



# STEM on Site Summer Program

## Design a Doghouse



Image Source: [Teach Engineering](#)

**Recommended for Grade Levels: 3-5**

### Content Notice

This activity has been put together as a free, open source resource from the Milwaukee School of Engineering STEM team for self-guided, at home learning. Unless otherwise noted, in person or live instruction is not provided and questions should be directed to [stem@msoe.edu](mailto:stem@msoe.edu).

Curriculum has been adapted from [UC Boulder](#)

### Safety Notice

Parents or guardians should review activity materials before students begin the activity. Some activities from MSOE may require cutting, hot gluing, electricity, manipulating sharp objects, and other tasks that may warrant adult supervision. MSOE is not liable or responsible for any injury, property damage, or other incidents that arise from completing these activities at home. If you have questions or concerns about any activities, please contact [stem@msoe.edu](mailto:stem@msoe.edu)

## Notes

Welcome to your Design a Doghouse Kit! Below you will find a few links to learn a little bit about Energy and Heat. We encourage you to watch the videos and read about heat transfer before starting your project.

This activity has been adapted from Teach Engineering's curriculum. MSOE has added videos and questions to consider along with post activities to adapt this activity to fit the at-home learning models currently being used during the pandemic.

A \$12 budget is referenced in this activity. Note that we encourage using materials you have around your home already and a cost sheet is provided in this activity to approximate how much those items might cost if you had to go out and purchase them.

## Goals

- Understand that heat travels from places with the warmest temperature to places with the coldest temperature (heat transfer)
- Demonstrate that light energy does or does not travel through various materials
- Understand the light can be absorbed or reflected

## Materials List

Note that the goal for this activity is to see how heat transfer works. If you're gathering materials at home, feel free to try other materials if you don't have something below. Think of the purpose a material might serve and what items you have on hand that may do the same.

If you ordered a kit from MSOE, all items except those marked with an asterisk(\*) will be included in your kit.

	NAME
	Cardboard (*)
	Plastic wrap (*)
	Aluminum foil
	Popsicle sticks
	Felt
	Foam (plates/cups)
	Construction paper
	Bubble wrap
	Plastic bottles (*)
	Newspaper (*)

### REQUIRED TOOLS

	2 Thermometers
	Writing tool for designing and drawing (*)
	Hot glue guns or other glue (*)
	Scissors (*)
	Small toy dog or any small stuffed animal works (*)
	Tape (*)

## Background Knowledge

How does heat transfer work?

[https://www.youtube.com/watch?v=YK7G6l\\_K6sA](https://www.youtube.com/watch?v=YK7G6l_K6sA)

Which materials make good insulators?

[https://www.youtube.com/watch?v=Yg8kXf\\_HKtU](https://www.youtube.com/watch?v=Yg8kXf_HKtU)

Light energy can be absorbed or reflected. Dark surfaces and objects absorb light and convert that light to heat energy, making the temperature of that object feel warmer. Shiny surfaces and light-colored surfaces reflect light, making those objects feel cooler. White reflects all colors of light and black absorbs all colors of light. We see colors because of the light that is reflected to our eyes. For example, an object that appears red to our eyes is reflecting red light and absorbing all the other colors of light.

Heat energy travels from places with the warmest temperature to places with the coolest temperature. Insulating materials can slow down the transfer of energy. Some materials slow down this transfer of energy because they contain trapped air. Air is a very good insulator, meaning it can slow down heat transfer. For example, double-paned glass windows are used in houses because the air gap between the panes of glass slows down heat transfer either into the house on a hot day, or out of the house on cold day. Fiberglass insulation in house walls and attics contains trapped air, which slows down the transfer of heat energy.

It is a misconception that cold air can be trapped inside a structure. Cold does not transfer; only heat transfers. The goal of our Summer Home Activity is to prevent as much heat transfer as possible in order to keep our puppy cool. By keeping the heat out, we are making the inside cooler.

## Constraints/Requirements

- All supplies used must be purchased within your \$12 budget.
- A budget tracking report must be provided prior to testing.
- The doghouse must protect the puppy from the outside heat.
- The dog must fit completely inside the doghouse.
- The doghouse temperature must stay under 90 °F when out in the sun for 30 minutes.
- The dog must be able to exit doghouse for access to a water dish!
- The doghouse must be a self-supporting structure.

## Building the Doghouse

1. Look over the [Materials Price List](#) (from Teach Engineering) and decide which materials you will use. Only choose materials you have readily available. Some materials on this list are in the kit (if you purchased one), others may easily be found around the house or at a craft store.
2. Sketch out a plan with each material labeled. Complete the Budget Tracking Sheet, found below. Remember you only have \$12.
3. Construct your doghouse. Remember the toy must fit inside and there must be a door for the dog to get in and out. You may find out that your initial plan is not working how you wanted it to, don't worry! Engineers make improvements all time. Make as many adjustments to your plan as necessary.
4. Place doghouse in testing area (outside in direct sunlight) with one thermometer inside the doghouse and one thermometer outside the doghouse.
5. Record beginning temperature inside and outside the doghouse.  
Beginning temperature in doghouse: \_\_\_\_\_  
Beginning temperature outside of doghouse: \_\_\_\_\_
6. Set a timer for 30 minutes.
7. Check and record the temperature inside and outside the doghouse after the 30 minutes.  
Ending temperature in doghouse: \_\_\_\_\_  
Ending temperature outside doghouse: \_\_\_\_\_
8. Discussion: Did your doghouse stay under 90 °F? What changes would you make next time? Were you surprised a material didn't work as well as you had expected?
9. Extension: Make changes to existing doghouse to try to keep the temperature even lower than before.

## Budget Tracking Sheet

**Optional:** Learn how spreadsheets work! If you have access to Google Sheets (free, online), Microsoft Excel, or similar see if you can put your budget tracking sheet into one of these programs. Can you set up your spreadsheet so that your cost automatically calculates based on your price and quantity?

Material	Price (from price list)	Quantity (how many of the material)	Cost
			<b>Total:</b>

