MAKEngineering Kit Facilitation Guide:

All Terrain Animal House

Task adapted from Teach Engineering STEM curriculum developed at the University of Colorado Boulder.
Some of the images are from previous individuals who completed a similar task.

ENGINEERING TASK

It is challenging for stray animals to survive extreme weather conditions. Your task is to design a prototype of an animal house that will help stray animals survive extreme weather conditions common to where you live—rain storms, really hot and really cold temperatures, earthquakes, or tornados.

DID YOU KNOW…?

- Only 1 out of every 10 dogs born will find a permanent home.
- The main reasons animals are in shelters: owners give them up, or animal control finds them on the street.
- Many strays are lost pets that were not kept properly indoors or provided with identification.
- It’s impossible to determine how many stray dogs and cats live in the United States. Estimates for cats alone range up to 70 million.

Source: dosomething.org

MATERIALS IN KIT

- 20 Popsicle sticks
- 10 Aluminum foil sheets
- 30 Cotton balls
- 1 Deck of playing cards
- 4-5 Felt pieces
- 15 Thumbtacks
- Yarn
- Scissors
- Masking tape
- Measuring tape
- 2 Thermometers
- Cardboard base

STEP 1—RESEARCH

What are the elements to keep an animal warm in winters and cool in summers? Think about wall isolation, roof design, and other feature that would make an animal house useful and offer protections against other weather conditions. Here are some videos to get you started and be sure to take notes about what you notice and might use in your own design.

https://youtu.be/d6xLYlg8qm8

https://youtu.be/0anNT4yVH08

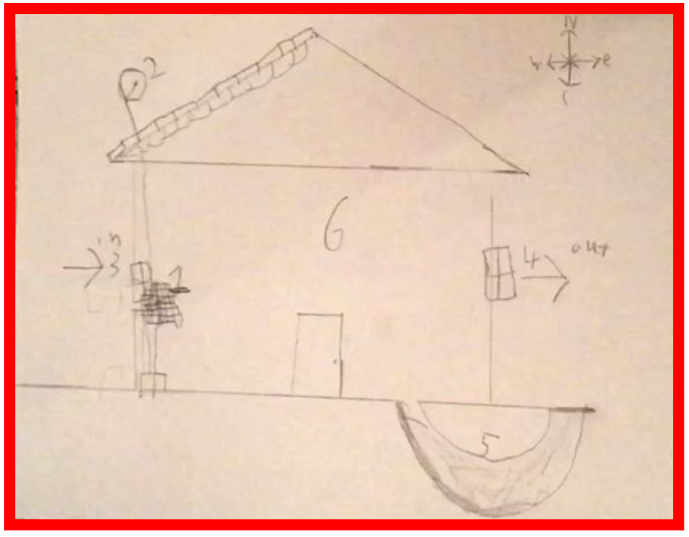
https://youtu.be/9HH9HsP1TPI

STEP 1—SUPPORT

Potential questions to ask:

- What additional information should we consider in the design of the animal house? What is common weather patterns in this area that we should consider?
- What keywords can we use in our search?
- How do we know if a source is trustworthy?
- I suggest we search for an animal (e.g., lizard, cat, dog) to use as we design and create the house. What do you think?

STEP 2—PLAN



How will the structure of the house withstand weather conditions where you live (e.g., wind, rain, snow)?

Based on your research, brainstorm and sketch 2-3 detailed designs of your animal house. List or label the materials you will use. You will build your house on a piece of cardboard.

STEP 2—SUPPORT

Potential questions to ask:

- What is the structure of the body of the house? What material might we use?
- How will you build the roof?
- Tell me what part of your design will allow the animal to enter and exit the house.
- What special features should we add to the house?
- Imagine you were an animal living inside this house, what suggestion might you make to the engineer? Why? How is this suggestion based on the goal of creating an all terrain animal house?

STEP 2—SUPPORT

You might encourage a scale drawing of the house. A scale drawing shows a real object that is either reduced or enlarged. For example, in the image on the left, 2 inches in the scaled drawing represents 5 feet when creating the prototype. What would 1 inch represent in feet? What about 3 inches? Where else have you seen scaled drawings?

MATERIALS IN YOUR HOME
DID YOU KNOW…?

Newspapers can be used in your prototype as a form of structure and support. The key is to take one sheet of newspaper and roll it tightly from one corner to another.

MATERIALS IN YOUR HOME—SCAVENGER HUNT

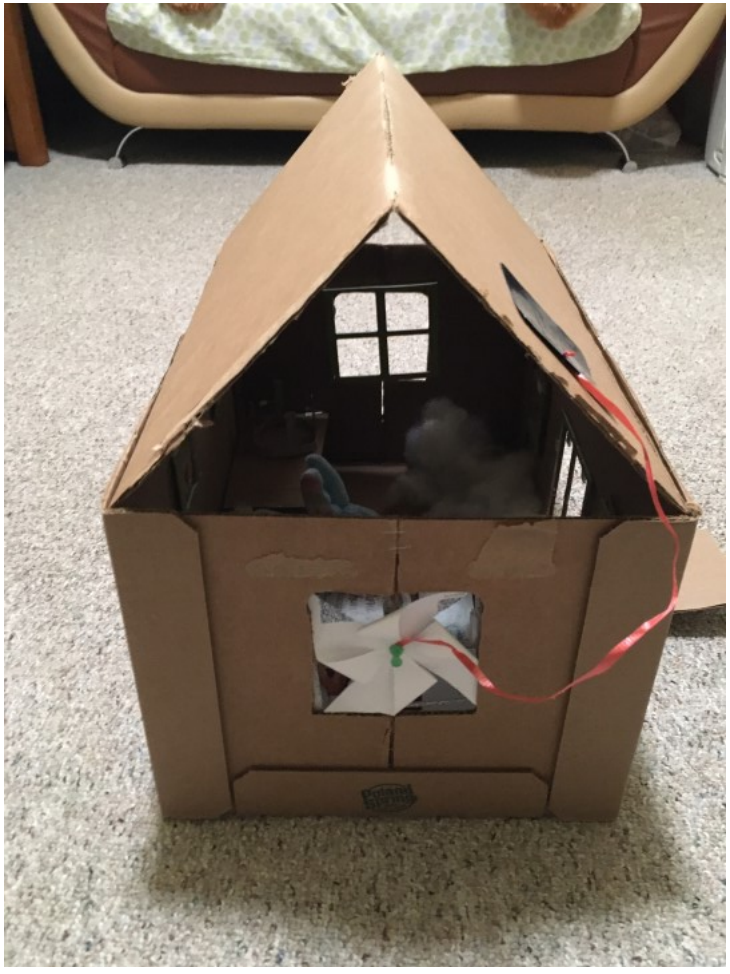
In addition to using materials from the kit, you can find items inside and outside your house that start with the letters below. Only one object per letter, but you can have more than one of that object. For example, for the letter L, you can use 30 leaves. Be strategic.

N P B L S T W

COMMUNICATE

Have a conversation around the research, planning, and gathering process. The camera can be focused on the designs or the materials from the scavenger hunt.

1. Explain one of your designs? What are it's features and how will these features withstand elements of the weather (e.g., hot and cold temperatures, rain, wind)?
2. What materials did you gather as part of the scavenger hunt? How do you think you will use the materials in your prototype? Provide two examples.



STEP 3—CREATE

Pick one of your designs from Step 2 and build your prototype. You can only use materials in the kit and those you gathered from the scavenger hunt.

STEP 3—CREATE

Potential questions to ask:

- Remind me why we are using this material? How will it help stray animals survive extreme weather conditions?
- How close does our prototype align with our initial design? Why did you make that change to the prototype?
- How will you secure your house on the cardboard so it is stable?
- How can I help? (Position child as lead engineer)

STEP 4—TEST (TEMPERATURE)

Place the animal house outside. Place one thermometer inside the animal house and the other thermometer outside the animal house. Read the temperature of both thermometers at least seven times over a 12-hour period. Document the time (in minutes) and temperatures in the table on the next page.

Is the temperature inside the house more than, less than, or the same as the temperature outside the house? Why? How does the inside temperature reflect how you

STEP 4—TEST (TEMPERATURE)

PSST. You do know that engineers keep track of their data like you are doing here.

Time	Time (min)	Inside Temperature	Outside Temperature
12:33 pm	0		

STEP 4—SUPPORT

Potential questions to ask throughout the different tests:

- Before we measure the temperatures, predict how temperatures inside or outside will change.
- How will the animal house withstand a windstorm? What are you basing your prediction on?
- What did we learn from this test?
- Would you make any changes or use different materials? Why or why not?
- I noticed _____. Why do you think that happened?

STEP 4—TEST (WIND)

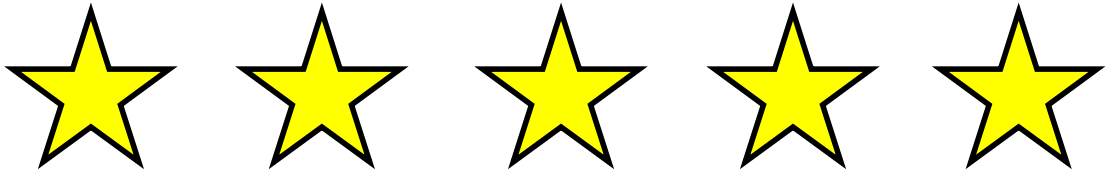
Do you think your animal house can withstand a windstorm for 8 seconds? Why or why not?
If it is a windy day, place your house outside to test.
If it is not a windy day, use a hair dryer on full speed to simulate the windstorm.

STEP 4—TEST (RAIN/SNOW)

How well will the animal house withstand rain and/or snow? Pour water onto the roof of your house using a watering can. Wait! You don't have a watering can? Let's make one. Use a thumbtack to punch holes into a bottle cap.

STEP 5—REFLECT & IMPROVE

How would you rate your prototype on a five-star scale?



What things did you consider for your five-star rating? What "tag line" captures your rating (e.g., "Built well. Animals of all kinds will enjoy.")

What improvements would you make? Why? What did you learn from your testing results? How can we make these improvements with the materials that we have?

COMMUNICATION

Have a conversation. The camera can be focused on the animal house.

1. What makes your animal house unique?
2. Explain how well (or not so well) the animal house survived the different weather elements simulated in the tests—temperature, wind, rain/snow.
3. If you could go back in time, would you get different materials during the scavenger hunt? Why or why not? If yes, what materials would you include?

PARALLEL PROTOTYPE

Choose another design from Step 2, create another prototype and test it in the same manner. How would you rate this house? Why? Based on your tests, which house is more likely to withstand different weather conditions?

DID YOU KNOW…?

Structural engineers design the “bones and muscles” for man-made structures such a buildings, bridges, and tunnels. It is their responsibility to calculate the stability and strength for things such as snow, wind, and earthquake forces. Can you identify these famous building designs?

15-A

DID YOU KNOW…?

Can you identify these famous building designs?

Sydney Opera House
(Sydney, Australia)

Chief Structural Engineer:
Sir Jack Zunz

Eiffel Tower (Paris, France)

Chief Structural Engineer: Gustave Eiffel

Ground Zero Ocular Building
(New York City)

Chief Structural Engineer:
Santiago Calatrava

WHAT TYPE OF ENGINEER ARE YOU?

Add a sticker to your Engineering Passport that identifies the type of engineer you were most like in the design of an all-terrain animal house. Don’t forget to write why you chose the type of engineer.

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