**Lesson 02: Energy Transformations and Transfers**

**Problem statement:** In this project you and your group will learn how to power a car.

**Learning objectives:** Students will understand what a circuit is and build a circuit with a fan. Students will also understand energy inputs and outputs, energy types, and how energy flows.

**Lesson standards (NGSS, CCSS, CTE):**

* Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. (MS-PS3-2)
* [Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS-PS3-5)](http://www.nap.edu/openbook.php?record_id=13165&page=94)
* [The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS3-3)](http://www.nap.edu/openbook.php?record_id=13165&page=94)

**Materials:**

* For each pair: a battery, 1 wire, light bulb, motor, fan
* Extension materials: switch, hand crank
* Light Circuit Worksheet
* Energy Transfers Worksheet

**Lesson preparation:**

**Time required:** 45 minutes

**Grouping of students for instruction:**

Students will be in partners. Prioritize placing into mixed skill groups. Make sure weaker students are partnered with stronger students.

**What is the instruction? Consider the PBL Procedure that is being addressed here:**

1. Tell the students that they are going to work with three pieces of equipment today, a battery, wire, and a light bulb. Explain to them that they will be attempting to make the light bulb light up using only these three pieces. Tell them they will be drawing their ideas and review the proper way to draw a diagram and how to label it. Hand out the “Light Circuit Worksheet” and have each student independently draw how they think the connection will work.
2. Split students into partners. Have the students compare their diagrams with their partner and decide together how they are going to attempt the problem. Give each pair of students a D battery, 1 wire, and a light bulb. Without telling them if their drawings are correct, have the groups work together to light the bulb. You may want to give the pairs privacy folders so other groups can’t see what they are doing.
3. When a pair is able to light the bulb, have them record a drawing of their solution in the first box. Inform them that there are three other ways to light the bulb. Have them continue to experiment with how to light the bulb in different ways.
4. You will continue this activity until the majority of groups have found how to light the bulb. You may have to support some partners and help them light the bulb.
5. If partners are completed with the worksheet and others are still working, you may want to add the following extensions to the project:
   1. Using a hand crank to power the light bulb
   2. Placing a switch in the circuit
6. When the majority of students are completed, you will want to bring the class back together to do a class discussion. Choose students to come up and draw their diagrams on an example worksheet in the front. When everyone is satisfied with the drawings and are all in agreement, draw the movement of the electricity on one of the diagrams. Talk to the students about what the movement is called (a circuit). Try to relate the word circuit to the word “circle”. If your students have seen energy types, you may want to include those on your drawing.
7. Have each group come trade their lightbulb for a motor and fan and they will spend a short period of time to get the motor to run the fan. (This should go pretty fast when they have discovered how to light the bulb)
8. An extension to the motor would be to have the students run the motor and light the bulb at the same time.
9. Hand out the Energy Transfers Worksheet to the students - one worksheet per student. Have them return their lab materials so there are no distractions for the students.
10. Working with their partners, have them draw the diagram of the motor and fan setup that worked. Bring the class back together and have the students help you make a master diagram for the front. Using arrows or highlighters, draw the circuit of energy that is occurring on the diagrams.
11. If your class has not seen energy types, you are going to want to have a discussion on energy types and transfers. This may be helpful to do anyway if your students have not seen this concept in a little while. You may want to include the following video as well:

**Accommodations:** None needed

**Extensions:** You may want to include extensions for students who complete the light bulb challenge such as: a hand crank or a switch.

**Assessment:**

Formative: Student drawings on “Light Circuits” Worksheet and class discussion

**References/Resources:**

Light Circuits Worksheet

Energy Types and Transfers Worksheet