

Florida Department of Education

COURSE DESCRIPTION – GRADE 10 – 12, ADULT

Subject Area:	Science
Course Number:	2002550
Course Title:	Solar Energy and Other Alternative Resources II
Credit:	1.0

Will meet graduation requirements for Science

- A. Major Concepts/Content.** This is the second in a two- level course series of an integrated Honor elective curriculum. Solar II is a student-centered curriculum. Students are expected to pursue in-depth investigations, comprehensive research, systematic analysis, and explore and use various applications of solar heat, solar photovoltaic, solar thermal, solar photochemical detoxification of water, and alternative fuels for transportation. They identify important factors that foster energy for sustainability. All concepts and their applications are addressed through exploratory investigations; short and long-term research projects, debate, forum, conferences, and designing and constructing solar products.

The content should include, but not limited to, the following:

- Unifying concepts, skills, attitude, application, and context of solar energy and other renewable resources
- Comprehensive understanding and application of Solar heat technologies
- Comprehensive understanding and application of Solar electricity (photovoltaic and solar thermal) technologies
- Solar photochemical detoxification of water, concepts, available technologies and applications
- Alternative fuels technologies and applications for transportation
- Solar energy and alternative resources, technology, society, and the environment: global energy-related issues and concerns
- Entropy in the world, efficiency, conservation, and energy for sustainability

This “Solar Energy and Alternative Resources II” course shall integrate the Goal 3 Study Performance of the Florida System of School Improvement and Accountability as appropriate to the content and processes of the curriculum.

- B. Special note.** This course shall include research, laboratory, and product design and construction, which incorporate the use of measurements, problem solving, laboratory apparatus, safety procedures and experimental procedures.
- C. Course requirements.** The requirements include, but not limited to, the benchmarks from the Sunshine States Standards that are most relevant to this course. Solar II requires passing solar I with at least 3.0 GPA

After successfully completing this course, the student will:

1. Demonstrate understanding and apply science processes and inquiry skills to design and conduct appropriate investigations and experiments pertaining to solar energy and other renewable resources. Students will collect, analyze, and interpret data, form conclusion, and communicate their finding.

- SC.H.1.4.1 know that investigations are conducted to explore phenomena, to check on previous results, to test how well a theory predicts, and to compare different theories (e.g., a) investigate and assess energy consumption at home and/or at school over a long period of time. Analyze data and compare it to other homes and schools. Identify specific ways to conserve energy in the places studied; b) check the design of several models of solar cookers. Test, analyze, and compare their efficiencies. Choose the one model that proved to have the best performance; construct the model and conduct an experiment to test its efficiency; analyze and compare the data collected with published experimental results).
- SC.H.1.4.2 know that from time to time, major shifts occur in the scientific view of how the world works, but that more often, the change that takes place in the body of scientific knowledge are small modifications of prior knowledge (e.g., investigate the history of using alternative energy resources. Discuss how the political, economical, and environmental conditions caused the success or the decline of their use).
- SC.H.1.4.5 understand that new ideas are limited by the context in which they are conceived, are often rejected by the scientific establishment, sometimes spring from an unexpected findings, and usually grow slowly from many contributors (e.g., a) investigate the history of using hydrogen as a fuel. Identify the misconception and the scientific facts about this fuel and its potential to becoming one of the major alternative resources in the future; b) explore photovoltaic technology and find out how and why it did evolve in the last fifty years).
- SC.H.2.4.1 know that scientists assume that the universe is a vast system in which basic rules exist that may range from very simple to extremely complex but that scientists operate on the belief that the rules can be discovered by careful, systemic study (e.g., identify the basic concepts and principles that are common between a simple parabolic solar cooker and a central receiver solar thermal plant).
- SC.H.3.4.2 know that technological problems often create a demand for new scientific knowledge and that new technologies make it possible for scientists to extend their research in a way that advances science (e.g. investigate the energy-related technological and environmental problems and how they are pressing the scientific community to further advance the research and development of new and cleaner alternative resources).
- SC.H.3.4.5 know that the value of a technology may differ for different people and at different times (e.g. investigate the success and the decline of the solar water heating technology during the first few decades of the 20th

century as related to the availability of fossil fuels. Compare the situation then to that of the beginning of the 21st century).

2. Apply knowledge and concepts related to solar energy and other renewable resources technologies.

SC.B.1.4.1 understand how knowledge of energy is fundamental to all scientific disciplines (e.g. a) identify all the energy resources that are produced directly or indirectly from the sun. Compare their efficiencies, advantages and disadvantages, and distinguish one source that you think it has the most potential to replace the conventional fuels. Explain why and how this could be possible; b) analyze the amount of energy consumed for heating and cooling in the U.S., and describe how a passive solar design of a house or a building could greatly reduce the energy consumption and the burning of fossil fuels).

SC.B.1.4.3 know that temperature is a measure of the average translational kinetic energy of motion of the molecules in an object (e.g., a) design and conduct an experiment to test the effect of various commercial insulating materials on the retention of heat in an object; b) calculate the efficiency of a solar heat collector and determine its specific heat; c) distinguish between a passive and active solar water heater, conduct a comparative study of the performance of both systems; d) assess and calculate the energy used for heating and cooling at home. Identify ways to reduce the amount of this energy by applying conservation measures).

SC.B.1.4.5 know that each source of energy presents advantages and disadvantages to its use in society (e.g., a) conduct a comparative study between the major energy resources. Identify the major advantages and disadvantages for each resource. Communicate your finding to your classmates through a PowerPoint presentation; b) design and conduct an experiment to test solar heat absorbency and solar heat storage using different materials).

SC.B.2.4.1 Know that the structure of the universe is the result of interactions involving fundamental particles (matter) and basic forces (energy) and that evidence suggests that the universe contains all of the matter and energy that ever existed (e.g., a) calculate the amount of matter and the amount of energy released from a nuclear explosion of a known mass or a known energy released; b) design and conduct an experiment to measure the total mass and energy before and after burning a piece of charcoal in a closed container. Explain how the total matter and energy is the same in the universe).

3. Demonstrate understanding of the principles of photovoltaic technology and its development and apply the learning in various solar projects and products; describe and explain the principles of solar thermal electricity and its applications.

SC.A.2.4.6 Understand that matter act as a wave, a particle, or something else entirely different with its own characteristic behavior (e.g., explain and

- demonstrate how a photovoltaic cell work using a semiconductor (silicon), and how photons move the electrons to produce an electric current).
- SC.C.2.4.2 know that electrical forces exist between any two charged objects (e.g., after assessing your energy consumption at home, determine the approximate percentage of energy you could save by applying energy conservation methods. Determine the approximate size and price of a photovoltaic system you could install to satisfy your household energy needs).
- SC.C.2.4.3 describe how magnetic force and electrical force are two aspects of a single force (e.g., a) design an experiment to test the change in the voltage, current, and power output of solar cells when they are connected in series or in parallel; b) design an experiment to test the effect of shade on the power output of a solar module. c) Design an experiment to test the optimum tilt angle that generate maximum power from a solar module).
- SC.B.1.4.4 know that as electrical charges oscillate, they create time-varying electric and magnetic fields that propagate away from the source as an electromagnetic wave (e.g., conduct a research to find out about the average amount of energy consumed in an amusement park. Design and construct a model to scale of a solar amusement park- a class projects).
- SC.C.2.4.2 know that electrical forces exist between any two charged objects (e.g., design and conduct an experiment to harness hydrogen using solar electrolysis of water. Calculate the efficiency of the system. Determine how the efficiency of the system would change by increasing the voltage or the current).
- SC.H.3.4.4 know that funds for science research come from federal government agencies, industry, and private foundations and that this funding often influences the area of discovery (e.g., conduct a longitudinal study (10 years) to check the total federal budget toward funding energy research and development. Analyze and compare the percentage of the budget allocated for each energy resources such as oil, natural gas, nuclear, hydropower, wind, solar and others.)

4. Gain knowledge and demonstrate understanding of photochemistry and the solar photochemical technology applications to reduce environmental pollution.

- SC.A.1.4.1 know that the electron configuration in atoms determines how a substance reacts and how much energy is involved in the reaction (e.g., explain the process of photolysis and how light is absorbed by certain chemicals. Describe how the photons absorbed raise the total energy of atoms or molecules. The electrochemically excited state of molecules generates reactive radicals that break down pollutants into harmless end-products).
- SC.A.1.4.4 experiment and determine that the rate of reaction among atoms and molecules depend on the concentration, pressure, and temperature of the reactants and the presence or absence of catalysts (e.g., conduct an experiment to compare the effect of UV radiation, solar radiation, and temperature on the detoxification of contaminated water in presence or absence of titanium dioxide or other metal oxides).
- SC.A.2.4.6 understand that matter may act as wave, a particle, or something else entirely different with its own characteristic behavior (e.g. design and conduct an experiment to demonstrate the process of photocatalysis in purifying and disinfecting air and water).
- SC.G.2.4.2 know that changes in a component of an ecosystem will have an unpredictable effects on the entire system but that the components of

the system tend to react in a way that will restore the ecosystem to its original condition (e.g., a) explain how photochemistry is used by nature in many self-repair light driven processes in the atmosphere and in water; b) discuss the causes of major water and air pollution and explain how the increasing release of greenhouse gases, the deforestation, and the CFC's depleting the ozone layer are too much to be handled by the earth systems in short time. Ecosystem restoration is a slow and long process).

5. Gain knowledge and demonstrate understanding of the major pollution caused by the fossil- fuels based transportation systems. Investigate and explain the various alternative fuels for transportation technologies.

- SC.H.3.4.1 know that performance testing is often conducted using small-scale models, computer simulations, or analogous systems to reduce the chance of system failure (e.g., a) design and construct a model to scale of an electric vehicle. Explain how it works, b) design and construct a model of a solar boat).
- SC.B.1.4.5 know that each source of energy presents advantages and disadvantages to its use in society (e.g., a) conduct a research to determine what are the major causes for air pollution. What are some effective ways to reduce air pollution? b) discuss how political, economic, and environmental implications may determine a society's selection of alternative and cleaner fuels).
- SC.C.2.4.6 explain that all forces come in pairs commonly called action and reaction (e.g., design and construct an electric vehicle to be entered in an electrathon. Test the distribution of weight and its effect on the performance and the speed of the car).
- SC.C.1.4.1 know that all motion is relative to whatever frame of reference is chosen and that there is no absolute frame of reference from which to observe motion (e.g., design and construct a magnetic circular track and train that work on levitation and an electric circular track and train of the same mass. Test and compare their speed, frequencies, and acceleration. Write a comprehensive report about your testing of the two train systems).
- SC.C.1.4.2 Know that any change in velocity is acceleration (e.g., design and construct model solar car, test its acceleration and velocity on a circular car track. Compare your design to that of your classmates and identify the factors that caused the difference in the performance of the tested cars).

6. Demonstrate understanding of the intimate relationship between energy, technology, society, and the environment. Investigate, analyze, and discuss energy-related issues

- SC.G.2.4.4 know that the world ecosystems are shaped by physical factors that limit their productivity (e.g., conduct a research to explore the effect of energy consumption on habitat destruction that threatens the balance of the food web and endangers wildlife).
- SC.G.2.4.5 understand that the amount of life any environment can support is limited and that human activities can change the flow of energy and reduce the fertility of the Earth (e.g., analyze population growth and the thriving fossil-fuel based technologies and relate them to the habitat destruction and limitation of resources).
- SC.D.1.4.3 know that changes in Earth's climate, geological activity, and life forms may be traced and compared (e.g., conduct

research on the recommendations of the last meeting of the Inter-governmental Panel on Climate Change (IPCC). Compare and analyze the decisions of the various developed countries on reducing greenhouse gases emissions. Describe and explain the position of the US towards the reduction of carbon dioxide emissions).

- SC.H.3.4.3 know that scientists can bring information, insights, and analytical skills to matters of public concern and help people understand the possible causes and effects of events (e.g., design, construct, and maintain a web site to describe, communicate, and share the solar energy program and its various activities. The web page will be available to other students and other schools, locally, nationally, and internationally).
- SC.H.3.4.6 know that scientific knowledge is used by those who engage in design and technology to solve practical problems, taking human values and limitations into account (e.g., investigate the use of energy in developing countries, analyze the possibilities to implement solar technologies and other alternative resources in these countries. Calculate the approximate amount of carbon dioxide and other greenhouse gases that won't be released in the environment as result of applying clean technologies).

7. Demonstrate a comprehensive understanding of sustainability. Investigate and analyze the exponential need for energy. Identify various clean energy resources that could insure sustainable development and sustainable future.

- SC.H.1.4.7 understand the importance of a sense of responsibility, a commitment to peer review, truthful reporting of the methods and outcomes of investigations, and making the public aware of the findings (e.g., conduct research to investigate various scientific issues related to energy consumption. Identify the various implications on the environment, economy, politics, and society. Organize and conduct a forum to discuss the various topics studied with community leaders and other students).
- SC.G.2.4.6 know the ways in which humans today are placing their environmental support at risk (e.g., conduct a research to assess the level of pollutants released as result of heavy reliance on fossil fuels combustion; investigate energy consumption by source in the world and compare it to that of the U.S. Compare the emissions of greenhouse gases among the developed countries emission and analyze your findings. Propose some ways to reduce harmful emissions without harming the economy or changing the life style).
- SC.B.1.4.2 understand that there is conservation of mass and energy when matter is transformed (e.g., investigate the concept of entropy in the world. Prepare for a debate to discuss if entropy is a natural phenomenon or it is primarily caused by the exponential increase of human activities).
- SC.H.3.4.2 know that technological problems often create a demand for new scientific knowledge and that new technologies make it possible for scientists to extend their research in a way that advances science (e.g. conduct a study to investigate the energy crisis throughout the world and in the US. Give concrete examples to describe how this crisis accelerated the development of new alternative energy resources and new infrastructures).

SC.H.1.4.7 understand the importance of a sense of responsibility, a commitment to peer review, truthful reporting of the methods and outcomes of investigations, and making the public aware of the findings (e.g., a) prepare lesson plan to teach elementary students how to harness solar heat to cook or distill water. In your plan, include the objectives, activities, materials, and a form of assessment;
b) prepare a lesson plan to teach middle school students how a solar cell works. In your plan, include objectives, activities, materials, and some form of assessment).