IGNITE ACTIVITY

GREEN BATTERIES

STEM²D Topics:
SCIENCE & ENGINEERING

Target Population:
Students, ages 13-15

GREEN BATTERIES is part of the STEM²D Student Activities Series.

Developed by FHI 360 and JA Worldwide as part of Johnson & Johnson's WiSTEM²D initiative (**W**inning in **S**cience, **T**echnology, **E**ngineering, **M**ath, **M**anufacturing, and **D**esign), the series includes more than 10 interactive and fun, hands-on activities for youth, ages 12–18, globally.

Green Batteries

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ACTIVITY DESCRIPTION

In this Ignite STEM²D activity, students will apply their science knowledge and use critical thinking and problem-solving skills to explore how chemical energy is converted into electricity.

ESTIMATED TIME

This activity is intended to be done at a career fair, science fair, exhibit, or other type of "booth" event. It typically takes **5 to 10 minutes** to complete.

STUDENT DISCOVERIES

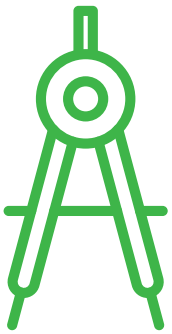
Students will:

- Apply their knowledge of science and physics to solve a problem.
- Build important STEM²D skills, such as communication and critical thinking.
- Have fun experiencing STEM²D.
- Be inspired to participate in other types of STEM²D experiences.

GETTING READY

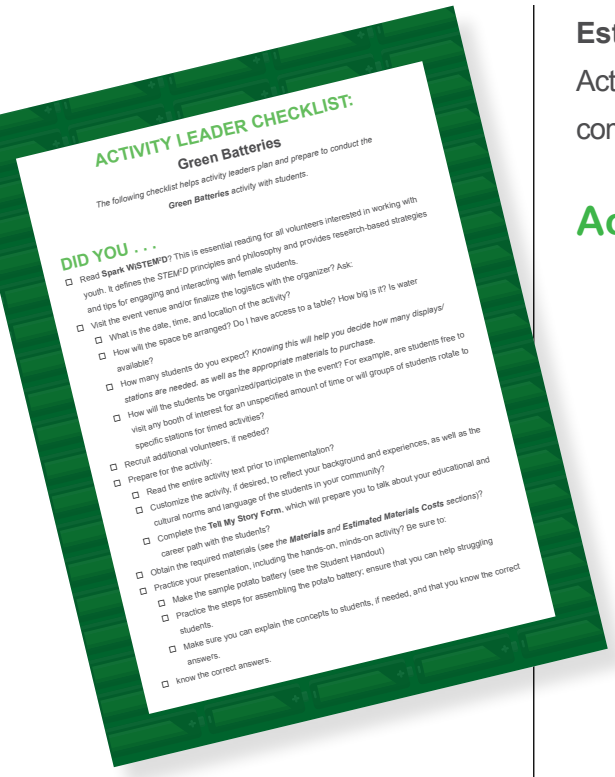
Materials

- Activity Leader Checklist
- Tell My Story Form, *optional*
- Student Handout, *several copies*
- Materials to make 50 batteries:
  - 100, eight-inch (8") lengths of copper wire
  - 50 shiny pennies
  - 50 galvanized steel nails
  - 50 potatoes
  - 50 small LED bulbs or miniature light bulbs (e.g. 1.2 V bulb)
- STEM²D brochures, flyers, or other informational materials, *optional and determined by the Activity Leader*



STEM²D Skills

- Communication
- Creative Thinking
- Critical Thinking
- Drawing Conclusions
- Problem Solving



ACTIVITY LEADER CHECKLIST:
Green Batteries

The following checklist helps activity leaders plan and prepare to conduct the **Green Batteries** activity with students.

DID YOU . . .

- ☐ Read **Spark WiSTEM²D**? This is essential reading for all volunteers interested in working with youth. It defines the STEM²D principles and philosophy and provides research-based strategies and tips for engaging and interacting with female students.
- ☐ Visit the event venue and/or finalize the logistics with the organizer? Ask:
  - ☐ What is the date, time, and location of the activity?
  - ☐ How will the space be arranged? Do I have access to a table? How big is it? Is water available?
  - ☐ How many students do you expect? *Knowing this will help you decide how many displays/stations are needed,* as well as the appropriate materials to purchase.
  - ☐ How will the students be organized/participate in the event? For example, are students free to visit any booth of interest for an unspecified amount of time or will groups of students rotate to specific stations for timed activities?
- ☐ Recruit additional volunteers, if needed?
- ☐ Prepare for the activity:
  - ☐ Read the entire activity text prior to implementation?
  - ☐ Customize the activity, if desired, to reflect your background and experiences, as well as the cultural norms and language of the students in your community?
  - ☐ Complete the **Tell My Story Form**, which will prepare you to talk about your educational and career path with the students?
- ☐ Obtain the required materials (see the ***Materials*** and ***Estimated Materials Costs*** sections)?
- ☐ Practice your presentation, including the hands-on, minds-on activity? Be sure to:
  - ☐ Make the sample potato battery (see the Student Handout)
  - ☐ Practice the steps for assembling the potato battery, ensure that you can help struggling students.
  - ☐ Make sure you can explain the concepts to students, if needed, and that you know the correct answers.
  - ☐ know the correct answers.

TIPS FOR WORKING WITH STUDENTS

Offer pointers or help students who are struggling to make their battery. This will keep the "assembly line" moving!

Estimated Materials Cost:

Activity leaders can expect to incur less than $50 in materials costs when completing this activity with student groups of up to 50 students.

Activity Leader Preparation

1. **Read Spark WiSTEM²D**. This is essential reading for all volunteers interested in working with youth. It defines the STEM²D principles and philosophy and provides research-based strategies and tips for engaging and interacting with students. Download at www.STEM²D.org.
2. Review the **Green Batteries Activity Leader Checklist** (at the end of this document) for details and specific steps for planning, preparing, setting up the venue, and implementing this activity.
3. See the **STEM²D Student Activities Overview** for additional information.

STEP-BY-STEP INSTRUCTIONS: Green Batteries

1. **Welcome & Introductions (1 minute)**
   - Welcome the students as they arrive at the table/booth.
   - Tell the students your name, your organization/company, and your job title/occupation.

2. **Learning Activity: Building a Potato Battery (3-4 minutes)**
   - Show students the pre-built (sample) potato battery.
   - Ask students to predict (guess) if they think the potato battery will be able to make the bulb light up.
   - Invite the students to test their prediction and construct their own potato battery. Tell students that there are three stations; each station includes the materials and directions for making the battery.
   - Once the students finish building their batteries. Ask:
     - How does the potato make the bulb light?
     - How does it work?
   - Expand on student knowledge. Explain the experiment using some key terms:
     - Today, you built a **battery**, just like the one in a car

or those used in a flash light, and successfully made electricity.
    - Batteries generate electricity by converting chemical energy to electrical energy. This involves a spontaneous electron transfer between two different electrodes and an electrolyte. When the electrons flow from one material to another, energy is released.
    - In our battery, the potato has a lot of juice, which serves as an **electrolyte**, fluid that easily transports charged particles.
    - A chemical reaction is generated between the two different **electrodes**: the zinc in the nail and the copper in the penny.
- Ask the students follow-up questions to gauge their understanding. Consider:
    - How long do you think the battery will last?
    - How could we make the battery stronger or more powerful?
    - Do you think you could charge a cell phone with a potato battery?

3. **Student Reflection (2 Minutes)**
    - Indicate that **green (or renewable) energy** is energy that is generated from renewable resources rather than **fossil fuels**, such as gas or coal; as a result, it doesn't pollute the environment.
    - Share some examples of green energy: sunlight, wind, rain, tides, waves, or geothermal heat.
    - Encourage students to review and reflect on the broader implications of this experiment. Consider asking:
        - Could this type of battery be a viable source of green (or renewable) energy?
        - What are some of the benefits/challenges of generating power from potatoes?
    - Tell students that this activity touches on many aspects of STEM^{2}D, including the sciences of physics and chemistry, as well as engineering.
    - Encourage the students to continue exploring careers in STEM^{2}D. Reassure them that they can do STEM^{2}D.
    - Thank the students for joining you today; let them keep their batteries if resources permit.

KEY WORDS

- **Battery**
- **Electrodes**
- **Electrolyte**
- **Fossil fuels**
- **Green/ Renewable Energy**

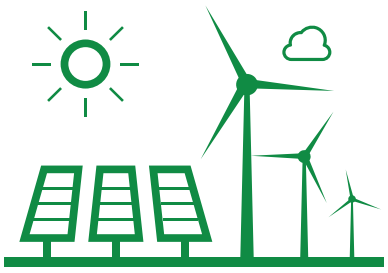
TIPS FOR MAKING CONNECTIONS

Potential benefits of generating power from potatoes:

- Potatoes are bio-degradable and won't harm the environment when creating energy.
- Potatoes can be grown in large quantities, inexpensively.

Some potential challenges of generating power from potatoes:

- Food source vs. energy source: Are there enough potatoes for people to eat? Will its use of power create food shortages?
- Availability of potatoes: What happens if there is a shortage? A bad harvest?
- Cost of potatoes: Will potatoes be too costly or unavailable in areas where potatoes are not typically gown?
- Shelf-life of perishable food items: How long can the potatoes be stored prior to use?



Types of green energy include the sun and the wind.

Key Words

Battery: A container consisting of one or more cells, in which chemical energy is converted into electricity and used as a source of power.
Electrode: A conductor through which electricity enters or leaves an object, substance, or region.
Electrolyte: A liquid or gel that contains ions and can be decomposed by electrolysis, e.g., that present in a battery.
Fossil Fuels: A natural fuel such as coal or gas, formed in the geological past from the remains of living organisms.
Green/Renewable Energy: Energy that is collected from renewable resources rather than fossil fuels, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat.
Light-Emitting Diode (LED): A two-lead semiconductor light source. It is a p–n junction diode that emits light when activated. When a suitable voltage is applied to the leads, electrons can recombine with electron holes within the device, releasing energy in the form of photons.

Activity Leader Reflection

After the activity, take a few moments to reflect on the following:

- What went well and what could be improved? What would you do differently next time?
- How comfortable did you feel talking about the broader applications of this activity?
- Do you have a better understanding of STEM²D concepts?
- How useful was the information presented in **Spark WiSTEM²D** to implementing this activity?
- Will you volunteer for this type of experience again?

Resources and References

Activity concepts and real-life connections provided by:

"Science Project: Vegetable Power," *Education.com.* Accessed 7 November 2017. https://www.education.com/science-fair/article/vegetable-power/

Chris Woodward. "Batteries," *Explain That Stuff!*, 9 March 2017. Accessed 7 November 2017. http://www.explainthatstuff.com/batteries.html

ACTIVITY LEADER CHECKLIST:

Green Batteries

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DID YOU . . .

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- ☐ Visit the event venue and/or finalize the logistics with the organizer? Ask:
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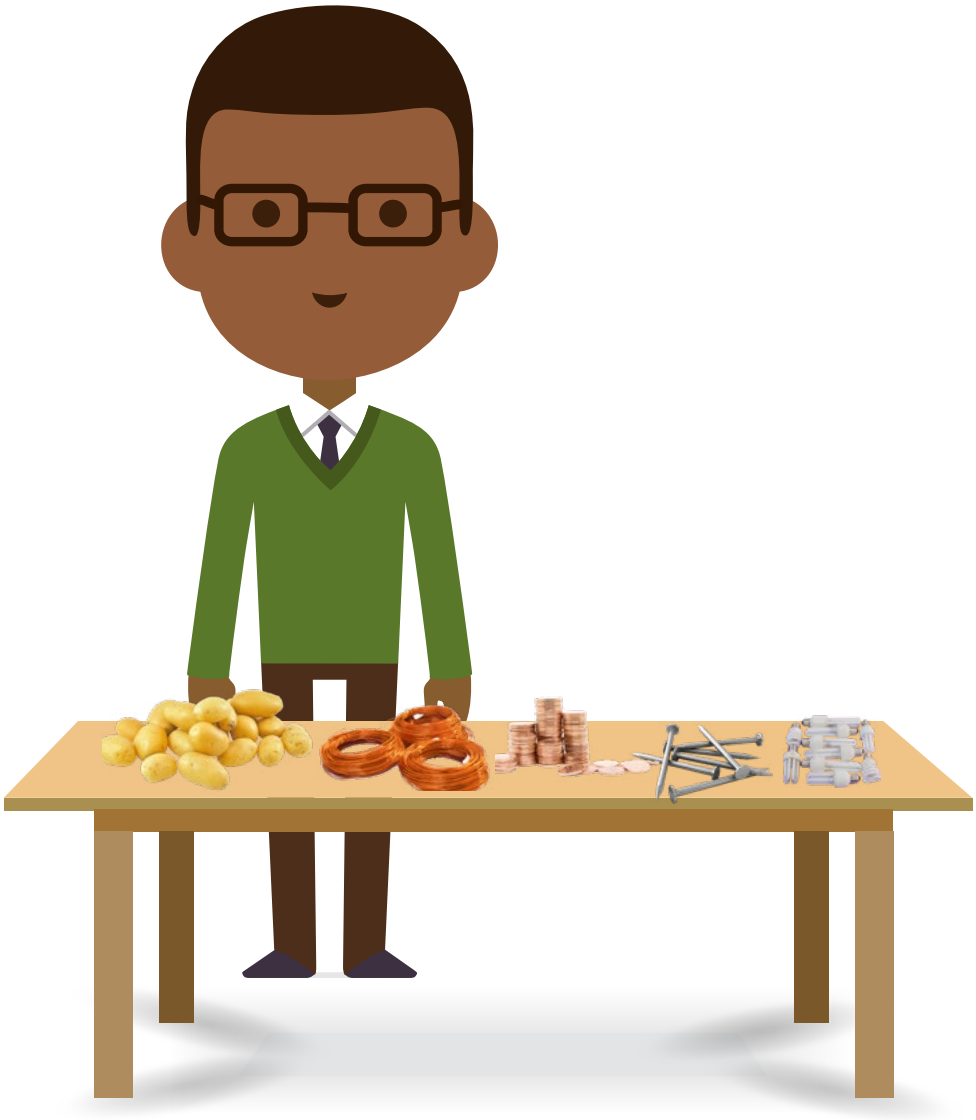
- ☐ Recruit additional volunteers, if needed?
- ☐ Prepare for the activity:
  - ☐ Read the entire activity text prior to implementation?
  - ☐ Customize the activity, if desired, to reflect your background and experiences, as well as the cultural norms and language of the students in your community?
  - ☐ Complete the **Tell My Story Form**, which will prepare you to talk about your educational and career path with the students?
- ☐ Obtain the required materials (*see the* ***Materials*** *and* ***Estimated Materials Costs*** *sections*)?
- ☐ Practice your presentation, including the hands-on, minds-on activity? Be sure to:
  - ☐ Make the sample potato battery *(see the* ***Student Handout****)*
  - ☐ Practice the steps for assembling the potato battery; ensure that you can help struggling students.
  - ☐ Make sure you can explain the concepts to students, if needed, and that you know the correct answers.

- ☐ Set up the site appropriately for the activity? At the booth or table, set up an “assembly line” with three stations to make the potato batteries (50). Place the directions (see ***Student Handout***) and the following materials at each station:
  - ☐ Station 1 materials: 100 pieces of copper wire, 50 steel nails, 50 pennies
  - ☐ Station 2 materials: 50 potatoes
  - ☐ Station 3 materials: 50 LED or miniature light bulbs
- ☐ Bring a camera, to take photographs, if desired.
- ☐ Obtain and collect permission slips and photo release forms for conducting the activity, if applicable?
- ☐ **Have fun!**



Tell My Story Form

This form will help activity leaders prepare to talk about
their STEM²D interests, education, and career path in a relevant and personal way.

ABOUT YOU

Name: _____

Job Title: _____

_____

Company: _____

When/Why did you become interested in STEM²D? _____

_____

_____

What do you hope young people will get out of this activity?_____

_____

FUN FACT:

Share a little about your background. Ideas:

- Share a memory from childhood when you first had your “spark” or “interest” in STEM.
- Detail your journey, highlighting what you have tried, what you learned, steps to success, etc.
- Failures or set backs are also great to talk about—difficulties, and/or challenges, and how you overcame them.

EDUCATION AND CAREER PATH

What classes/courses did you take in secondary school and in college that helped or interested you most? _____

_____

How did you know you wanted to pursue a STEM²D career? _____

_____

What was your postsecondary path, including the institution you attended and your degree? *If you switched disciplines, make sure you explain why.* _____

_____

What your current position entails. *Be sure to include how you use STEM²D during a typical work day.* _____

_____

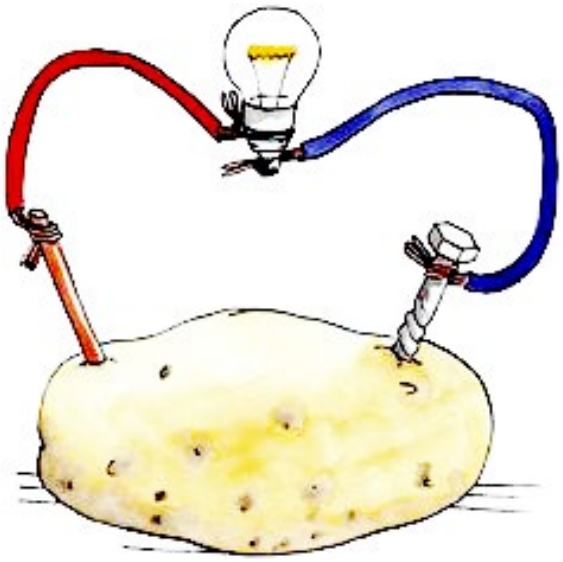
Green Batteries

Student Handout

STEP-BY-STEP INSTRUCTIONS

REQUIRED MATERIALS

- 2 copper wires
- 1 penny
- 1 galvanized steel nail
- 1 LED light bulb
- 1 potato (or other fresh fruit/vegetable)



STATION 1:

1. **Gather the first set of materials:**
    - 2 copper wires
    - 1 penny
    - 1 nail
2. **Wrap one end of the copper wire around the penny.**
3. **Using the second copper wire, wrap one end of the wire around the nail.**

STATION 2:

1. **Select a potato.**
2. **Insert the nail into the potato.**
3. **Insert the penny into the potato about one (1) inch from the nail. DO NOT allow the penny and the nail to touch.**

STATION 3:

1. **Wrap the copper wire coming off the penny around the long leg of the LED light bulb.**
2. **Wrap the wire coming off the nail around the short leg of the LED light bulb.**
3. **Watch the LED light up.**

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