

# Project Planning Template

## Passive Solar House

<b>COURSE:</b> Energy/Engineering	<b>DURATION:</b> 4 weeks	<b>TEACHER:</b>	
GLOBAL ISSUE OVERVIEW			
<p>Green is more than a color.... Global warming is a trending topic that elicits strong responses. Regardless of one's opinion, the need for reliable energy is undeniable; an increasing world population leads to increasing demand for energy. For many, energy for business use and for personal use is dangerous, unreliable, or financially inaccessible. Additionally, fossil fuels, a common source of energy, are finite, degrade the environment, and the location of key reserves of fuel in politically unstable areas of the world makes reliance on them susceptible to erratic supplies and extreme fluctuations in price. Clean energy in the form of solar or wind represents possible solutions.</p> <p>No matter the climate or geographical region, passive solar houses stay at a comfortable temperature year round with minimal energy inputs. These buildings make efficient use of the sun and heat recovery so that conventional heating systems are unnecessary throughout even the coldest of winters and warmest of summers. A passive solar house requires as little as 10% of the heating and cooling energy used by typical buildings, and the passive solar house concepts can be adapted to any climate. In the face of rapidly increasing energy prices, our ever-increasing carbon footprint, and the forecasted effects of climate change, passive solar house design is an extremely economical and environmentally friendly alternative.</p>			
STANDARDS ADDRESSED			
Career/Technical Knowledge and Skills	Academic Knowledge and Skills	21 <sup>st</sup> Century Skills	
<ol style="list-style-type: none"> <li>Explore the effect of geographic location, climate, and solar orientation on a building's energy use.</li> <li>Become familiar with various elements of a green building (high-performance design).</li> <li>Describe the advantages and limitations</li> </ol>	<p><b>Writing:</b></p> <ul style="list-style-type: none"> <li>W.9-10.3</li> <li>W.11-12.3</li> <li>WHST.9-10.2</li> <li>WHST.11-12.2</li> <li>WHST.9-10.4</li> </ul>	<p><b>Learning and Innovation Skills:</b></p> <ul style="list-style-type: none"> <li>Creativity and Innovation</li> <li>Critical Thinking and Problem Solving</li> <li>Communication and Collaboration</li> </ul>	

<p>of CAD and digital modeling software.</p> <ol style="list-style-type: none"> <li>4. Identify features of CAD and digital modeling software.</li> <li>5. Construct and test day-lighting studies to evaluate effectiveness of passive design strategies.</li> <li>6. Explain the role of digital modeling in the process of creating a building.</li> </ol>	<ul style="list-style-type: none"> <li>• WHST.11-12.4</li> <li>• WHST.9-12.7</li> </ul> <p><b>Speaking:</b></p> <ul style="list-style-type: none"> <li>• SL.9-10.1</li> <li>• SL.9-10.4</li> <li>• SL.9-10.5</li> <li>• SL.9-10.6</li> <li>• SL.11-12.1</li> <li>• SL.11-12.4</li> <li>• SL.11-12.6</li> </ul> <p><b>Technology:</b></p> <ul style="list-style-type: none"> <li>• 8.2.12.C.6</li> <li>• 8.2.12.C.7</li> <li>• 8.2.12.D.1</li> <li>• 8.2.12.D.3</li> </ul> <p><b>Science:</b></p> <ul style="list-style-type: none"> <li>• HS-LS2-7</li> <li>• HS-ESS3-2</li> <li>• HS-ESS3-4</li> <li>• HS-ETS1-1</li> <li>• HS-ETS1-2</li> <li>• HS-ETS1-3</li> </ul>	<p><b>Life and Career Skills:</b></p> <ul style="list-style-type: none"> <li>• Flexibility and Adaptability</li> <li>• Initiative and Self-Direction</li> <li>• Productivity and Accountability</li> <li>• Leadership and Responsibility</li> </ul> <p><b>Architecture and Construction:</b></p> <ul style="list-style-type: none"> <li>• AC.1</li> <li>• AC.2</li> <li>• AC-DES.1</li> <li>• AC-DES.2</li> <li>• AC-DES.3</li> <li>• AC-DES.6</li> <li>• AC-DES.7</li> <li>• AC-DES.8</li> </ul> <p><b>Science, Technology, Engineering, and Mathematics:</b></p> <ul style="list-style-type: none"> <li>• ST.1</li> <li>• ST.4</li> <li>• ST-ET.1</li> <li>• ST-ET.4</li> <li>• ST-ET.5</li> </ul>
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**PROJECT DEFINITION & GOALS/OBJECTIVES**

One of the key factors in sustainable design is sunlight. The way the sun moves across the sky in different geographic locations affects how architects design for each place. People concerned about energy usage can design to take advantage of radiant heat energy in the winter and create shading devices to reduce cooling loads in the summer. Students will comprehend how understanding the sun’s movement can be used to maximize energy efficiency and minimize the negative impact buildings have on the environment.

*Students will ...*

- Explore the effect of geographic location, climate, and solar orientation on a building’s energy use

- Become familiar with various elements of a green building (high-performance design)
- Understand the advantages of creating physical and digital models in the sustainable design process
- Describe the advantages and limitations of CAD and digital modeling software
- Identify features of CAD and digital modeling software
- Construct and test daylighting studies to evaluate effectiveness of passive design strategies
- Identify energy-saving appliances and design features that can be utilized in a home

### SCENARIO OR PROBLEM: What scenario or problem will you use to engage students in this project?

Your extremely wealthy clients, Mr. and Mrs. Grant, are looking into building a single family vacation home in one of the following locations: 1) Guanacaste, Costa Rica, 2) Salzburg, Austria, 3) Reykjavik, Iceland, or 4) Santa Monica, California. They want their home to be as environmentally friendly as possible, and fully embracing “form follows function,” they are much more concerned with the functionality of the home than the architectural features. Therefore, they have decided to come to your civil engineering firm to design their home. They did a great deal of research on their own and are very interested in having a passive solar home built to increase their overall energy efficiency. They are also interested in having alternative energy sources power the home, if possible. As they understand that the energy efficiency of this home will save them a great deal of money in the long run, money is no object for this project. The Grants have a great deal of interest in innovations in materials, energy alternatives, efficiency, and consumption, so money is no object in the pursuit of minimal maintenance and operating cost, which they anticipate recouping over time.

Their wishes for their home include the following:

- 2 bedrooms with closets
- 2 bathrooms
- Kitchen
- Dining area
- Living room
- Laundry room
- Large porch
- Open floor plan
- Energy efficient design
- Ample daylighting
- Rainwater collection site

You must consider all of the following when designing this home:

- Solar geography of location throughout the year
- Average temperatures of location throughout the year
- Building layout

- Window orientation
- Insulation
- Materials
- Thermal mass
- Shading
- Ventilation
- Daylighting
- Alternative energy sources and locations

Your task:

- Choose location.
- Research solar geography, yearly temperatures, passive solar design considerations, and alternative energy sources (journal).
- Design and hand sketch passive solar home (include all measurements), based on location chosen and client requests (journal).
- Create 3D rendering of home.
- Create 3D model of home (assume  $\frac{1}{4}'' = 1'$ ).
- Present home design.

### Essential Questions

- What's the impact of solar energy?
- How do climate and solar orientation affect energy use?
- How are "green" building practices an effective approach to construction projects globally.

### Grade Level Adaptations

Size and scope of project can be modified to suit various grade levels.

**ASSESSMENT: How will you determine what students have learned? (Check all that apply)**

FORMATIVE		SUMMATIVE	
Quizzes/Tests		Multiple Choice/Short Answer Test	
Notes/Graphic Representations	X	Essay Test	
Rough Draft		Written Product with Rubric	
Practice Presentation		Oral Presentation with Rubric	X
Preliminary Plans/Goals/Checklists of Progress	X	Other Product or Performance with Rubric	
Journal/Learning Log	X	Self-Evaluation or Reflection	X
Other:		Evaluation by Authentic Audience	
		Other: 3D model	X

**MATERIALS, RESOURCES, or CONSTRAINTS: What materials and resources will be needed? Are there any perceived challenges?**

**Materials:**

- Computer access
- CAD software or Google SketchUp
- Internet access
- Glue
- Foam board or cardboard
- Scissors or box cutters
- Decorative items for models (fake grass, stones, paper, solar panels, etc.)

**Resources:**

U.S. Department of Energy, Passive Solar Design: [http://apps1.eere.energy.gov/buildings/publications/pdfs/building\\_america/29236.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/29236.pdf)

Affordable Passive Solar Planbook for North Carolina: <http://energy.appstate.edu/sites/energy.appstate.edu/files/APSplanbook.pdf>

Student-Project-Plan-Reviewing – Individual Reflection Questions from Project Management Toolkit for Teachers found at <http://pmief.org/learning-resources/learning-resources-library/project-management-toolkit-for-teachers?tab=Toolkit%20Materials>

**SUPPORT, MODIFICATIONS, AND EXTENSIONS: What is needed to provide support for students who have difficulty learning the content, modify for students with special learning needs, or to provide enrichment for advanced students?**

Size and scope of project can be modified to suit individual accommodations.

**CALENDAR OF MAJOR LEARNING ACTIVITIES—What are the learning activities or tasks for each day? Are there any project milestones? When will formal assessment activities occur?**

Week 1				
Monday	Tuesday	Wednesday	Thursday	Friday
Choose location. Research solar geography, temperatures, passive solar design considerations, and alternative energy sources. Journal thoughts/ideas.	Research solar geography, temperatures, passive solar design considerations, and alternative energy sources. Journal thoughts/ideas.	Research solar geography, temperatures, passive solar design considerations, and alternative energy sources. Journal thoughts/ideas. Begin design sketch of layout in journal.	Continue working on design sketch of layout in journal.	Continue working on design sketch of layout in journal. Submit research and design sketch for feedback.
Week 2				
Alter sketch based on feedback. Begin designing 3D rendering with CAD software or Google SketchUp.	Design 3D rendering with CAD software or Google SketchUp.	Design 3D rendering with CAD software or Google SketchUp.	Design 3D rendering with CAD software or Google SketchUp. Submit design for feedback.	Alter design based on feedback. Begin creating 3D model.
Week 3				
Continue working on 3D model.	Continue working on 3D model.	Continue working on 3D model.	Continue working on 3D model.	Continue working on 3D model. Submit for feedback.

Week 4				
Alter 3D model based on feedback. Begin working on presentation.	Continue working on presentation.	Formal assessment of project via presentations.	Formal assessment of project via presentations.	Formal assessment of project via presentations. Self-reflection – using PMI Individual Reflection Questions.
<b>STUDENT REFLECTION ACTIVITIES</b> —How will students reflect on their work? Add reflection questions and/or activities here.				
<p>Self-reflection – using PMI Individual Reflection Questions.</p> <p>Individual Reflection Questions from Project Management Toolkit for Teachers found at <a href="http://pmief.org/learning-resources/learning-resources-library/project-management-toolkit-for-teachers?tab=Toolkit%20Materials">http://pmief.org/learning-resources/learning-resources-library/project-management-toolkit-for-teachers?tab=Toolkit%20Materials</a></p>				

Adapted from: Southern Regional Education Board, Unit Planning Template, 592 10th St. N.W., Atlanta, GA 30318-5776