Title: Building from Base Plans	Grade(s): 7th / Math	BIG Idea: Spatial Visualization
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Real-World Connection:

Building plans are often used by architects and engineers as a two-dimensional "map" of a structure showing various views-front, back, right, and left. It can also be used by archeologists attempting to recreate cities from ruins. You can use a video clip from *Lost Worlds* (http://www.history.com/videos/lost-worlds-about-lost-worlds#lost-worlds-about-lost-worlds OR http://www.history.com/videos/lost-worlds-about-lost-worlds#was-atlantis-located-in-ancient-greece) to show applications of how to translate between 2D and 3D objects. Base plans emphasize spatial visualization and scale.

* There is an ad at the beginning of the video you will want to play past; then pause for showing the rest to students*

How Students will Experience the Connection:

      Video Clip   Photo   Podcast

      Print Media (article, ad, etc.)   Vodcast   Other

GPS Standards

M7G2. Students will demonstrate understanding of transformations.
a. Demonstrate understanding of translations, dilations, rotations, reflections, and relate symmetry to appropriate transformations.

M7G3. Students will use the properties of similarity and apply these concepts to geometric figures.
a. Understand the meaning of similarity, visually compare geometric figures for similarity, and describe similarities by listing corresponding parts.

M7G4. Students will further develop their understanding of three-dimensional figures.
b. Sketch, model, and describe cross-sections of cones, cylinders, pyramids, and prisms.

M7P4. Students will make connections among mathematical ideas and to other disciplines.
c. Recognize and apply mathematics in contexts outside of mathematics.

Objectives:

Students will be able to:

1. **Draw a base plan of a cube model**

2. **Reflect both 2-D and 3-D objects using a Mira**

3. **Identify and construct the line of reflection**

4. **Identify the properties of similarity as it applies to views of an object (front/rear and left/right are reflections of each other)**

5. **Construct a 3-D cube model from a set of 2-D base plans**

Materials:
Overhead Projector
Computer to show video and PPT (see attached)
Dot Paper Transparency
Per Person:
2 pgs of 1cm Dot Paper (http://lrt.ednet.ns.ca/PD/BLM/table_of_contents.htm)
Mira reflection tool
Pencils
Per Group (3-4 students):
1 Base Plan lab sheet
1 Reflection lab sheet
25 1-inch snap cubes

Related Task:

Show the video clip about Lost Worlds. The video will give students a clue about the topic of the lesson.

Ask: What do you think we are going to do?
Ans: We are going to build our own lost world using a plan like the ruins in the video.

Part I. Place students into groups of 3-4. To help illustrate that buildings look different from different sides, show the first two slides of Stonehenge. You can also hold up a book to the class and comment on the four different "views": front, back, right and left.
Our ruins will be built out of snap cubes. **Give 10 blocks per group and the base plan lab sheet.**

1. Explain what a base outline is and show the cube model for students to copy. Explain this view is the same as what would be seen from the air when looking down on the ruins.

2. Have students draw the base outline (footprint) of the model on dot paper. They may want to first draw this on their shared lab sheet, then copy onto their own dot paper. Verify understanding that the base outline is 2-D while the model is 3-D by having students share their outlines. Students then compare their outlines to the key shown on the overhead projector. **The model should stay put on the lab sheet.**

3. Explain that a base plan is different from a base outline in that the plan has numbers in each square to show how tall the building is at that spot. Have students label their base outline with the plan numbers shown on the overhead. Students should verify with their group members that everyone has the correct number scheme. **The number scheme should match the overhead. Does everyone's match?**

4. Each student will then be asked to draw the front/back/right/left views of their cube model on the dot paper. Make sure they label the sides with the correct names. Display a model on the overhead projector. Show the slides of the large-sized cube model to help students get an idea of the 3-D to 2-D nature of the task. Students may have trouble seeing the 2-D view of the model. Suggest getting down to "eye level".
    Ask: Compare the four views.   What relationships do you see among them? How are they alike and how are they different?
    Ans: Students should identify that the front/back and right/left are reflections (or mirror images) of each other. **Take up the blocks here.**

5. Have some students share their building plans. Discuss why a set of building plans needs only the base outline and the front and right views (the back and left are reflections of the other views)

Part II. Show the slide with the Lincoln Memorial reflecting pool. We will be using a special tool called a Mira to draw reflections for us. Distribute Miras. Groups will need 10 blocks for step 2 below. * Emphasize the beveled side faces the student and the Mira sits on the line of reflection.*

1. Have students fold their base plan in half "hamburger", then draw an outline of their right hand on the right side of the fold (on the reverse side). Have them place the Mira on the fold line, then try to draw the reflection of their hand on the other side using the Mira. **Verify that students do not trace their left hands but actually draw the reflection.** Students may need assistance with using the Mira for the first time. They can check their accuracy by using their left hand.
2. **Distribute per person: rulers, reflection lab sheets, a 2nd piece of dot paper; per group: 10 cubes. Each group will construct a cube model of this base plan, and then use a Mira to draw the line of reflection, and the front and right views (p.20)** The Stonehenge slides can be shown to give students an idea of how we are going to use our information. Given the base plan they should be able to construct a cube model of our ruins and a set of building plans.
   Ask: Can you build a model of our ancient building from just the base outline like the Stonehenge top view?
   Ans.: You need at least the front and right views to build up from the base outline (or a base plan with the numbers in the blocks).

3. **Students will write the answers to the two questions posed on the reflection lab sheet on the front or back of their dot paper.**
   1. What does it mean for a figure to have *line symmetry*? Give an example. **Ask: Are the reflected views the same distance from the line of reflection? Ans**: Students should observe they are.

Why is it possible to describe a building with a set of only three drawings (the base outline, the front view, and the right view) rather than a set of views showing the base outline and all four side views? **The reflections can give the other views.**

Learn More:

Lappan, Fey, Fitzgerald, Friel, & Phillips (1998). *Ruins of Montarek* from the connected
        mathematics geometry series. East Lansing, MI: Dale Seymour Publications.

Lost Worlds: About Lost Worlds. (2011). *The History Channel website*. Retrieved 9:47, June 29,
2011, from http://www.history.com/videos/lost-worlds-about-lost-worlds.