

EMC Design Challenge, February 6 & March 15 2017

The Challenge:

Design the best device (empty box, basically) for capturing and storing (heat) energy from the sun

The Process:

In February, teams will test materials and possible device designs, and decide how much and what type of materials to order for March's competition. Teams will discuss their plans and their volume and budget calculations with judges for feedback.

In March, the devices will be built and placed in the sun for temperature data to be recorded. Teams will record their data and check their final calculations. Judges will interview teams to learn about their rationale for their design and review calculations and device performance.

Materials provided for February 6 for designing and testing prototypes:

- 1 ruler
- 1 thermometer
- 1 sheet of black construction paper
- 1 sheet of white construction paper
- 1 piece of aluminum foil
- 1 piece of pink cling wrap
- 1 piece of blue cling wrap
- 1 piece of clear cling wrap
- 1 piece of foam
- 1 roll of tape (should last for *both* events)

The Specifications:

- Your device must be designed to hold exactly 600 cubic centimeters of air inside (rounded to the nearest cubic centimeter)
- Your device can be any size and shape so long as the inside holds 600 cm³ of air
- You can only use the following materials which you must "purchase" from the EMC judges:
 - black construction paper (.5 cents per square centimeter)
 - white construction paper (.5 cents per square centimeter)
 - aluminum foil (.4 cents per square centimeter)
 - pink cling wrap (.1 cents per square centimeter)
 - blue cling wrap (.1 cents per square centimeter)
 - clear cling wrap (.1 cents per square centimeter)
 - foam (5 cents per square centimeter)
 - tape (1 small roll is provided free to each team)
- You have \$25 to spend on materials for your device

- Your device must have a thermometer visible, or a way to easily peek at a thermometer, inside the device.
- The device must rest, free-standing, on a flat base.
- You may not use any of the free materials provided today for testing devices to construction your actual device next month.
- You *may* take the testing materials home to continue to refine your device.
- You *may not* buy additional materials for testing

The Judging:

Judges will consider:

- The team's design process, rationale, and teamwork: 60 points
- The accuracy of the volume and budget calculations:
 - Volume of the device is accurate: 10 points
 - Surface area of the base is accurate: 5 points
 - Surface area of the sides is accurate: 5 points
 - Total cost of the device is accurate: 20 points
- The rate (in degrees Celsius per minute) that the thermometer inside device heats up: 20 points for the highest rate, 15 for 2 next-highest, 10 for 3 next-highest, 5 for heating up at all
- The maximum temperature the thermometer of the device reaches: 20 points for the highest maximum, 15 for 2 next-highest, 10 for 3 next-highest, 5 for heating up at all

Budget & Design Sheet (for final draft)

Sketch of device with dimensions & materials clearly labeled



Calculations for surface area of the base:

Height of the device:

Calculations for total surface area of the device:

Will any parts of the surface have multiple layers of materials? Yes/No

Calculation of *total* square centimeters of material needed:

Cm² of paper used:

Total cost of paper:

Cm² of foil used:

Total cost of foil:

Cm² of plastic used:

Total cost of plastic:

Cm² of foam used:

Total cost of foam:

Check materials total:

Total cost (must be less than \$25):

Materials Order Sheet:

Cm² of paper needed:

Total cost of paper:

Black:

White:

Cm² of foil needed:

Total cost of foil:

Cm² of plastic needed:

Total cost of plastic:

Clear:

Pink:

Blue:

Cm² of foam needed:

Total cost of foam:

Check materials total:

Total cost (must be less than \$25):