

## 12.3: The Tree Projector

Yet another method to project an image of the Sun safely during a solar eclipse. My students were able to observe and photograph the images of the Sun in eclipse using this method during the Great American Eclipse of 2017. Some were even able to use a kitchen colander to project multiple images of the Sun and photograph them!

### Academic Standards

#### Science and Engineering Practices

- Developing and using models.
- Planning and carrying out investigations.
- Analyzing and interpreting data.
- Argument from evidence.

#### Crosscutting Concepts

- Systems and system models.
- Structure and function.

#### Next Generation Science Standards

- Space systems (K-5, 6-8, 9-12).
- Engineering and design (K-5, 6-8, 9-12).
- Waves and electromagnetic radiation (6-8, 9-12).
- The Earth-Moon system (6-8, 9-12).

### For the Educator

#### Facts you need to know

1. NEVER look at the Sun directly!
2. Observing a projected image of the Sun on the sidewalk, this activity is perfectly safe for all ages.
3. We will use the leaves in the trees – and the spaces between the leaves – to project an image of the Sun on paper.
4. The projected solar image will be large enough and bright enough for an entire class to view it at once.

#### Teaching and Pedagogy

This one sounds a bit weird, but it really works! If you have a chance to see an eclipse, find a shady tree. Ideally, there should be some spots of sunlight shining through the tree onto the ground or a nearby wall. These spots of sunlight are actually **projected images of the solar disk!** As the eclipse progresses, you will notice that they are no longer “spots” of sunlight, instead they have become spots with a bite out of them! If the eclipse progresses far enough (more than 50%), you will see hundreds of bright crescents projected on the ground beneath the tree! This makes a beautiful and mysterious photograph if you can manage to capture it!

While in principle, this should also be possible with the Moon when it is lit more than half way, I have not been able to accomplish it. This could be an interesting challenge for your students to try!

#### Student Outcomes

##### What will the student discover?

1. A solar eclipse is a rare and wonderful event that is not to be missed. For many students, this will be a once-in-a-lifetime experience – do not allow them to miss it!
2. The new Moon will at times be perfectly lined up to allow it to pass in front of the disk of the Sun, causing an eclipse.
3. In order to see a **total** eclipse, you must be in **exactly** the right spot! The shadow of the Moon on the Earth’s surface is usually not more than 50 miles wide, and the shadow traces a path across the Earth called the **path of totality**. You must be inside this narrow path to see a total eclipse!
4. Most people will not see a total eclipse, instead we get to see a partial eclipse because we are on one side or the other of the path of totality. This is still a wonderful event and worthy of our observation and study.

### What will your students learn about science?

1. People have been predicting solar eclipses for several thousand years. Scientists and mathematicians today predict these events with marvelous precision.
2. Predictions are still just that – predictions made using a scientific model much as we have been doing throughout this book. Modern predictions of the timing and extent of a solar eclipse are not exact. This is a chance for students to see the precision – and the uncertainty – of modern science in one magnificent activity.

## Conducting the Activity

### Materials

1. You need an eclipse, and a leafy tree.
2. A flat surface for the solar image to fall upon – a sidewalk works very well. If the Sun is low during the eclipse, you may find that the image will be nicely projected on the side of a building such as a house or garage.
3. If you have no convenient flat surface around your tree, a flat piece of cardboard that has been painted white will do. A pizza box of something similar works very well.

## Building the Tree Projector Model

1. This model requires no preparation – you simply use the landscape to your advantage.

### Exploring the Tree Projector Model

1. I know of no other activity that inspires such wonder and amazement in children and adults alike. Watch and photograph the hundreds of solar images during the eclipse as they shimmer on the ground.
2. As the eclipse progresses, the shape of the solar image on the ground will change. First you will see a small ‘bite’ out of the solar disk, then a large section will disappear, finally you will see only a thin crescent – hundreds of them – projected on the ground just before the Sun goes completely dark during totality!

### Discussion Questions

1. How does the tree create these images of the Sun?
  - **Answer** The spaces between the leaves on the tree act just like the small hole in our pinhole camera.
2. Why don’t we see solar images under the trees every day?
  - **Answer:** We do! The ‘dappled sunlight’ under a tree is hundreds of round images of the Sun. We take these round images for granted, not realizing what we see every day. Only during an eclipse, when the shape of the Sun changes dramatically do we see hundreds of crescent suns and stare in wonder!

## Supplemental Materials

### Following Up

Let all your parents know about your Tree Projector project. Encourage the parents from your class, and your students, to take as many photos of these delightful images as they can and post these photos in your class after the eclipse!

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