## Overview
During this lesson, students will gain understanding of renewable and non-renewable energy sources. They will recognize the danger of burning fossil fuels on our planet, and will invent their own means of producing renewable energy. Students will integrate and exhibit learning by creating a ‘solar panel’, ‘solar-powered fan’ and ‘solar-powered car’.

## Key Information

### Lesson Structure

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### Lesson Topics
(refer to the Standards Alignment Map)

- **NGSS Earth and Space Science 5-ESS3-1**
- **CCSS Maths**
- **CSTA Computer Science**
- **CCSS English Language Arts**

### Materials Required

- SAM Labs STEAM Kit
- Tissue Paper
- Sticky putty

The Student Handouts can be used alongside each lesson.
Warm-Up
Recognize and categorize renewable and non-renewable forms of energy.

Prior Knowledge Required
- Most non-renewable energy sources are fossil fuels; coal, petroleum, and natural gas.
- Burning fossil fuels is harmful to the environment; when coal and oil are burned, they release carbon dioxide, which pollutes the air, water and land, and contributes to global warming.

Key Information to Share:
- **Renewable energy** comes from resources that can be replenished - they will not run out.
- **Non-renewable energy** comes from resources that cannot be replenished - they will run out at some point. Examples are coal, natural gas and oil (these are **fossil fuels**).
- Burning fossil fuels on Earth has caused a hole in the **ozone layer**, the layer of protective gases surrounding the planet, and allowed harmful rays, namely UV radiation, through the atmosphere resulting in global warming.
- UV rays can lead to cancer in humans. In the environment, UV rays negatively affect plant growth and ecosystems.

Activity:
- Think, pair, share: “**What makes an energy source renewable?**
- Students can sort images on the Teacher Slides into ‘renewable’ and ‘non-renewable’ energy sources. Option to print images for students to sort in pairs.
- “**How are non-renewable energy sources damaging the environment?**”

**Link forward:** Students explore renewable energy sources and how they are utilized.
Mini-lesson
Explain different forms of renewable energy, and how these can be effectively utilized.

Key Information to Share:
- Renewable energy is ‘clean’; it does not produce harmful gases during production.
- Renewable energy comes from natural resources. Examples include:
  - Wave (or tidal) power which uses the sea to generate energy
  - Hydropower uses dams on rivers to generate electricity.
  - Geothermal power which uses heat from the Earth’s core to generate energy.
  - Wind turbines which convert the movement of the air into electricity.
  - Solar panels utilize solar power; they harness energy (light) from the sun which is converted into electricity. Electrons in the panels are stimulated by the sunlight. The energy is then converted, firstly into DC (direct current) electricity, then passing through an inverter, creates AC (alternating current) electricity. This electricity then flows into the electric box (or circuit breaker) ready to be used to power electrical items.

★ Option to Discuss: Formation of fossil fuels; the greenhouse effect.

Activity:
- Display the images of types of energy and its source. Students can match them up, calling out as each form of energy is pointed to.
- Think, pair, share: “What are the positives and negatives of each form of renewable energy?”
- Students can work in pairs to invent a means of producing renewable energy specific to their geographical area. For example, if they live near the coast they could create something powered by tidal power, or by water.

In their Student Handout, students can record their renewable energy designs, before presenting their ideas to the rest of the class.

- Display the slide showing a diagram of solar panels on a house. Discuss: “How do solar panels work?”

Students can complete the keyword activity in the Student Handout.

Keywords:
- **Renewable energy**
  - Power generated from resources which can be replenished.
- **Non-renewable energy**
  - Energy that comes from resources which cannot be replenished once they have been used up, e.g. fossil fuels.
**Fossil fuels**  
Fuel, such as gas, coal and oil, formed from the remains of plants and animals.

**Ozone layer**  
A layer of the Earth’s atmosphere; a mass of protective gases surrounding the planet.

**Solar power**  
Power gained from the energy of the Sun’s rays, which can be transferred into electricity.

**Wind turbine**  
A machine, often shaped like a windmill, which converts the movement of the air into electrical energy.

**Let’s Discuss:** “What makes an energy source renewable?” With a partner, students can discuss what could happen to our planet if we don’t increase the amount of renewable energy solutions.

**Link forward:** Students create a model to simulate the function of a solar panel. They then use the ‘solar panel’ to power a ‘fan’ and a ‘car’.

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**Worked Example – Let’s Build!**  
Create a system to simulate the function of a solar panel.

<table>
<thead>
<tr>
<th>Instructions</th>
<th>Workspace</th>
<th>Notes</th>
</tr>
</thead>
</table>
| **Step 1**  
Turn on and pair:  
• 1 Light Sensor block  
• 1 RGB LED block  
and drag onto the workspace. Also drag on:  
• 1 Filter block  
• 2 Compare blocks  
• 2 Color blocks  
• 1 Inverse block.  
Connect the blocks as shown. | ![workspace_diagram](image) | Explain that the Light Sensor will simulate the function of a solar panel and the RGB LED will represent the amount of power being generated. |
Grade 5 Lesson 5
Solar Power

**Step 2**
In the settings of the blocks, set as follows:
- Filter: '30–89'
- 1st Compare: '≥ 90'
- 2nd Compare: '≤ 29'
- 1st Color: red
- 2nd Color: green.

Test your system.

Discuss how the values of the Light Sensor should output as follows:
- '0–29' = no color (no sunlight) - this is achieved through the Inverse block
- '30–89' = green ('solar panel' absorbing sunlight)
- '90–100' = red ('solar panel' absorbing high levels of sunlight)

Discuss why a color indicator for the strength of sunlight may be useful. Opportunity for students to choose different colors.

Students may wish to place their 'solar panels' in the window to experiment with the Light Sensor readings.

**Challenge 1**
Create a modification to the system to simulate a solar-powered fan.

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<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><img src="image1.png" alt="Workspace Image" /></td>
<td>Explain that this will mean the 'fan' only turns when the Light Sensor detects light values of '30' or above.</td>
</tr>
<tr>
<td>Turn on and pair:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1 DC Motor block and drag it onto the workspace. Also drag on:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1 additional Filter block.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connect the blocks as shown.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><img src="image2.png" alt="Workspace Image" /></td>
<td></td>
</tr>
<tr>
<td>In the settings of the Filter, set to '30–100'.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Step 3
Build your ‘fan’:

- Attach 1 Wheel to the DC Motor.
- Secure tissue paper strips to the Wheel.

Note, sticky putty has been used here to secure the tissue paper strips.

### Step 4
Slot the red Car Controller on top of the yellow Chassis.

- Insert the RGB LED into the long slot of the Car Controller.
- Insert the DC Motor into the small slot.
Step 5
Test your system.

Explain that the Light Sensor will now power both the RGB LED and the ‘fan’.

Opportunity to discuss wind power and the function of wind turbines.

Checks for understanding: “What is the purpose of the Inverse block in the system? Which four are types of renewable energy?”

Challenge 1 – Debug It!
How can I alter the direction of the DC Motor?

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| **Step 1**
Drag onto the workspace:
- 1 Key Press block
- 1 Switch Direction block

Connect the blocks as shown. |

Ensure students test that pressing the Key Press alters the direction of the ‘fan’. Discuss the impact this has on the effectiveness of the ‘fan’. |
## Challenge 2
Create a modification to the system to simulate a ‘solar-powered car’.

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<td><img src="image1" alt="Workspace Image" /></td>
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</table>
| Remove from the workspace:  
  - Key Press  
  - Switch Direction.  
| Turn on and pair:  
  - 1 additional DC Motor block and drag onto the workspace.  
| Connect the blocks as shown. |

**Step 3**  
Attach 1 Wheel to the new DC Motor.  
Insert both DC Motors into the yellow Chassis.  
Attach 1 Rollerball underneath the Chassis.  
Insert the Light Sensor and RGB LED into their white casing and attach to the top of the Chassis.  
Note, first the ‘fan’ must be disassembled to construct the ‘car’.  
Ensure students recognize that they must change one DC Motor rotation to ‘Counter-clockwise’ for the ‘car’ to move in a straight line.  
Encourage students to discuss when the outputs are triggered. Ensure that they understand that the ‘car’ will start moving when the RGB LED illuminates green, showing that the Light Sensor value is greater than ‘30’.  
Option to discuss how this ‘car’ could be modified to use in the real world as an energy-efficient alternative to fossil fuels.  

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Students can complete activities in the Student Handout.

Checks for understanding: “Why are the two Filter blocks used in the system? Which statement about burning fossil fuels is correct?”

Chili Challenges

- **Experiment with driving the ‘car’.** Can you add a function to the current system to control the steering and speed of the ‘car’?
- **Experiment with the colors of the RGB LED.** Can you add a function to the current system so the RGB LED flashes a different color when the Light Sensor reads a value between ‘50’ and ‘90’?
- **Experiment with the AND logic block.** Can you add this block to the system and program it to affect the RGB LED output?

Exit Ticket
Reinforce the learning objectives of the lesson. Students can:
- annotate their system in the Student Handout.
- reflect on key takeaways by completing an exit ticket summarizing what they’ve learned.