Lesson Concept: Energy sources to run motors can be energy from the sun (solar) or energy stored in batteries (chemical).

Link: In the previous lesson, students completed the sub-concept of transfer and transformation of energy. This lesson introduces the source of energy to run small motors can be the sun or chemical energy stored in a battery. The next lesson deepens the understanding of renewable and non-renewable energy.

Time: 45 minutes

Materials: Per Group (groups of 2)
- Photovoltaic cell
- Motor with paper disc attached
- Any sized battery

Individual
- H1a,b Renewable vs. Non-Renewable Energy

Advance preparation:
1. Cut out round disc and tape to the shaft of the motor. Refer to R1 (Set Up of PV Cells).
2. Duplicate H1a,b (Renewable vs. Non-Renewable Energy).

Teacher Note: You will need a sunny day for the photovoltaic cells to work. Cloudy or foggy days will not provide enough solar energy for them to work.

Procedure:
Engage (5 minutes) Energy is used for almost all daily activities including toys and games.

1. Ask students to brainstorm what type of energy they have used today? Chart types.
2. Distribute H1a,b (Renewable vs. Non-Renewable Energy). Ask students to think about games and toys used and list the type of energy used for each game or toy.
3. Ask students to share their information with their partner and update their list of types of energy they used today after their conversation with their partner.
4. Create a class list of all types of energy used today. All energy we use today has a source. Some sources can be renewed and some sources are not renewable. Today we are going to explore why some sources of energy are renewable and non-renewable.
Explore/Explain #1 (10 minutes) Energy sources include batteries that can be powered by chemicals in the battery.

5. As a class, read the battery introduction on H1a (Renewable vs. Non-Renewable Energy).

6. Distribute the batteries and motors to student partners. Ask students to attach the motor to the battery.

7. Ask students to observe and record their observations about how the battery is the source of energy for the motor.

8. Where does the energy come from in a battery? What happens to batteries that have been used?

Explore #2 (20 minutes) Energy sources include batteries that can be powered by collecting the sun’s radiant energy.

9. Read and discuss the photovoltaic cell introduction on H1a (Renewable vs. Non-Renewable Energy).

10. Collect the batteries and distribute the photovoltaic cells to student partners. Ask students to attach the motor to the photovoltaic cell.

11. Walk students outside and place with the photovoltaic cells in the sunlight.

12. Ask students to observe and record their observations on H1a (Renewable vs. Non-Renewable Energy) for observations #3 – 6.

13. Where does the energy come from to run the motor? What happens to photovoltaic cells that have been used for a long period?

Explain #2 (5 minutes) Energy sources that use solar energy are renewable and energy sources from batteries are not renewable.

14. Ask students to complete conclusion questions #1 – 4 on H1b (Renewable vs. Non-Renewable Energy) listing the advantages and disadvantages of using both batteries and photovoltaic cells.

15. Ask students to discuss their answers with their partners. Encourage students to add to their answers with ideas from the partner.

Extend/Evaluate (5 minutes) Renewable (solar) and non-renewable (battery) sources to run motors have pros and cons and selection of the source is determined by weighing the pros and cons.

16. Ask students to complete conclusion questions #5 – 6 on H1b (Renewable vs. Non-Renewable Energy) determining when a battery or photovoltaic cell would be best used.

17. Ask students to discuss their answers with their partners. Share with the class.
RENEWABLE VS NON-RENEWABLE ENERGY

What types of energy did you use today? List below.

**BATTERY**
Batteries are a non-renewable source of energy. Once the battery wears out, it cannot be used any more. It is not renewable without getting more chemicals to put in the battery. A new battery would need to be found.
1. Attach the battery to the motor creating a closed circuit. Record observations.

**PHOTOVOLTAIC CELLS**
Photovoltaic (PV) cells absorb solar radiant energy and convert it to electricity. A motor converts electricity into motion. Energy from the sun is renewable. The energy from the sun will not run out in our lifetime. We’ll go outside into the sunlight to power our motor using solar energy.

2. Attach the wires from the PV cell to the “hooks” on the motor.
3. Place the PV cell in bright sunlight – observe and record

4. Cover part of the PV cell with your hand – observe and record

5. Hold the PV cell at different angles – show angle to the sun and record observations under each diagram.

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6. What situation you tested worked best?
   Draw it – include sun, wires, PV cell, how held, etc.
Conclusion:

1. What are the advantages of using batteries as a source of energy?

2. What are the advantages of using the photovoltaic cells as a source of energy?

3. What are the limitations of using batteries as a source of energy?

4. What are the limitations of using photovoltaic cells as a source of energy?

5. If you had a choice between a battery or a PV cell to power a flashlight, which would you choose and why?

6. If you had a choice between a battery or a PV cell to power a toy car, which would you choose and why?
Set up of Photovoltaic Cells

Photovoltaic Cell with motor and disk attached.

Photo showing wires connecting to the hooks on the bottom of the motor.