

Build a Battery!

NSSL Event for October, 2005

Your challenge is to build the lightest possible electrochemical cell that produces the greatest amount of voltage. You will also need to be able to answer questions on the electrochemistry behind batteries, including writing half-reactions and calculating theoretical voltages.

Requirements:

Your group (up to four people) must bring to the competition an already assembled set of materials that you will use as your battery, MINUS ALL LIQUID COMPONENTS. You will be provided with liquid solutions to use at the competition. Do not bring your own solutions. When you arrive, your battery device must be DRY for judges to check it. You must also bring a written list of all the components in your electrochemical cell. This list must clearly indicate the name and amount of each liquid you will need to add to your battery to make it function. Your battery may use a maximum of three different kinds of liquids (see list below), totaling 300ml.

Your group must bring safety goggles, aprons or lab coats and a calculator to use in the competition.

You will have 20 minutes to measure out and add the liquids you need into your battery. Your battery must be designed with two contacts sticking out that are easily accessible for voltage testing, without getting the multi-meter contacts wet. Your battery also needs to be encapsulated in a way that judges can easily see inside AND open the device. No parts of the battery device may be sealed. Devices that produce any gas (rendering them potentially explosive) or are too hot to touch with bare hands will be disqualified. Each battery must be able to be lifted by the team members and placed on a digital balance in order to be massed. If any liquid is leaking out of the battery device, it will not be able to be massed and therefore will be disqualified. If the device needs to be supported by something in order to be placed on the balance, the mass of that object will be included in the total mass of the battery device.

Once liquid components are added by your team, the total mass, voltage produced by your battery be measured using a multi-meter. Final score will be determined by the following formula:

$$\text{Score} = \frac{\text{Voltage (V)}}{\text{Mass (g)}}$$

The team with the highest score wins.

Answers to the written questions will be used as a tie-breaker—the more correct answers, the higher the score.

Materials Allowed (may be cut into any size and shape)
(ONLY materials on this list are permitted to be incorporated into the battery device.
Your group may use other tools and materials in assembly, but they may not be
incorporated into the device in any way):

Galvanized Nails
Iron Nails
Copper Nails
Pennies
Nickels
Dimes
Quarters
White or brown paper towels
Filter paper
Plastic soda, milk, soft drink, and water bottles and caps
Baby food jars
Milk cartons
Juice boxes
Paper bags
Plastic bags (including Ziploc)
Strips of zinc, copper, steel or aluminum foil or sheet metal
Copper wire (any gauge)
Rosin core solder
Plastic or glass eyedroppers and bulbs
Cotton balls
Duct tape
Hot glue
Alligator clips (stainless steel)
Dialysis tubing
Cotton string or rope (any thickness)
Plastic culture dishes (6, 12, 24 etc cells okay) or spot plates
Plastic containers used for micro-scale chemistry

Liquid components may ONLY include the following aqueous solutions (These will
be provided at the competition; you should test your device in advance using them):

0.5 M NaCl
0.5 M Potassium Nitrate solution
0.5 M copper sulfate solution
0.5 M Zinc sulfate solution
0.5 M copper (II) sulfate solution
0.5 M sodium sulfate solution
0.5 M KCl solution
Coke, Pepsi
Lemon, orange, or lime juice
Gatorade