

Going Solar

AIM

This lesson is intended to support ESL and vocational students on Career and Technical Education programs who may wish to find employment opportunities in the growing solar power industry.

The lesson seeks to develop language skills for English language learners specifically with regard to vocabulary and grammatical structure pertaining to the use of solar energy in the green building industry

OBJECTIVES

At the end of this session, students will be able to:

- Differentiate between renewable energy sources and fossil fuels.
- Understand solar energy and how it is created.
- Identify the component parts of a solar panel.
- Assess the role of solar power in the green building industry.

TARGET GROUP

Intermediate to advanced ESL students (levels 6–9)

(For the purpose of this lesson, the target group levels range from 1 through 9, with the following guidelines: 1 = beginning, 5 = intermediate, 8 =advanced.)

NOTE

This lesson was developed for potential candidates of the San Francisco CityBuild program, a job training program underwritten by the Mayor's Office on Workforce and Economic Development. Another program of interest to students, also underwritten by the Mayor's Office, is the Green Launch Pad program at City College of San Francisco.

OVERVIEW

This lesson focuses on energy efficiency, in particular the use of solar energy in the green building industry. Students will learn how solar panels are constructed and installed and how energy from the sun is captured and converted into electricity.

Note: The activities in this lesson can be delivered online except for the crossword, which will need to be printed out. With online delivery, instructions should be explained very clearly.

ACTIVITIES

1. Warm-up

Begin by streaming the following clip about solar power (see "Energy Sources")

<http://www.kqed.org/education/educators/clue-into-climate/renewable-energy.jsp>

After students have watched the video, initiate a group discussion about renewable energy by posing the following questions to the class:

- What is the difference between renewable energy sources such as solar power and fossil fuels such as oil?
- What is solar power?
- What is a solar panel?

2. The solar panel

Stream the video on solar panel installation (03:36), available at <http://www.5min.com/Video/Solar-Panel-Installation-196579477>.

View a slideshow of solar panel installation on the roof at KQED, available at <http://www.kqed.org/assets/slideshow/solarpanelinstall/index.jsp>

Draw a detail of a solar panel on the board with component parts marked from A to F as shown below. Or distribute a worksheet with the solar panel drawing and the following vocabulary list to each student. Ask students to work individually to match up the vocabulary with the correct meaning and then compare their answers with a partner.

Afterward invite a volunteer to come to the front of the class and identify the respective parts of the solar panel on the board.

CityBuild Job Training Program

<http://www.sfcta.org/content/view/281/101/>

Green Launch Pad Program

<http://www.heysf.org/city-college-of-san-francisco-offering-green-job-training-program-2386.html>

LENGTH

90 minutes

MATERIALS

Clue into Climate video clip:

Energy Sources <http://www.kqed.org/education/educators/clue-into-climate/renewable-energy.jsp>

Video of solar panel installation at <http://www.5min.com/Video/Solar-Panel-Installation-196579477>

Slideshow of solar panel installation on the roof at KQED <http://www.kqed.org/assets/slideshow/solarpanelinstall/index.jsp>

QUEST video clip: Solar City:

The Future of Nanosolar <http://www.kqed.org/quest/television/solar-city-the-future-of-nanosolar>

For more detailed information about solar energy, view Solar Energy and Solar Panel Installation, Google Tech Talks, September 12, 2007. <http://video.google.com/videoplay?docid=7759784139556617197>

Handouts **Anatomy of a Solar Panel**

Solar House

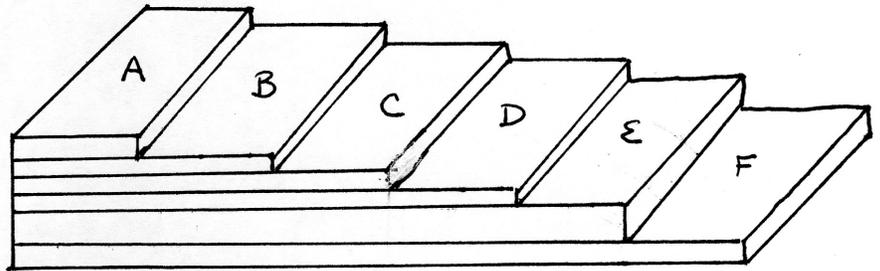
Appendix 1 – Crossword

Appendix 2 – True/False and

Multiple Choice Questions

HANDOUT

Anatomy of a Solar Panel



ANSWERS	
A: Cover glass	C: Contact Grid
B: Anti-reflective Coating	E: P-Type Silicon
D: N-Type Silicon	F: Back Contact

Match the vocabulary words in column A with the definitions in column B.

A. Vocabulary	B. Meaning
1. Anti-reflective coating	a. The last layer of a solar panel
2. Back contact	b. The first layer of a solar panel
3. Contact grid	c. The second layer of a solar panel, which reduces reflection so that less light is lost
4. Cover glass	d. The third layer of a solar panel before the N-type silicon
5. N-type Silicon	e. The last layer of silicon before the back contact
6. P-type silicon	f. The first layer of silicon after the contact grid

3. How solar power is converted into electricity

Stream the clip from *QUEST* “Solar City: The Future of Nanosolar,” which shows how solar power is converted into electricity.

<http://www.kqed.org/quest/television/solar-city-the-future-of-nanosolar>

Write the following vocabulary on the board and ask students to work individually to match the vocabulary with the correct meaning and then compare their answers with a partner.

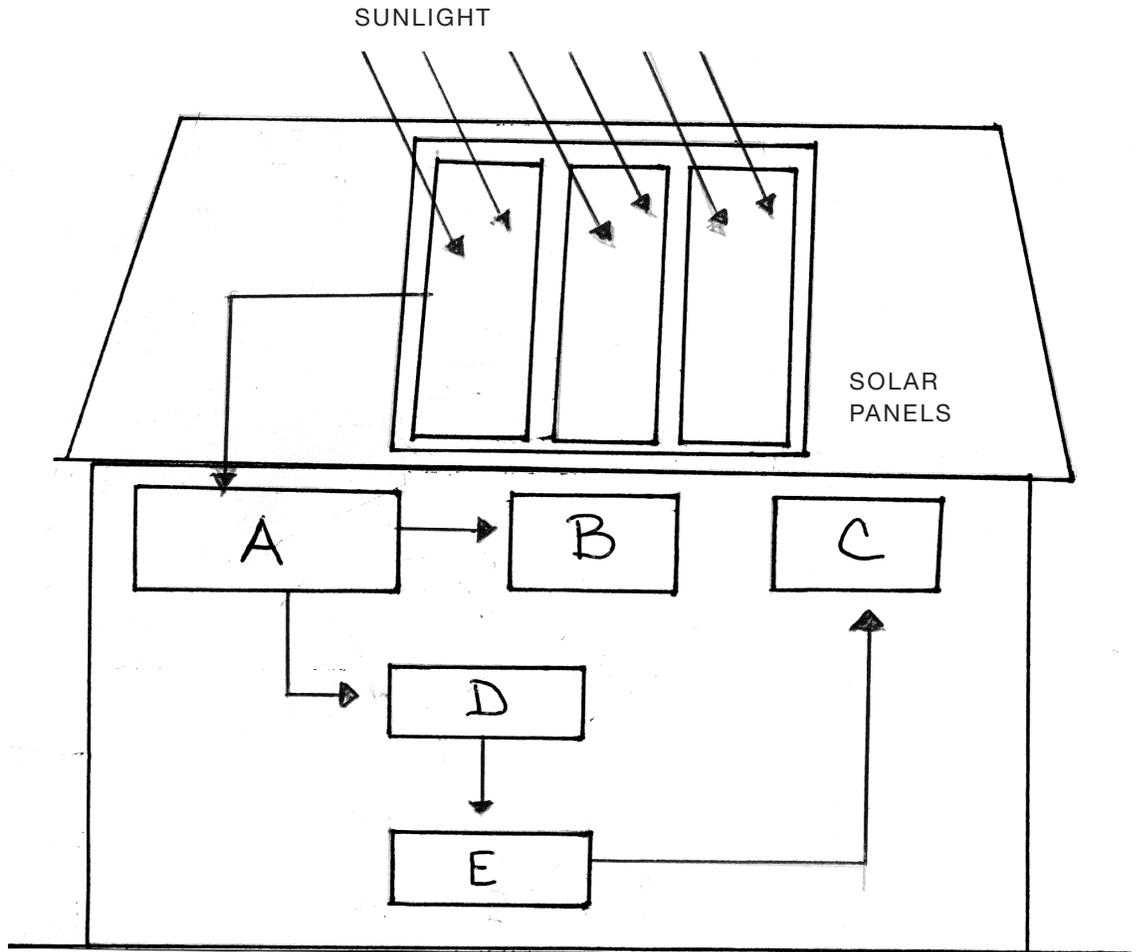
A. Vocabulary	B. Meaning
1. AC power	a. Stores solar energy for use; not used in every system
2. Battery	b. Changes DC power from solar panels to AC power to be used in the home
3. Charge controller	c. Alternating current
4. DC power	d. Takes solar energy into the home
5. Inverter	e. Direct current

Draw a diagram on the board of a house with solar panels on the roof and five empty boxes in their respective positions in the main body of the house (see diagram).

Or hand out the Solar House diagram below and ask students to identify the boxes. Encourage them to compare their answers with a partner and then invite a volunteer to identify the empty boxes on the board and explain how the process works, that is, how sunlight is converted into electricity.

HANDOUT

Solar House



- ANSWERS**
- A: Charge Controller
 - B: DC Power
 - C: AC Power
 - D: Batteries
 - E: Inverter

4. Discussion

Suggest students work in groups of four to discuss the following questions:

- What are the benefits of green building?
- Is the solar power industry likely to grow and have job opportunities in the future? Why or why not?
- What kind of skills will an individual need in order to obtain work in the green building industry?

Invite a representative from each group to present their responses to the class, recording ideas on the board as each group reports back.

5. Crossword puzzle

Conclude the lesson with the crossword puzzle (see Appendix 1). Students may enjoy this as a game to test their knowledge.

6. Assessment/review

To assess or reinforce understanding and recall of vocabulary and concepts covered in this lesson, assign the **True/False** and **Multiple Choice Questions** in Appendix 2.

DEVELOPED BY

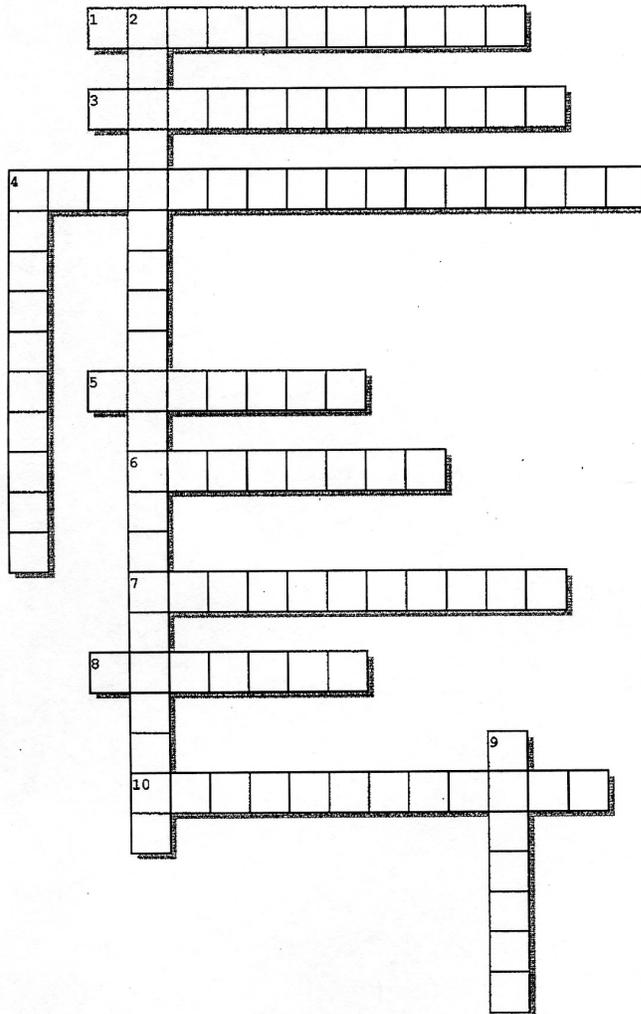
Ken Lee, ESL instructor at City College of San Francisco

APPENDIX 1: BLANK CROSSWORD

Going Solar

Name: _____

Date: _____



ACROSS

- 1. The last layer of a solar panel
- 3. The last layer of silicon before the back contact
- 4. Takes solar energy into the house
- 5. Direct Current
- 6. Changes DC power from solar panels to AC power
- 7. The third layer of a solar panel before the N-type silicon
- 8. Stores solar energy for use
- 10. The first layer of silicon after the contact grid

DOWN

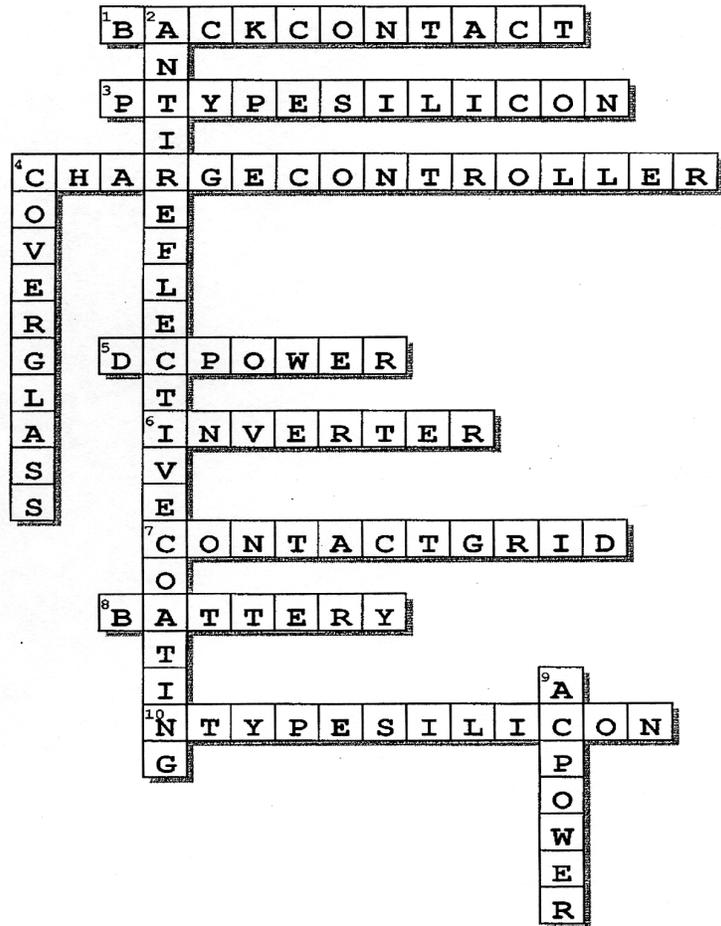
- 2. The second layer of a solar panel; reduces reflection
- 4. The first layer of a solar panel
- 9. Alternating current

CROSSWORD ANSWERS

Going Solar

Name: _____

Date: _____



APPENDIX 2: ASSESSMENT/REVIEW

True / False and Multiple Choice Questions

Answer **TRUE** or **FALSE**

1. The **charge controller** takes energy into the house.
2. **P-type silicon** is the first layer of silicon in a solar cell.
3. An **inverter** changes AC power from solar panels to DC power.
4. The first layer of a solar panel is the **cover glass**.
5. The **battery** is used in every solar system.
6. The second layer of a solar panel is the **anti-reflective coating**.
7. The **N-type silicon** is the second layer of silicon in a solar cell.
8. **AC power** is alternating current.
9. The **contact grid** is the third layer of a solar panel.
10. The **back contact** is the last layer of a solar panel.

Multiple Choice Questions: Choose the correct answer or answers.

1. An **inverter** _____.
 - a. Changes AC power to DC power.
 - b. Changes DC power to AC power.
 - c. Reduces the power going into a home.
2. The **contact grid** _____.
 - a. Is between the anti-reflective coating and the P-type silicon.
 - b. Is between the anti-reflective coating and the N-type silicon.
 - c. Is the third layer of a solar panel.
3. The **charge controller** takes solar energy _____.
 - a. Out of the house.
 - b. Into the house.
 - c. Away from the house.
4. The **battery** _____.
 - a. Is used in every solar energy system.
 - b. Is not used in every solar energy system.
 - c. Stores solar energy for use.
5. The **cover glass** is the _____.
 - a. Last layer of a solar panel.
 - b. Second layer of a solar panel.
 - c. First layer of a solar panel.

6. The ***P-type silicon*** is the _____.
 - a. Third layer of silicon in a solar cell.
 - b. First layer of silicon in a solar cell.
 - c. Second layer of silicon in a solar cell.

7. The ***N-type silicon*** is the _____.
 - a. Third layer of silicon in a solar cell.
 - b. First layer of silicon in a solar cell.
 - c. Second layer of silicon in a solar cell.

8. The ***back contact*** is the _____.
 - a. First layer of a solar panel.
 - b. Second layer of a solar panel.
 - c. Last layer of a solar panel.

9. ***Anti-reflective coating*** _____.
 - a. Reduces reflection so that more light is lost.
 - b. Reduces reflection so that less light is lost.
 - c. Is the second layer of a solar panel.

10. ***DC power*** is _____.
 - a. Direct current.
 - b. Changed by the inverter into AC power.
 - c. Alternating current.

ANSWERS

True / False

1. The **charge controller** takes energy into the house. **T**
2. **P-type silicon** is the first layer of silicon in a solar cell. **F**
3. An **inverter** changes AC power from solar panels to DC power. **F**
4. The first layer of a solar panel is the **cover glass**. **T**
5. The **battery** is used in every solar system. **F**
6. The second layer of a solar panel is the **anti-reflective coating**. **T**
7. The **N-type silicon** is the second layer of silicon in a solar cell. **F**
8. **AC power** is alternating current. **F**
9. The **contact grid** is the third layer of a solar panel. **T**
10. The **back contact** is the last layer of a solar panel. **T**

Multiple Choice

1. An **inverter** _____.
 - a. Changes AC power to DC power.
 - b. Changes DC power to AC power.**
 - c. Reduces the power going into a home.
2. The **contact grid** _____.
 - a. Is between the anti-reflective coating and the P-type silicon.**
 - b. Is between the anti-reflective coating and the N-type silicon.
 - c. Is the third layer of a solar panel.**
3. The **charge controller** takes solar energy _____.
 - a. Out of the house.
 - b. Into the house.**
 - c. Away from the house.
4. The **battery** _____.
 - a. Is used in every solar energy system.
 - b. Is not used in every solar energy system.**
 - c. Stores solar energy for use.**
5. The **cover glass** is the _____.
 - a. Last layer of a solar panel.
 - b. Second layer of a solar panel.
 - c. First layer of a solar panel.**

6. The ***P-type silicon*** is the _____.
 - a. Third layer of silicon in a solar cell.
 - b. First layer of silicon in a solar cell.
 - c. Second layer of silicon in a solar cell.**

7. The ***N-type silicon*** is the _____.
 - a. Third layer of silicon in a solar cell.
 - b. First layer of silicon in a solar cell.**
 - c. Second layer of silicon in a solar cell.

8. The ***back contact*** is the _____.
 - a. First layer of a solar panel.
 - b. Second layer of a solar panel.
 - c. Last layer of a solar panel.**

9. ***Anti-reflective coating*** _____.
 - a. Reduces reflection so that more light is lost.
 - b. Reduces reflection so that less light is lost.**
 - c. Is the second layer of a solar panel.**

10. ***DC power*** is _____.
 - a. Direct current.**
 - b. Changed by the inverter into AC power.**
 - c. Alternating current.

Support for KQED's ESL Green Economy Project was provided by the
Union Bank Foundation