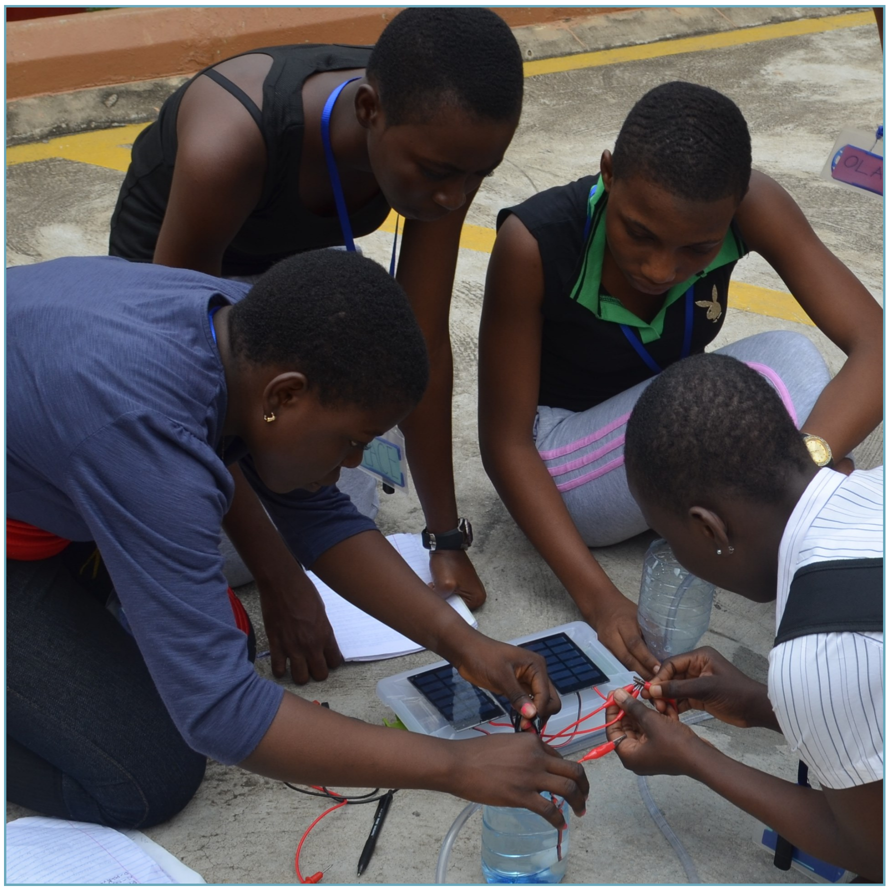
Solar Energy– Photo Voltaic

Outreach Program Lesson Plan



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Working To Advance STEM Education for African Girls

WAAW Foundation is non-profit organization dedicated to bringing hands-on STEM education to girls all over Africa.

Our Mission: To increase the pipeline of African women in Science, Technology, Engineering and Math (STEM) disciplines and to ensure this talent is engaged in African innovation.

Our Vision: To eradicate poverty in African through female education and science and technology innovation.

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Solar Energy– Photo Voltaic

Class Description-

In this class, students will explore how solar panels work using a large model. They will experiment with small solar panels to find out what makes them operate efficiently, and how they can be used to run electronic devices, like a water pump.

Total class time: 90 minutes

Class Outcomes-

-Students will

Materials List-

The kit to teach this class should include:

-sidewalk chalk

-masking tape

-ping pong balls (about 20)

-SUN Angle Science Kits from KidWind (3 or 4?)

-bowls or cups for water pumping (6- 2 per team)

-scrap cardboard

-clear plastic protractors (one per team)

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Pre-Class Preparation and Set-Up ([time allotment])

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[Side bar is for additional teaching notes.]

Introduction (5 minutes)

Ask the students– Where does earth's energy come from? From the sun! There are many different ways that we can capture and use this energy, and the way that we are going to explore today is through photo voltaic (PV) cells. Who has seen a solar panel before? Solar panels use PV cells to convert the sun's energy into electricity that we can use

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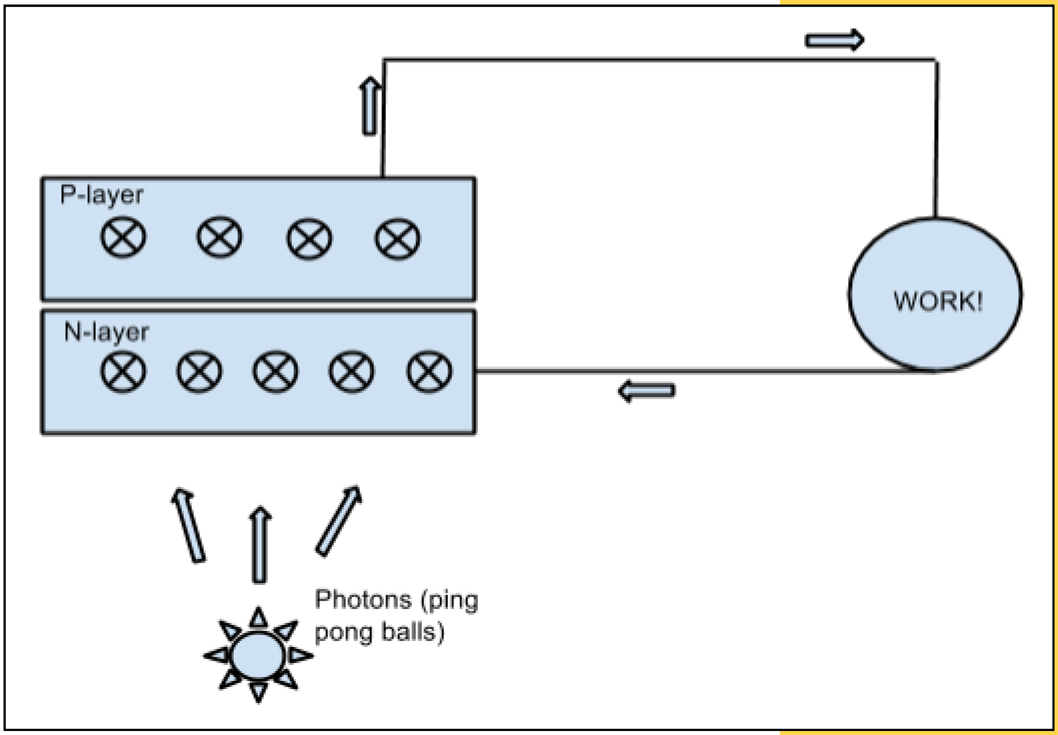
Human Solar Panel (30 minutes)

Before we start using these solar panels, we should try to understand a little bit about how they work.

In this activity, we will create a huge model of a PV cell using our bodies, sidewalk chalk (or masking tape on the floor if playing indoors), and ping pong balls. Using the sidewalk chalk, draw the following playing court:



Have some students stand in the 'p-layer' and some in the 'n-layer'. Both layers are made of silicon, which is a semiconductor (electrons can flow through the material, but not extremely easily. The 'n-layer' of silicon has phosphorus added to it, an element that gives it extra electrons (n for negative charge). The 'p-layer' has some boron added to it, which gives it a tendency to attract electrons (p for positive).

The students are all electrons- there should be more students in the n-layer than in the p-layer to start the activity. Those in the n-layer should be a little squished- they are anxious to get moving! But because silicon is a semiconductor, they can't move yet. They need more energy in order to move. Those in the p-layer should have plenty of space- not super excited... yet.

[Side bar is for additional teaching notes.]

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Human Solar Panel (continued…)

To start the activity, have a student (or you, the teacher) stand and be the sun. The sun throws solar radiation or photons (ping-pong balls) towards the n-layer of the solar panel. Just throw one photon to start. The students (electrons) in the n-layer should try to catch the photon as it is thrown in their direction. If a student catches the photon, it boosts their energy just enough to jump from the n-layer to the p-layer. When they jump to the p-layer, the student will 'bump' one of the existing p-layer electrons. This student then gets bumped out of the p-layer and must travel through the wire back to the n-layer. We have a flow of electrons, which means we have electricity!

Now that we have a circuit, we can add in a load- a motor, a light bulb, a pump, etc.- to get WORK out of the circuit. When the students reach the work circle, they should do some 'work' (a dance, jumping jacks, etc) before moving on down the wire back to the n-layer.

Now that we have our model, we can use it to explore some concepts:

1. We can't catch 100% of the photons that come our way. The same is true with a real solar panel. Some are absorbed (caught) and can be used, but others are reflected (bounced away) just like in our model. Comparing the amount of solar radiation that is available vs. what is actually absorbed allows us to find efficiency. Run the activity again, this time recording how many photons are caught and calculate the efficiency of the model.

2. What would make it harder to catch photons? What if the sun was at a different angle? (Have the sun throw photons from off on the side.) How about if there was something in between the sun and the n-layer? (Have one student be a cloud and try to get in the way of the photons.) Run different experiments to see how these things might affect the efficiency of the model.

[Side bar is for additional teaching notes.]

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PV Experiments (45 minutes)

Divide your students into groups of 3-4 and distribute materials.

[Side bar is for additional teaching notes.]

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Conclusion ([time allotment])

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Clean Up ([time allotment])

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[Side bar is for additional teaching notes.]

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[Class Title]

References-

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