5-E CLASSROOM STEM ACTIVITY:
RENEWABLE ENERGY

Jill Cataldi
AN INTERVIEW WITH A MISSION ENGINEER AT SOLAR IMPULSE

SOLAR IMPULSE FLYING OVER
NAGANO MOUNTAIN REGION

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If you haven’t heard of Solar Impulse by now, you’ve probably been living under a rock ... or more specifically, under a rock without a smartphone. The Sweden-based aviation innovation company aims to achieve the first round-the-world solar flight. Despite some technical setbacks, the team plans to launch their landmark flight in 2016.

Solar Impulse wouldn’t be possible without the hard work of the many engineers, scientists and numerous STEMiners who support the organization. We sat down with Laila Fathi, a mission engineer at Solar Impulse, to learn more about the amazing things they are accomplishing and how she piloted her own STEM career.
**STEM JOBS: Laila, how did you start your career at Solar Impulse?**

**LAILA FATHI:** I began by studying meteorology at the University of Vienna. After two years of studying, I heard of the possibility to study aeronautical engineering in another city in Austria. I applied and was accepted into the program in 2009. During my studies in Austria I visited the Paris Air Show in 2011, where Solar Impulse was one of the exhibitors. There I met two of the mission engineers working for Solar Impulse and immediately applied as an intern for the following year. I got the opportunity to join Solar Impulse in 2012 as an intern for the Morocco mission. After finishing my studies in 2014, I once again joined the team of Solar Impulse as a mission engineer for the round-the-world solar flight.

**SJ: What kind of career opportunities are provided at Solar Impulse?**

**LF:** There are different teams working for Solar Impulse. A technical team, located in Switzerland, focuses on building our solar powered aircraft. They include mechanical, electrical and structural engineers, as well as aerodynamic specialists. Mission Control is based out of Monaco, where mission engineers, meteorologists, mathematicians and a controller focus on mission planning and execution. In regards to the flight, we have two pilots, a logistics team, press team, media team and a ground crew operations team working hand in hand.

**SJ: What do you love about working with Solar Impulse? Any great memories that stick out in particular?**

**LF:** I really appreciate the spirit and the work environment of the Solar Impulse team. I like their vision of making the world a better place to live without exploiting their resources. I also really love airplanes: the aviation industry is creative, innovative and full of passion. At Solar Impulse I got the chance to combine my two passions: aviation and meteorology. Weather is paramount to flying Solar Impulse and I have the chance to learn a lot from our experienced team of meteorologists. Our Pacific flight, especially the moment when the pilot and the team decided to continue the flight from Japan to Hawaii (a 118-hour flight), was a great memory.

**SJ: What advice would you give to young women looking to pursue a similar career path?**

**LF:** It is important not to give yourself a border. If a girl is interested in the aviation industry, even if it’s a male dominated career field, she should try and focus on her dream. Even if it gets hard, everything is possible. If you’re interested in aeronautical engineering, start flying by yourself, no matter if that includes paragliding, gliding, flying model airplanes or even piloting small aircraft. This will give you a better understanding of engineering, motivate you in your studies and give you the chance to meet experienced people who are working, or used to work, in aeronautical engineering.
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Here are some ideas for how middle school teachers could use this story as a launching point for integrated STEM learning. Our activities follow the 5-E Learning Cycle Model.

**Part 1: Engage**
1. Open the floor to discuss with students the various types of renewable energy (solar, wind, wave, tidal, etc.) to determine which renewable energies students are familiar with and which are new.
2. Brainstorm with students to compare and contrast the various types of renewable energy, based on what they already know about them.
3. The United States Army Corps of Engineers (USACE), Solar Impulse, Lockheed Martin, and the National Oceanic and Atmospheric Administration (NOAA) have all worked with renewable energy in some capacity. Have students read the STEM Jobs article on Solar Impulse, since their primary focus is on using renewable energy.
4. Show videos that can be found at [edu.STEMjobs.com/teacher-resources](edu.STEMjobs.com/teacher-resources) for brief overviews of both wave and tidal energy, and the way one company is harnessing each.

**Part 2: Explore**
1. The students will be split into 5 groups. Students will work together in the groups to investigate the various ways of harnessing renewable energy. Each group will be assigned one specific source of renewable energy to focus on: Solar, Wind, Wave, Tidal, and Geothermal. All members of the group will work together on all aspects of the project, but each member of the group will be given a specific aspect of the renewable energy to examine further. Suggested resources for research can be found at [edu.STEMjobs.com/teacher-resources](edu.STEMjobs.com/teacher-resources).

   - **Efficiency:** How is the energy captured/stored? How does energy work to provide power? What are some ways in which it can be used?
   - **Predictability:** Does the energy have a predictable behavior? What are some predictions that can be made? Is its availability consistent or does it vary?
   - **Cost:** How much time and money would go into building a power plant to utilize a renewable energy resource? What kind of cost savings can be expected as a result of using the renewable energy?
   - **Environmental Impacts:** How will the surrounding environment (people, wildlife, etc.) be impacted?

2. In the event that there are not enough students to make 5 groups of 4 students, 4 groups can be created and one renewable energy can be omitted or Wave and Tidal Energy can be combined to be one focus, due to their similarities. In the event that more than 5 groups becomes necessary, renewable energy resources can be reused and it will be to the teacher’s discretion which topic is repeated. Groups should still work independent of each other, even if they are sharing topics.
Part 3: Explain

The group will put together a presentation in order to visually display their findings and to be able to present the information to the rest of the class. As each group creates their presentation, each member of the group will offer the information they were able to gather on their specific aspect of the renewable energy. Important points of the research should be displayed on a poster board (tri-folds might be best for their stand and display quality). Visuals on the poster board should include pictures and key points of information.

Part 4: Elaborate

Discuss in an open forum with the students which renewable energy might be best for where they live. Why? Which energy might be the least useful? Why? The class can discuss new and innovative ways of improving the designs to perhaps accomplish more than one task. Can a design be modified to harness both wave power and solar power to increase the energy output?

Part 5: Evaluate

Students will be given a worksheet (see attached) to complete for each renewable energy resource. They will be given time after each presentation to tour and revisit each energy to complete their worksheet with notes about each. Though students can work together with the members of their group to fill out the portion for their particular energy, they still must each submit their own paper. Teachers will follow the attached rubric to score the student projects.
Renewable Energy Resource Worksheet

Fill out each portion for each renewable energy resource type.

1. Energy Type: SOLAR
   A. Uses (How is the energy captured/stored? How can the energy be used? How does it work?)

   B. Predictability (How predictable is the resource? Is it consistent or does it vary? How much does it vary?)

   C. Cost (What would it cost to build a structure to harness and store the energy for use? How long would it take? In what ways could money be saved by using the renewable energy?)

   D. Environmental Impacts (How is the surrounding environment impacted?)

2. Energy Type: WIND
   A. Uses (How is the energy captured/stored? How can the energy be used? How does it work?)

   B. Predictability (How predictable is the resource? Is it consistent or does it vary? How much does it vary?)

   C. Cost (What would it cost to build a structure to harness and store the energy for use? How long would it take? In what ways could money be saved by using the renewable energy?)

   D. Environmental Impacts (How is the surrounding environment impacted?)
3. Energy Type: WAVE
   A. Uses: (How is the energy captured/stored? How can the energy be used? How does it work?)

   B. Predictability (How predictable is the resource? Is it consistent or does it vary? How much does it vary?)

   C. Cost (What would it cost to build a structure to harness and store the energy for use? How long would it take? In what ways could money be saved by using the renewable energy?)

   D. Environmental Impacts (How is the surrounding environment impacted?)

4. Energy Type: TIDAL
   A. Uses: (How is the energy captured/stored? How can the energy be used? How does it work?)

   B. Predictability (How predictable is the resource? Is it consistent or does it vary? How much does it vary?)

   C. Cost (What would it cost to build a structure to harness and store the energy for use? How long would it take? In what ways could money be saved by using the renewable energy?)

   D. Environmental Impacts (How is the surrounding environment impacted?)
5. Energy Type: GEOTHERMAL
   A. Uses: (How is the energy captured/stored? How can the energy be used? How does it work?)

   B. Predictability (How predictable is the resource? Is it consistent or does it vary? How much does it vary?)

   C. Cost (What would it cost to build a structure to harness and store the energy for use? How long would it take? In what ways could money be saved by using the renewable energy?)

   D. Environmental Impacts (How is the surrounding environment impacted?)
**Rubric**

Students’ research and presentations will be scored using the following rubric. Points can be adjusted to give the project appropriate weight in your classroom. Worksheets completed by viewing others’ presentations will also be graded.

Student Name:___________  Role:___________

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<thead>
<tr>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
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<tbody>
<tr>
<td>Student contributed valuable information to group. Information was clear, concise, and thorough.</td>
<td>Student contributed good information to the group. Information was clear and concise.</td>
<td>Student contributed some information to the group. Some key concepts were missed.</td>
<td>Student contributed information, but many key concepts were missed.</td>
<td>Student contributed minimal information to the group.</td>
<td>Student did not participate.</td>
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<table>
<thead>
<tr>
<th>5</th>
<th>4</th>
<th>3</th>
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<tbody>
<tr>
<td>Presentation was clear and visually appealing. All key information was included.</td>
<td>Presentation was clear and easily understood. All key information was included.</td>
<td>Presentation was basic and some key concepts were missing.</td>
<td>Presentation was incomplete and many key concepts were missing.</td>
<td>Presentation included minimal information and visuals.</td>
<td>Presentation was not done.</td>
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Next Generation Science Standards

MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Cross-Curricular Connections

CCSS.ELA-Literacy.RH.6-8.7. Integrate visual information (e.g. in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

CCSS.ELA-Literacy.WHST.6-8.7. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

CCSS.ELA-Literacy.SL.7/8.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7/8 topics, texts, and issues, building on others’ ideas and expressing their own clearly.

Texas Essential Knowledge and Skills – Science

6.2.B design and implement experimental investigations by making observations, asking well-defined questions, formulating testable hypotheses, and using appropriate equipment and technology

6.7.B research and debate the advantages and disadvantages of using coal, oil, natural gas, nuclear power, biomass, wind, hydropower, geothermal, and solar resources