

Design a Garden with FormIt Lesson Plan

This lesson plan can be used to help students understand how the sun moves in the sky through the year, and why an understanding of the sun's path is important to design. By designing a garden, the students will discuss the importance of solar energy for plants – and, by extension, solar power generation and building design. Students will encounter these topics by quickly creating a 3D model of an area near where they live, simulating shadows, and understanding the impact of solar position in laying-out a garden on the site.

The Plants	How Much Light?		
	Morning	Noon	Evening
• Tomatoes	[Yellow bar]		
• Roses	[Yellow bar]		
• Violets	[Yellow bar]		
• Ferns	[Blue bar]		

Objectives and Goals:

- Students will understand the role of location (latitude, longitude) and the seasons on the Sun's position in the sky, and the resultant shadows cast
- Students will understand the importance of solar radiation in the growth of plants, as well as in electricity generation and for heating of buildings
- Students will be able to have a conversation on topics of sustainable design and energy efficiency, incorporating the above concepts
- Students will be able to use Autodesk FormIt for creating 3D models of buildings and analyzing shadows

Standards Met (Common Core):

- **CCSS.ELA-Literacy.RST.11-12.3:** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
- **CCSS.ELA-Literacy.RST.11-12.7:** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
- **CCSS.ELA-Literacy.RST.11-12.9:** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Materials Required:

- iPads (one per student / group)
- Internet access for iPads [for using the satellite image portion of the lesson]

- Projector [for introductory presentation]

Activity:

Step 1 (Before Class):

Download FormIt to iPads. This should be done in advance of the class you are teaching by at least a day. Also, make sure the iPads are fully charged before using them in class.

Step 2 – Introductory Presentation (5-10 min):

A brief introductory presentation should be made on the goals for the activity (see accompanying PowerPoint presentation). The aim of the presentation is to give students an overview of the project as well as introduce them to the basic modeling methods in FormIt (if you are comfortable using the tool you may choose to teach it without the included video tutorials). It should also motivate students to design a garden for where they live.

You may want to ask students what they know about how the sun's position changes in the sky throughout the year. Ask the students what they know about solar energy and its different forms: direct heating (solar hot water, direct tain) vs. energy generation (PV panels).

Step 3 – Open FormIt and Get Started with (20-30 minutes):

[NOTE: This step requires that you have internet access for your iPad(s).]

Getting comfortable with modeling: It's good to get the students started modeling in FormIt quickly. Each student or group of students will receive an iPad.

The first step is to create a new file and select the area that they want to model using the select location tool. The videos in the accompanying Instructable will help you explain how to create the 3D models in Form IT and visualize shadows in your model. Have the students get comfortable with modeling first, then have them import the satellite underlay and model their house.

- <http://www.instructables.com/id/Design-Your-Garden-for-the-Sun/>
- **Modeling:** http://www.youtube.com/watch?feature=player_embedded&v=N8CqsCPZyOg
- **Shadows:** http://www.youtube.com/watch?feature=player_embedded&v=4GEMVyF82R0

You can play these videos for the class, or do a live demo. If you play the video, you may want to pause it occasionally to give the students time to learn.

Importing satellite imagery: They will import a satellite image of the desired area to model on top of. Using this image they should model all of the buildings (and trees) that could have an impact on their garden by potentially casting shadows on it.

Step 4 – Analyze the Shadows (5-10 minutes):

After they've created their models, give the students time to study the shadows and design their garden.

The PowerPoint includes 4 basic species of plants that they can try to lay-out on the site, and information about the sunlight required for each. This will set some design parameters. The four included species give a good range of options for the students to choose from, but feel free to add others. These should be displayed during the activity for students to reference.

Using the shadow analysis tool students should investigate what they can grow in their gardens. It is important to consider times of year and the effect on the shadows cast. When will they first plant their garden? When will the plants

stop growing? How do the shadows change both throughout the day and throughout the year? (You will cover these questions during the wrap-up discussion)

Step 5 – Finishing Class Discussion (10-20 minutes):

The students will briefly present their models and findings. What would grow best in their garden?

After the quick presentations students should discuss the importance of understanding the Sun's location in the sky – and revisit some of the questions from the opening discussion.

- How is it affected by the seasons? Why?
- What else does this apply to? If you were trying to maximize the amount of sun falling on solar panels how would you do it?
- Given the local climate how would they design a new house to take advantage of the sun / shade?
- What would the shadows do at different latitudes – or on different sides of the equator?

Step 6 – Clean Up (2 minutes):

Students should return their iPads calmly and quietly at the end of class.

Homework and Assessment:

For homework, students should write a one page assessment of the importance of solar position on sustainability. This should reflect the final discussion in class but include research conducted outside of the classroom. They should address both how solar position is important on a large scale designs, and in their own life. For example, why is it easier to collect solar energy near the equator? How does the orientation of their house affect their sleep patterns (e.g. sleeping next to an East facing window might mean they wake up earlier in the summer and later in the winter)? These responses will be graded based on the understanding of the concepts, ability to integrate and evaluate multiple sources of information, and clarity of thought.