

# Building for Future Severe Weather – A Design Thinking Approach

## Description

Over a period of two days, students will complete a design challenge centered around sustainable exterior building products that are designed for high performance during severe hailstorms.

## Introduction

Companies are looking for employees that are innovative thinkers. Design Thinking is a process that students can learn that encourages them to become innovative thinkers. This process may be broken down into 5 basic steps: Empathy, Define, Ideate, Prototype, and Test. This lesson will use Design Thinking as a framework for students to learn that climate change is impacting more than just the environment. Changing climate affects how humans live in our environment.

Current scientific research is showing that climate change could lead to an increase in the frequency of hailstorms with large damaging hail. (<http://www.nature.com/nclimate/journal/v7/n7/full/nclimate3321.html>) Manufacturers of roofing, siding and windows are taking this into consideration when designing new exterior building products. The culminating activity in this lesson will be a product designed by students to withstand severe hail.

## Curriculum Alignment

College Board AP Environmental Science Topic Outline

IB – Earth Systems & Resources: The Atmosphere (includes weather and climate)

VIIB – Global Change: Global Warming (includes impacts and consequences)

Next Generation Science Standards

HS-ETS 1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

## Objectives

Students will practice and integrate design thinking skills.

Students will learn how climate change is affecting weather patterns.

Students will design a sustainable exterior building product to withstand severe hail.

## Time & Location

This lesson will take two 90-minute classroom periods.

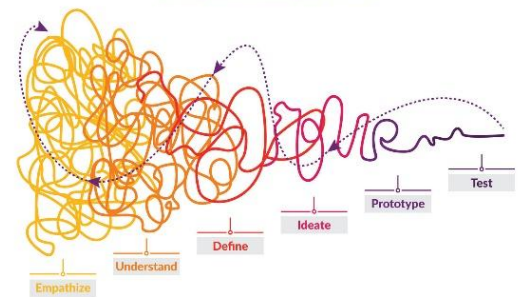
## Teacher Materials

[Brainstorm Rules](#) (tape one to each table)

Data projector

computer with internet connection

Human-centered  
Design Thinking Process



## Student Materials

### Day 1

[Empathy Map directions](#) (1 per group)

Chalk markers/Neon Expos (both work great on black lab tables)

[Point of View Madlib](#) (one per group)

Chart paper/whiteboards or black tables

Post it notes

[Hailstorms & Climate Change article](#)

### Day 2

Design Thinking tool box (1 per group) ([list of possible supplies](#))

## Safety

None

## Student Prior Knowledge

Design Thinking Process

Climate Change

## Teacher Preparations

- Divide students into groups of 4
- Copy 1 POV madlib for each group
- Copy 1 set of brainstorm rules for each group
- Put together Design Thinking prototype toolboxes
- Familiarize yourself with Design Thinking using the following websites:  
<https://designthinkingforeducators.com/>  
<https://dschool-old.stanford.edu/groups/k12/>  
<http://www.livebinders.com/play/play?id=1062783>
- Dive deeper into types of exterior building supplies with the links below:  
Siding - <http://www.sidingestimator.org/types-of-siding/>  
Roofing – <https://www.angieslist.com/articles/types-roofing.htm>

## Activities

### Day 1

1. Video - Basics of a hailstorm (5 minutes) Show students the video on the science of a hailstorm. Spend a few minutes discussing the video with students. Clarify understanding of strength of updrafts and size of hailstones.  
[https://www.youtube.com/watch?v=B6fxBN4v\\_2k&index=1&list=PLY\\_KXdMNVCVXV62XQhijj1kpz4CM5muiq](https://www.youtube.com/watch?v=B6fxBN4v_2k&index=1&list=PLY_KXdMNVCVXV62XQhijj1kpz4CM5muiq)

2. Hailstorm article from CNN (15 minutes) - This design challenge is being completed at the end of the unit on climate change. After learning the basics of a hailstorm, give students the CNN article about current hail research and climate change. After they read the article, as a group, have the students answer the following questions. After the questions are answered, have each group present their answers to the questions.
  - \* Why do you think this is important research?
  - \* How does this impact humans?
  - \* How does this affect how we construct buildings?
3. Present Design Challenge to students.  
Design a sustainable exterior building product that can protect a house from property loss during a severe hailstorm.
4. Build **Empathy** – Learn about the audience for whom you are designing. Who is my user? What matters to this person? (total time - 20-30 minutes)

Students will watch a series of news clips of homeowners that have experienced severe damage to their homes from a hailstorm.

Before the video, give each group a stack of post it notes and give students the following guidelines for recording information.

- Only one statement/observation on each post it note.
- Your user will be a homeowner. That is who you should focus on.
- Quotes from the user.
- Observations about the user.
- Note something that “struck” you.
- Write words that you do not know.
- Describe a connection to something you learned or read previously.
- Pose a question about the videos.

Building for Severe Weather – Empathy playlist (10 minutes):

[https://www.youtube.com/playlist?list=PLy\\_KXdMNVCVWhSq12fCbLT73MUEpOIXob](https://www.youtube.com/playlist?list=PLy_KXdMNVCVWhSq12fCbLT73MUEpOIXob)

After the video, students will work in groups of four and gather all their findings in one place.

Students will organize their findings using an empathy map (see instructions on next page).

Give students the following instructions:

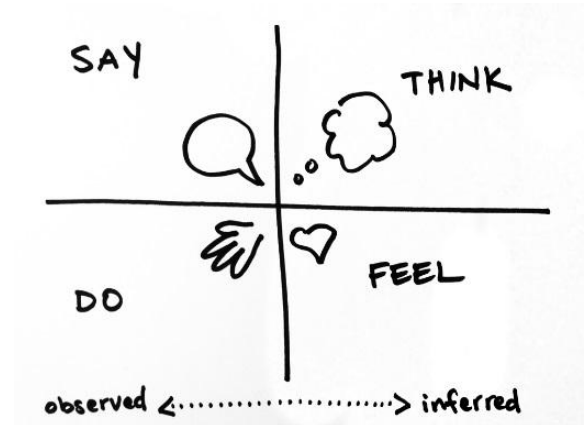
- Create a four quadrant layout on chart paper, whiteboard or on the table. (The quadrants will be labeled using the titles in the diagram to the right.)
- Use your post it notes from the videos to complete the map. You may add additional post it notes. Use the following as guidelines

**SAY:** What are some quotes and defining words your user said?

**DO:** What actions and behaviors did you notice?

**THINK:** What might your user be thinking? What does this tell you about his or her beliefs?

**FEEL:** What emotions might your subject be feeling?



Note that thoughts/beliefs and feelings/emotions cannot be observed directly. They must be inferred by paying careful attention to various clues. Pay attention to body language, tone, and choice of words.

- Once you have filled out the four quadrants, analyze your groups' empathy map. Keeping in mind your design challenge, write any needs (things they are trying to do) and insights (ways they want to feel) that you have gained on a different set of post its and place them outside of the empathy map.
  - Take a picture of your Empathy Map.
5. **Define** – Create point of view that is based on user needs and insights. What are their needs? (5-10 minutes)  
Students will take the needs and insights gathered from the empathy map and use them to fill in the left side of the [POV madlib](#).

Once the left side is complete, students will use that side to aid them in completing the right side of the paper. This will be their problem statement/Point of View statement.

6. **Ideate** - (20-30 minutes total)

The first step for ideation is brainstorming solutions for your user's POV statement. Keep in mind your design challenge.

Use post it notes and your table. Remember to follow the brainstorm rules. You will have 15 minutes.

The second step involves groups selecting which ideas that they will prototype. The students group will go through all of the ideas using the following guidelines.

- Move ideas that are the same, similar or related in some way into groups.
- Decide on a couple of themes for the selection of ideas: *Most likely to succeed, Most likely to delight, Most breakthrough, Wildest idea etc.* Don't fall into the trap of only selecting ideas that upfront seem viable – prototype and test some of the crazy ideas before you dismiss them as impossible or unrealistic.
- Give each team member one or two votes in each category and, without discussing, vote individually on the ideas.
- Take a picture of the idea board that your group has created.

how to brainstorm: **RULES**

**DEFER JUDGEMENT**  
**GO FOR VOLUME**  
ONE CONVERSATION at a time  
**BE VISUAL**  
**HEADLINE**  
**Build on the Ideas of Others**  
**Stay on TOPIC**  
**Encourage WILD IDEAS**

- Pick at least three ideas to prototype for the next stage in the design thinking process.

## Day 2

7. **Prototype** – Students will build their top ideas from the ideation activity. Students will have 30 minutes to build their prototypes using their design thinking toolkits. At the end, they will choose one prototype to test/present to their user.
8. **Test/Ply Gem consult** – A representative from Ply Gem will be in class on this day and will meet with each group to look at their prototype and offer suggestions.
9. **Ply Gem presentation** – The Ply Gem representative will talk to the class about regulations, sustainability and insurance companies.

## Assessment

Students will submit the following to Google Classroom:

- Picture of empathy map
- Picture of idea board
- Pictures and descriptions of the prototypes

## Critical Vocabulary

none

## Author Information

Leslie Horne teaches at Holly Springs High School in Wake County. Mrs. Horne is a National Board Certified Teacher and was a graduate of the Teaching Fellow program at East Carolina University. She has taught Science in North Carolina for 20 years. Over that period of time she has taught Biology, AP Environmental Science, Chemistry and AP Biology. Currently she is teaching AP Environmental Science and Chemistry and is an advisor for the Science Olympiad team.

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## Mentor Information

Lee Clark-Sellers is the Innovation Officer at Ply Gem Building Industries. Her job is to lead the incubation hub, Foundation Labs, as well as drive Innovation throughout the enterprise. Ms. Clark-Sellers has a BSEE and Master of Science in Management from NCSU. She has lived abroad for 3 years, establishing labs in India and Eastern Europe. Additionally, she has served as an Innovation Judge for the Consumer Electronic Show (last 4 years) and mentored multiple start-ups.

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