Environmental Physics Standards

The Georgia Performance Standards are designed to provide students with the knowledge and skills for proficiency in science. The Project 2061's *Benchmarks for Science Literacy* is used as the core of the curriculum to determine appropriate content and process skills for students. The GPS is also aligned to the National Research Council's *National Science Education Standards.* Technology is infused into the curriculum. The relationship between science, our environment, and our everyday world is crucial to each student's success and should be emphasized.

The performance standards should drive instruction. Hands-on, student-centered, and inquiry-based approaches should be the emphases of instruction. This curriculum is intended as a required curriculum that would show proficiency in science, and instruction should extend beyond the curriculum to meet the student needs.

The hands-on nature of the science curriculum standards increases the need for teachers to use appropriate precautions in the laboratory and field. The guidelines for the safe use, storage, and disposal of chemicals must be observed. Safety of the student should always be foremost in science instruction.

Science consists of a way of thinking and investigating, and includes a growing body of knowledge about the natural world. To become literate in science, therefore, students need to acquire understandings of both the **Characteristics of Science** and its **Content.** The Georgia Performance Standards for Science require that instruction be organized so that these are treated together. Therefore, **A CONTENT STANDARD IS NOT MET UNLESS APPLICABLE CHARACTERISTICS OF SCIENCE ARE ALSO ADDRESSED AT THE SAME TIME.** For this reason they are presented as co-requisites.

This Performance Standards include four major components. They are

The Standards for Georgia Science Courses. The Characteristics of Science co-requisite standards are listed first followed by the Content co-requisite standards. Each Standard is followed by elements that indicate the specific learning goals associated with it.

Tasks that students should be able to perform during or by the end of the course. These tasks are keyed to the relevant Standards. Some of these can serve as activities that will help students achieve the learning goals of the Standard while others can be used to assess student learning. Many of these tasks can serve both purposes.

Samples of student work. As a way of indicating what it takes to meet a Standard, examples of successful student work are provided. Many of these illustrate how student work can bridge the Content and Characteristics of Science Standards. The Georgia DOE Standards web site will continue to add samples as they are identified and teachers are encouraged to submit examples from their own classroom experiences.

Teacher Commentary. Teacher commentary is meant to open the pathways of communication between students and the classroom teacher. Showing students why they did or did not meet a standard enables them to take ownership of their own learning.

Georgia Performance Science Standards-- Explanation of Coding

Characteristics of Science Standards

SKCS1
Science **K**indergarten **C**haracteristics of **S**cience Standard #**1**

S8CS2
Science Grade **8** **C**haracteristics of **S**cience Standard #**2**

SCSh8
Science **C**haracteristics of **S**cience **h**igh school Standard #**8**

Content Standards

S5P3
Science Grade **5 Physical** Science Standard #**3**

S4E2
Science Grade **4** **E**arth Science Standard #**2**

S7L4
Science Grade **7** **L**ife Science Standard #**4**

SC1
Science **C**hemistry Standard #**1**

SB4
Science **B**iology Standard #**4**

SPS6
Science **P**hysical **S**cience Standard #**6**

SP3
Science **P**hysics Standard #**3**

SEVP2
Science **E**nvironmental **P**hysics Standard #**2**

Environmental Physics

The Environmental Physics curriculum is designed to extend student investigations that began in grades K-8. This curriculum is extensively performance, lab based. The course will examine the physics behind contemporary environmental problems. Students will explore global warming, the problem of ozone depletion in the stratosphere, alternative energy sources, and environmental issues associated with nuclear power. Students will apply physical and mathematical principles to environmental problems. It would be appropriate to utilize resources on the Internet for global data sets and interactive models.

The prerequisite for this course is completion of AP Physics.

Major Concepts	Skills
Law of Conservation of Energy	Records investigations clearly and accurately
Work Energy Theorem	Uses scientific tools
Energy flow in Ecological Processes	Organizes data, interprets graphs, tables, and charts
Nature of light and the Electromagnetic Spectrum	Writes clear reports
Reflection, refraction, and diffraction of waves	Uses proper units
Electromagnetic radiation	Analyzes scientific data via calculations and inference
Composition, structure, and dynamics of the Earth's atmosphere	Uses appropriate models
Greenhouse Effect	Asks quality questions
Interrelationship between human activities and Earth's atmosphere, biosphere, and lithosphere	Uses technology
Global warming	Follows safety techniques
	Recognizes the importance of explaining data with precision and accuracy

Co-Requisite – Characteristics of Science

Habits of Mind

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

a. Exhibit the above traits in their own scientific activities.
b. Recognize that different explanations often can be given for the same evidence.
c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

a. Follow correct procedures for use of scientific apparatus.
b. Demonstrate appropriate technique in all laboratory situations.
c. Follow correct protocol for identifying and reporting safety problems and violations.

SCSh3. Students will identify and investigate problems scientifically.

a. Suggest reasonable hypotheses for identified problems.
b. Develop procedures for solving scientific problems.
c. Collect, organize and record appropriate data.
d. Graphically compare and analyze data points and/or summary statistics.
e. Develop reasonable conclusions based on data collected.
f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

a. Develop and use systematic procedures for recording and organizing information.
b. Use technology to produce tables and graphs.
c. Use technology to develop, test, and revise experimental or mathematical models.

SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

a. Trace the source on any large disparity between estimated and calculated answers to problems.
b. Consider possible effects of measurement errors on calculations.
c. Recognize the relationship between accuracy and precision.
d. Express appropriate numbers of significant figures for calculated data, using scientific notation where appropriate.
e. Solve scientific problems by substituting quantitative values, using dimensional analysis and/or simple algebraic formulas as appropriate.

SCSh6. Students will communicate scientific investigations and information clearly.

a. Write clear, coherent laboratory reports related to scientific investigations.
b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data.
c. Use data as evidence to support scientific arguments and claims in written or oral presentations.
d. Participate in group discussions of scientific investigations and current scientific issues.

The Nature of Science

SCSh7. Students analyze how scientific knowledge is developed.

Students recognize that:

a. The universe is a vast single system in which the basic principles are the same everywhere.
b. Universalprinciplesarediscoveredthroughobservationandexperimental verification.
c. From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Major shifts in scientific views typically occur after the observation of a new phenomenon or an insightful interpretation of existing data by an individual or research group.
d. Hypotheses often cause scientists to develop new experiments that produce additional data.
e. Testing, revising, and occasionally rejecting new and old theories never ends.

SCSh8. Students will understand important features of the process of scientific inquiry.
Students will apply the following to inquiry learning practices:

a. Scientific investigators control the conditions of their experiments in order to produce valuable data.
b. Scientific researchers are expected to critically assess the quality of data including possible sources of bias in their investigations' hypotheses, observations, data analyses, and interpretations.
c. Scientists use practices such as peer review and publication to reinforce the integrity of scientific activity and reporting.
d. The merit of a new theory is judged by how well scientific data are explained by the new theory.
e. The ultimate goal of science is to develop an understanding of the natural universe which is free of biases.
f. Science disciplines and traditions differ from one another in what is studied, techniques used, and outcomes sought.

COMMON CORE LITERACY STANDARDS FOR READING IN SCIENCE -GRADE 11-12

Key Ideas and Details

L11-12RST1. Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
L11-12RST2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
L11-12RST3. 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.

Craft and Structure

L11-12RST4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
L11-12RST5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
L11-12RST6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

Integration of Knowledge and Ideas

L11-12RST7. 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.
L11-12RST8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
L11-12RST9. 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.

Range of Reading and Level of Text Complexity

L11-12RST10. By the end of grade 12, read and comprehend science/technical texts in the grades 11-12 text complexity band independently and proficiently.

COMMON CORE LITERACY STANDARDS FOR WRITING IN SCIENCE -GRADE 11-12

Text Types and Purposes

L11-12WHST1. Write arguments focused on discipline-specific content.

a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
e. Provide a concluding statement or section that follows from or supports the argument presented.

L11-12WHST2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).

Production and Distribution of Writing

L11-12WHST4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

L11-12WHST5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

L11-12WHST6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Research to Build and Present Knowledge

L11-12WHST7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

L11-12WHST8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

L11-12WHST9. Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

L11-12WHST1. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Co-requisite - Content Standards

SEVP1. Students will investigate current energy resources, the conversion of energy in ecological processes, the utilization of energy, and the environmental consequences of energy use.

a. Apply the Law of Conservation of Energy and Work-Energy Theorem to explain the flow of energy in ecological processes.
b. Apply the laws of thermodynamics to the human environment.
c. Explain the relationship between matter and energy.
d. Differentiate between renewable and nonrenewable resources including how different resources are produced, rates of use, renewal rates, and limitations of sources.
e. Describe the basic physics underpinning wind, hydroelectric and solar energies.
f. Discuss the problems of energy demand and explain the possible contributions of renewables to energy supply, and availability.

SEVP2. Students will understand how spectroscopy and detection technology may be used for monitoring environmental processes and pollutants.

a. Explain the nature of light and the electromagnetic spectrum.
b. Explain the processes that result in the production of electromagnetic waves.
c. Explain the flow of energy by electromagnetic radiation.
d. Calculate energy, frequency and wavelengths according to the Planck-Einstein relationship.
e. Qualitatively relate the energy of electronic transitions to the specific color of light observed.
f. Use analytical spectroscopy techniques to monitor environmental processes.
g. Explore the behavior of waves in various media in terms of reflection, refraction, and diffraction.
h. Demonstrate the transfer of energy through different mediums by mechanical waves.

SEVP3. Students will evaluate and discuss the fundamental processes that cause atmospheric circulation and create climate zones and weather patterns, and learn how carbon cycling between atmosphere, land, and ocean reservoirs helps to regulate the Earth's climate.

a. Describe the composition, structure and dynamics of Earth’s atmosphere.
b. Discuss the main factors influencing Earth’s temperature.
c. Describe the transport of solar radiation through the atmosphere to the Earth’s surface and subsequent radiation back through the atmosphere into space.
d. Discuss the Greenhouse Effect and greenhouse gases.

SEVP4. Students will recognize that human beings are part of the global ecosystem and will evaluate the effects of human activities and technology on ecosystems.

a. Explain the consequences of human activities on the atmosphere, biosphere, and lithosphere.
b. Discuss the global energy budget and the reasons for current reliance upon fossil fuels.
c. Describe how energy and other resource utilization impact the environment.
d. Describe the effects and potential implications of pollution and resource depletion on the environment at the local and global levels.
e. Provide a critical discussion of the causes and consequences of ozone depletion and global warming and discuss possible remedial actions.
f. Explain how human activities affect global and local sustainability.