ECO-ENGINEERS
Grades 7 - 8

NJCCCS: 5.1, 5.3, 5.4

Field Trip Overview:

This companion to our "Sustainable Living" program challenges older students to contend with some of the complex questions that confront (and confound!) real-world professionals. What building materials are the most sustainable? Should we invest in alternative energies or focus on conservation? Utilizing computer-based resources students will answer these questions and others while designing a model of a sustainable home.

Background Information:

A green building is one that makes use of sustainable development techniques in order to minimize the impact that the building has on the environment. Sustainable development includes using rapidly renewable and recycled materials, using certified wood, utilizing renewable energies (solar power, wind turbines, etc…), conserving power by using proper building and heating and cooling techniques, and conserving water.

With the increase in world population, precious resources that we once took for granted are quickly being depleted or misused. Forests are disappearing and lakes are drying up. If we continue down the path we are making, there will be nothing left to sustain life. With this in mind, we are shifting the way we make buildings and houses so that we can maintain our current quality of life while conserving our natural resources.

Vocabulary:

Embodied energy: the amount of energy required to provide a material, product, or service; this includes acquiring raw materials, production, and delivery to point of use

Non-renewable resource: a resource that cannot replace itself; e.g., petroleum, natural gas

Point of use: the site of development where a material or product will be used or installed

Renewable resource: a natural resource that has the ability to replace itself

Perpetual resource: a natural resource that cannot replace itself but because of natural cycles and forces cannot be diminished and as a result will exist indefinitely; e.g., sunlight, wind, water

Sustainability: the degree to which a material or human practice negatively impacts the environment

Life cycle: the period of time a building is in service before being decommissioned

Lifespan: the period of time an installed building material is expected to last before needing replacement

References / Resources:

- The Center for Green Schools
- NJMC Center for Environmental and Scientific Education
- U.S. Green Building Council

ECO-ENGINEERS

Pre-Trip Activities

Drawing Floor Plans

Note: This lesson is not designed as an introduction to but a review of scale.

Grades: 7/8

Type: Indoor

Setting: School and/or home

Duration: Classroom activity: 1 hour
At-home activity: 45 minutes

Subjects: Math

NJCCCS: 4.MD, 4.G, 5.G, 7.G

Objectives: Students will be able to: 1)determine the scale of a floor plan given the actual dimensions of the rooms shown; 2) determine the appropriate scale for a floor plan of their classroom; 3) demonstrate proficiency in the use of scale by generating a floor plan of their homes

Skills: analysis, calculation, comparison, discussion, drawing, measuring, observation and recording.

Materials

Pencils	
Protractors[1]	One per student pair
Tape measure (12' minimum)[2]	One per student pair
8.5" x 11" graph paper	One sheet per student pair
Masking tape or blue painter's tape	One roll per student pair
Black permanent markers	One per student pair
Sample floor plan	One per student pair
Chalk line[3] 	One per student pair
[1] string and a meter stick can be substituted for a tape measure; students stretch the string to the full dimension being measured and determine the length of the string using the meter stick [2] chalk and a meter stick can be substituted for a chalk line [3] a sheet of paper can be substituted for a protractor to measure 90° angles	

Procedure:

1. Introduction

a. Review with the class what scale is and the various ways it can be represented on a model, map, or architectural drawing (graphically or as a ratio). Explain to the class that they will be developing their ability to produce a floor plan, practicing first with their classroom and later with their homes.

b. Distribute copies of the floor plan provided to student pairs. Instruct the class to determine the scale of the plan by measuring a drawn dimension of a room or area in the house and comparing this to the actual dimension shown in the drawing.

2. Activity: Scale drawing of classroom

a. Explain to the class that they are going to generate a floor plan of their classroom. Instruct them to draw a rough draft of the room on scrap paper without taking any measurements or being concerned with scale.

b. As students complete their rough drawings, they should begin to measure the following aspects of the classroom:

- Length of each wall
- Furniture dimensions:
  - length & width of tables and chairs
  - width & depth of cabinets/countertops and book shelves
  - diameter of round tables
- Width of doors and windows
- Distances between pieces of furniture as well as pieces of furniture and walls or fixtures

Figure 1a.

c. As the above measurements are determined students should record them on lengths of masking tape and affix them directly on the object along the dimensions they apply to (see Figures 1a. and 1b.). This method is designed to allow the class to work more efficiently, reducing the work load for each student group while giving them all the opportunity to contribute to the end result.

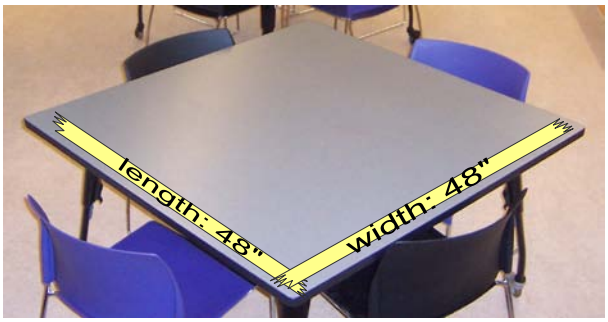

Figure 1b.

d. To determine the spacing between furniture or between a piece of furniture and a fixed object such as a built-in base cabinet, students use a chalk line to draw parallel lines out from both corners on one edge of the piece to the object or fixture each of these lines first comes in contact with (see Figure 2). Students then measure these lines and record their measurements on masking tape placed on the floor next to the chalk lines. To determine the position of a round table, the method is similar. Students first find the center point of the table then measure out from that point to two closest points in the room at 90° from each other (see Figure 3). An oval or similarly shaped table should be positioned in the same manner as a four-sided one. Students first find the center point of the table, and make a note of the table's length and width. These figures are then used to draw a rectangle on the floor with the same length and width as the table. The distances to the nearest objects are then measured and recorded using the method described above.

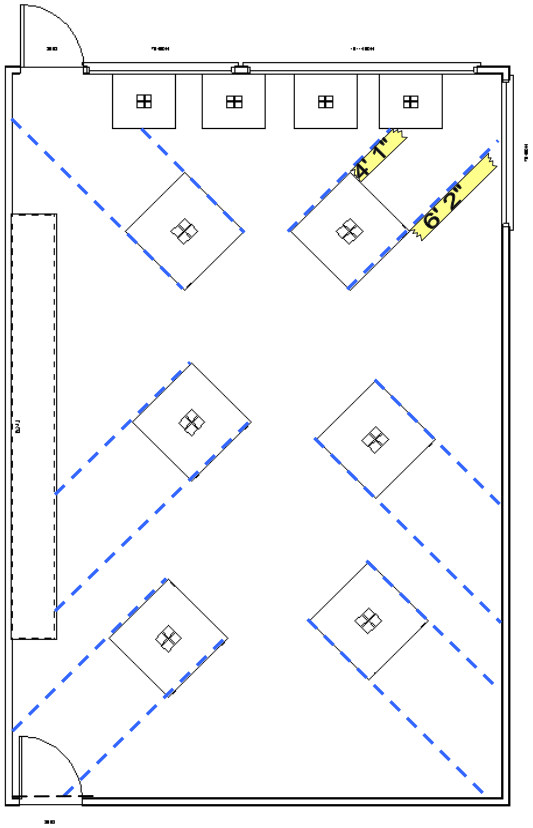

Figure 2

e. Once the students have recorded all the necessary measurements they should begin their scale drawings.

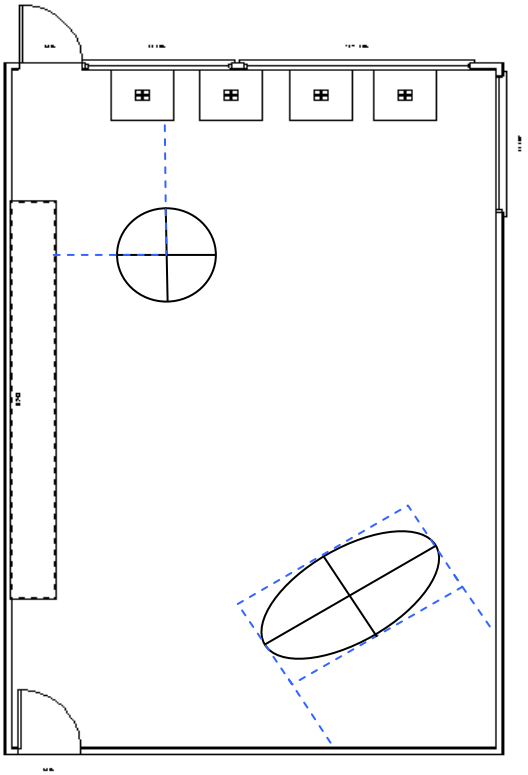

Figure 3

3. Closure

Use the floor plans the students have created to generate discussion about the classroom, addressing some of the following questions:

What furniture arrangement would maximize open floor space?

Are there areas in the classroom that appear cramped in the floor plan? Do these areas feel cramped in practice? How could you rearrange the classroom (including doors and windows) to remedy this?
If you had complete freedom to redesign your classroom, what would you change?

Extension:
Have the students redesign the classroom without changing the footprint. Give them the freedom to make any modifications or additions but stipulate that it must provide adequate seating and table space for the student population that typically utilizes the room.

At-home exercise:
Have the students generate a floor plan of their homes providing them with the following guidelines:

- The floor plan must depict one large room (200-400 ft^2) or more.
- The floor plan must show all furniture and appliances in the room as well as any doors/doorways, windows and closets.
- The rendering must be to scale.