



TOPIC OF STUDY

Solar Installation



KEY TERMS

equipment grounding conductor (EGC)
ground
ground fault protection device (GFPD)
ground fault
grounded
bonding
earthed
grounding electrode conductor (GEC)

LESSON

Grounding

OBJECTIVES

Students will:

- Describe the reasons for grounding
- Identify key components of system grounding
- Compare and contrast bonding and grounding
- Explain how to properly ground a PV system

BIG IDEA(S)

Connecting electrical systems to the earth is an important safety mechanism.

TASK LIST SUBCATEGORY

- 404 Describe relevant codes and requirements for permitting and interconnection
- 702 Recognize and use electrical concepts, terminology, relationships, and formulas
- 704 Describe the elements of an electrical service

OVERVIEW

This session covers grounding in detail. Grounding is important for both design and installation. The *NEC* requires that all exposed or accessible PV equipment and circuits be properly connected to earth (grounded) using specified methods and equipment. As installed PV systems age, grounding issues emerge that impact system safety.

STANDARDS

PA

3.4.10.A1. Illustrate how the development of **technologies** is often driven by profit and an economic market.

3.4.10.E7. Evaluate structure design as related to function, considering such factors as style, convenience, safety, and efficiency.

INSTRUCTIONAL

TEXTS/REFERENCES

Solar Electric Handbook: Photovoltaic Fundamentals and Applications; Solar Energy International; Pearson 2013

MATERIALS NEEDED

Content: Textbook and web sites listed in resources

Technology: Computer with access to YouTube

IMPLEMENTATION (LESSON PLAN)

ENGAGE

1. Using think-pair-share method, ask students to answer the question, “why can a bird sit on a power line and not get an electric shock?”
2. Show video explaining the answer: <https://youtu.be/rtnmCf2QFTc>

EXPLORE

1. Provide teams of students with a variety of electrical components including some metal junction boxes, metal conduit, pvc conduit, copper wire, etc.
2. Ask teams of students to layout the items so that they show a system that is bonded. Teams should raise their hand and show their work to the teacher.
3. Ask teams of students to layout the items so that they show a system that is grounded. Teams should raise their hand and show their work to the teacher.

EXPLAIN

- Have student teams explain their work above and also explain the difference between bonding and ground a system.

EXTEND

1. Provide a basic PV System diagram to each student.
2. Ask students to identify areas of the system which should be bonded and/or grounded.
3. Teacher should review the typical areas in the PV system where this occurs.

EVALUATE

- Create an exit ticket with the following questions:
 - What is grounding and how does it occur?
 - How is the grounding process explained?

RESOURCES/LINKS

Grounding (Physics): How Does it Work and Why is it Important?

<https://sciencing.com/polarization-and-electric-induction-what-is-it-and-how-does-it-work-w-examples-13721176.html>

Grounding - The Removal of a Charge

<https://www.physicsclassroom.com/class/estatics/Lesson-2/Grounding-the-Removal-of-a-Charge>

On the Grounding and Bonding of Solar Photovoltaic Systems

<https://www.iaei.org/page/2021-01-grounding-and-bonding-solar-photovoltaic-systems>

OSHA 10 Ground Fault Protection lesson

https://tools.niehs.nih.gov/wetp/public/Course_download2.cfm?tranid=2495

Photovoltaic System Grounding: Solar America Board for Codes and Standards

http://solarabcs.org/about/publications/reports/systemgrounding/pdfs/SystemGrounding_studyreport.pdf

To Ground or Not to Ground: That is Not the Question

<https://www.solar-electric.com/lib/wind-sun/PV-Ground.pdf>

Why don't birds get electrocuted on power lines?

<https://youtu.be/rtnmCf2QFTc>