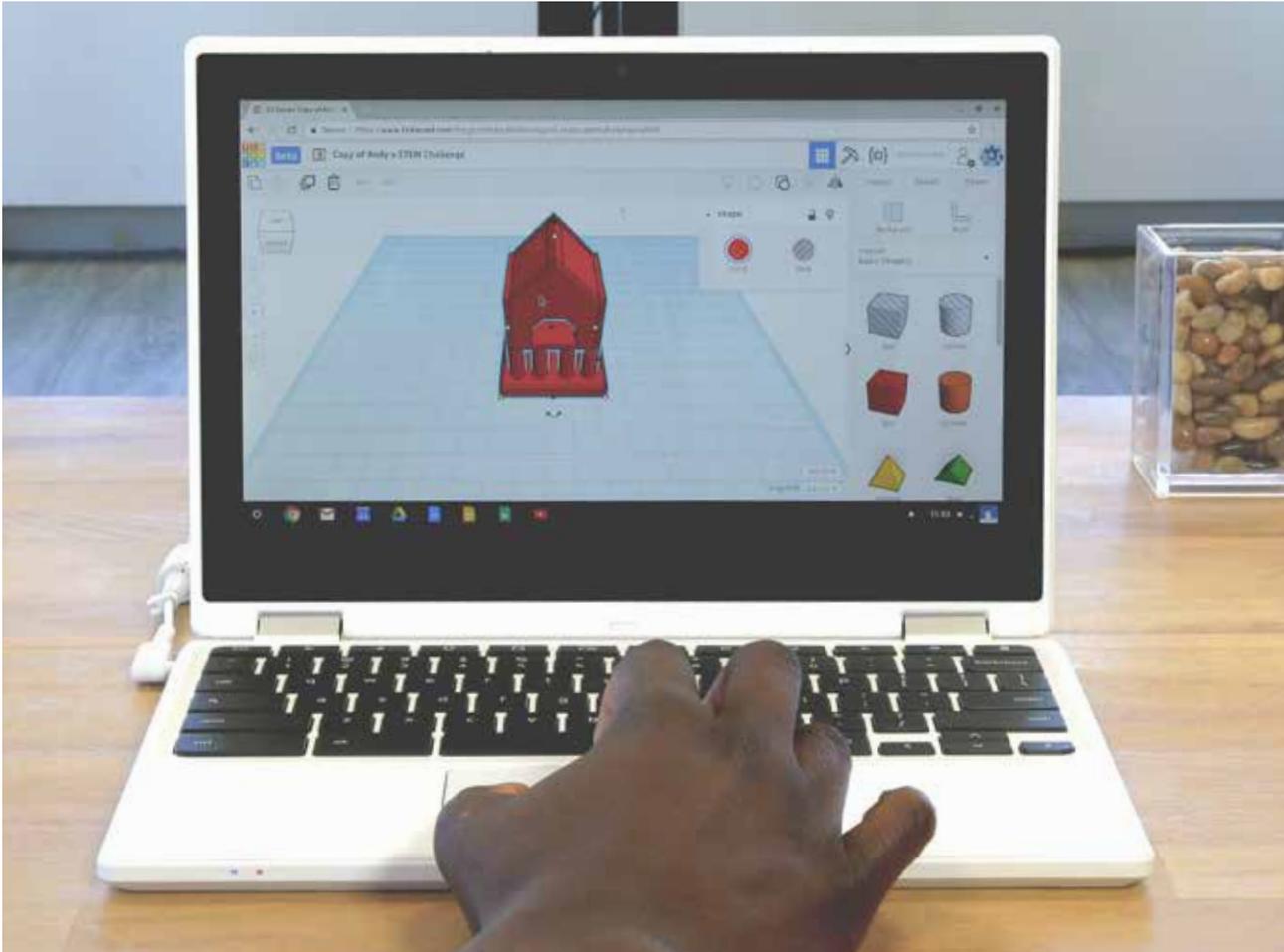
**MS-ESS2-4 Earth’s Systems** Develop a model to describe the cycling of water through Earth’s systems driven by energy from the sun and the force of gravity.

**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.

**3-5-ETS1-2 Engineering Design** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

**3-5-ETS1-3 Engineering Design** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

## TEACHER PREPARATION



**A. Create Tinkercad accounts:** Students must have an active account in order to design their structures.

**B. Place sand or stones** at the bottom of the plastic bin to replicate soil and to create a firm base for testing the printed structures.

**C. Use a small book** to prop the bin up at a slight incline.



**STUDENT  
ACTIVITY****STEP 01:  
DISCUSS AND BRAINSTORM**

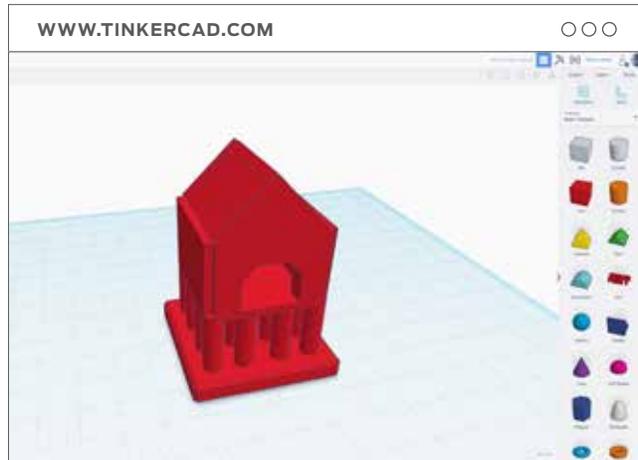
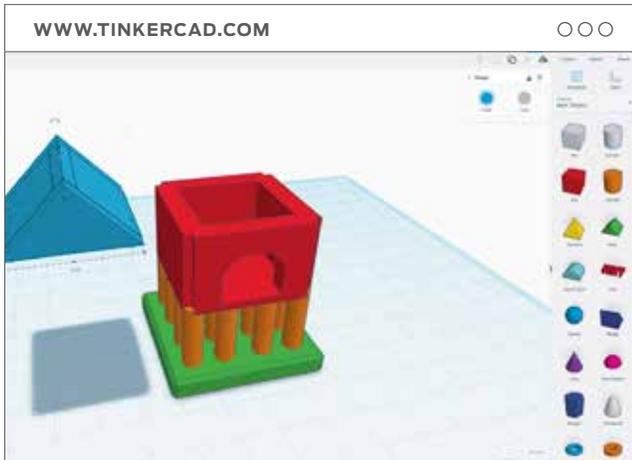
**A. Discuss** how communities deal with weather challenges, such as floods and hurricanes.

**B. Research** how heavy rain can cause flooding; use this information to create a structure that will withstand a flood.

**C. Brainstorm** which type of structures would be most beneficial in a flood-prone environment.

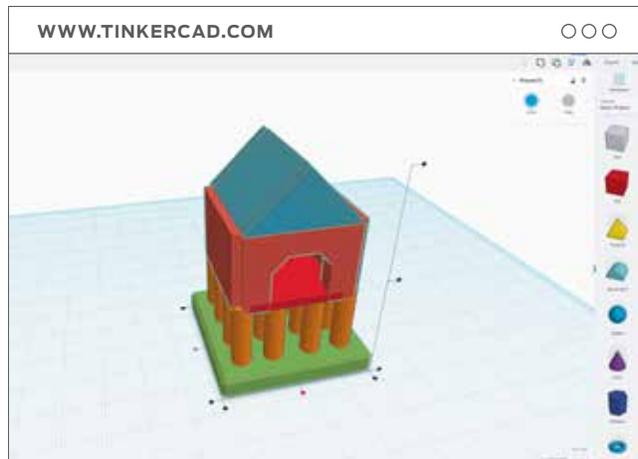
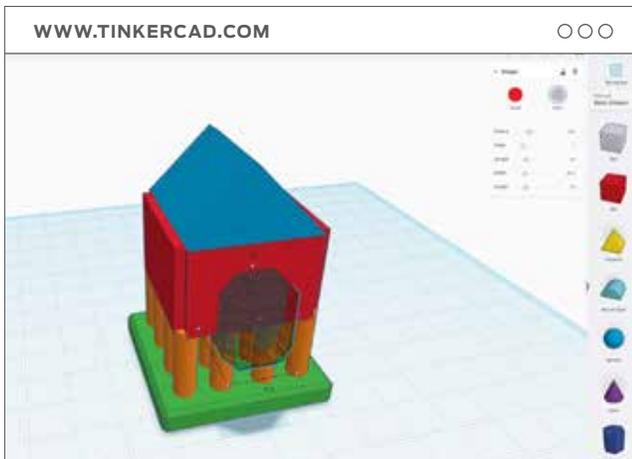
## STEP 02: TINKERCAD INSTRUCTION

In order for you to successfully complete this project you will need a basic understanding of how to use Tinkercad software. Review and practice the following tools before building your structure.



**A. Move:** This includes rotate, scale, etc.

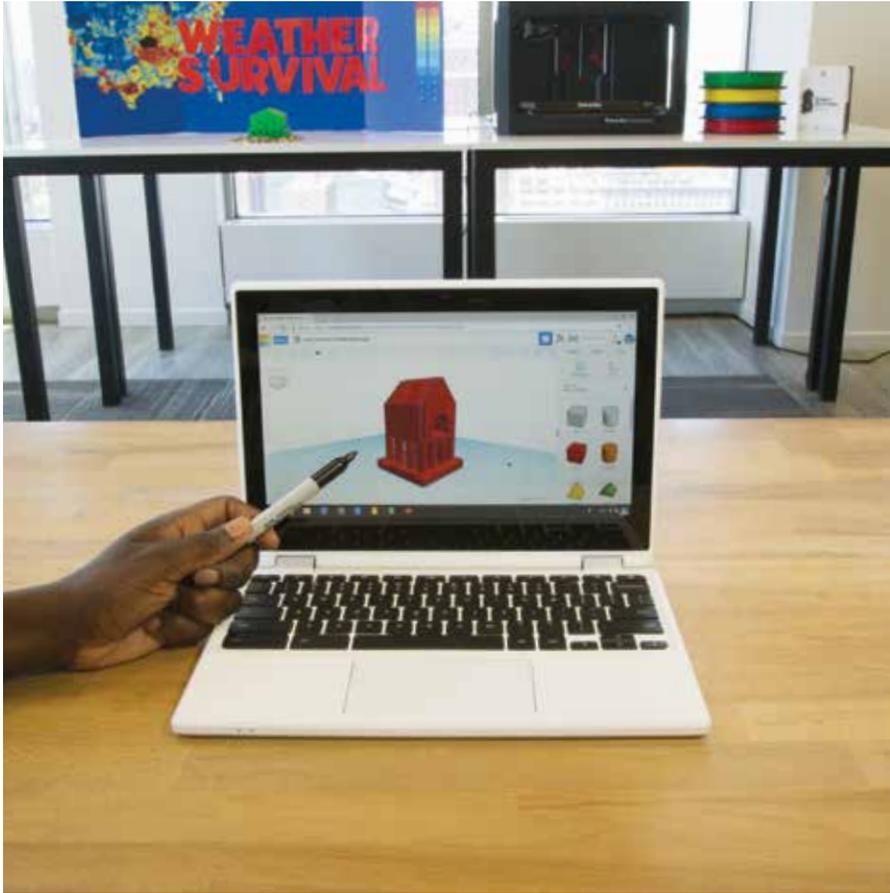
**B. Group/Ungroup:** These functions allow you to merge one or more shapes to create your weatherproofing structures. This tool also allows you to use holes to cut from an existing shape. Grouping is an essential step in exporting files for 3D printing.



**C. Hole:** Holes in Tinkercad are shapes that are used to remove material from another object. You can use holes to create windows, doors or other cutouts.

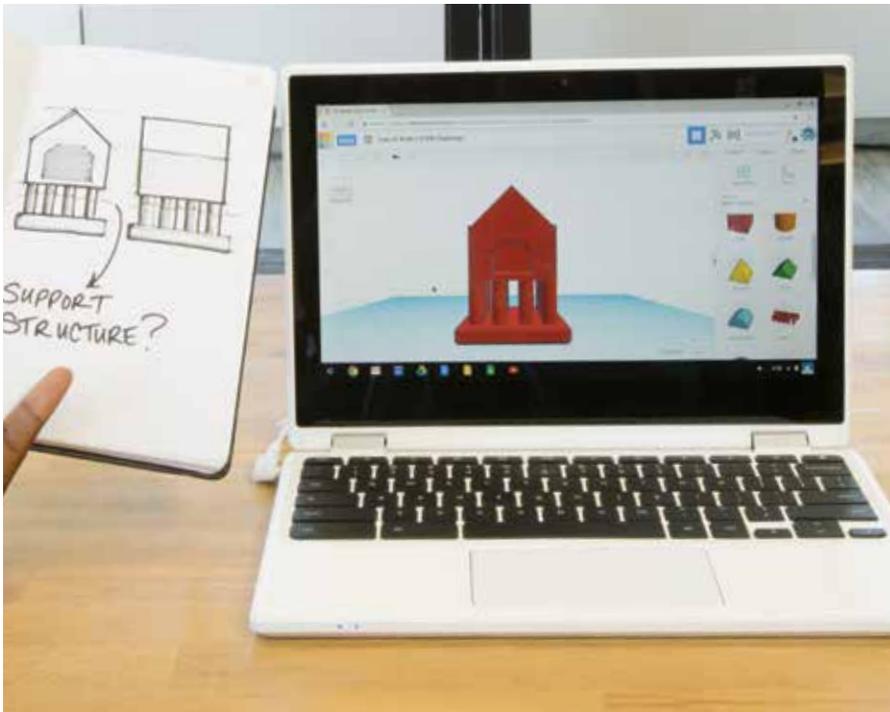
**D. Align:** Align can save you time when moving objects. This tool allows you to line up edges or centers of models.

## STEP 03: DESIGN



### A. Design structures:

Once you are familiar with the basic operation of Tinkercad software, start designing your own flood-proof structure. This should take 1 - 2 class periods for design and iteration.



### B. Review structures:

Once you have completed your design, review it with your group and teacher. Make sure all parts of your model are touching so that it will print successfully. Also make sure your model is grouped into one part.

## STEP 04: PRINT



**A. Export:** Click **export** in the upper right side of the Tinkercad software window. Select the .STL format to start the download.

**B. Prepare:** Once you have completed and exported your model, import it into MakerBot Print™ to prepare for printing.

**C. Print** all models with the same settings to ensure consistent testing.

**Print Settings:**

Rafts	Yes
Supports	Depends on Model
Resolution	0.2mm
Infill	5%

## STEP 05: TEST

One at a time, test each group's model in a mock flooding simulation to see how well each structure performs under heavy rain and flooding. Keep the following questions in mind:

- › Does the model stay in place?
- › Are there parts of the model that could easily be washed away?
- › Does the model stand above the water line?



**A. Place structure** into the water bin, using the sand/ stones as your soil.

**B. Add water** to the bin to simulate heavy rain. Observe the behavior of the model once water reaches flood levels.



## STEP 06: REFLECT

**A. Complete the worksheet:** Answer the following questions on the provided worksheet:

- › Did your structure stand up to the flood? Explain what happened when you tested it.
- › If you had a chance to redesign, what would you do differently?



# **WEATHER SURVIVAL CHALLENGE**

**STUDENT NAME**

**DRAW YOUR STRUCTURE:**



**Did your structure stand up to the flood?**

Explain what happened when you tested it.

---

---

---

---

---

---

---

**If you had a chance to design your structure,  
what would you do differently?**

---

---

---

---

---

---

---

## PROJECT COMPLETE: REIMAGINE AND REBUILD



---

### GOING FURTHER

**A.** Have students redesign their structures using what they learned from their first test. Test the new models and compare the results.

**B.** Change some of the print settings, such as increasing the infill density, and run the same flood test again: what happens?

**C.** Now that students have designed structures for a flood environment, ask how they would design structures to withstand other severe weather like tornados, hurricanes, etc.

# LEGAL

## TRADEMARKS

MakerBot, MakerBot Print and MakerBot Replicator are trademarks or registered trademarks of MakerBot Industries, LLC. All rights reserved.

Tinkercad is a trademark or registered trademark of Autodesk, Inc.

All other brand names, product names or trademarks belong to their respective holders. All rights reserved.

## SCREENSHOTS

Tinkercad™ software screenshots reprinted courtesy of Autodesk, Inc.

All screenshots belong to their respective holders.

MakerBot Educators Guidebook, including Project 7, is an official product of MakerBot Industries, LLC, and is not authorized, sponsored, associated with, or otherwise associated with any of the other parties listed above in this Legal section or otherwise mentioned in the book.