Virginia Science

Physics

Physics PH

1 **The student will demonstrate an understanding of scientific and engineering practices by.** PH.1

- a asking questions and defining problems PH.1.A
  - i ask questions that arise from careful observation of phenomena, examination of a model or theory, unexpected results, and/or to seek additional information PH.1.A.I
  - ii determine which questions can be investigated within the scope of the school laboratory PH.1.A.II
  - iii make hypotheses that specify what happens to a dependent variable when an independent variable is manipulated PH.1.A.III
  - iv generate hypotheses based on research and scientific principles PH.1.A.IV
  - v define design problems that involves the development of a process or system with interacting components and criteria and constraints PH.1.A.V
- b planning and carrying out investigations PH.1.B
  - i individually and collaboratively plan and conduct observational and experimental investigations PH.1.B.I
  - ii plan and conduct investigations or test design solutions in a safe manner PH.1.B.II
  - iii select and use appropriate tools and technology to collect, record, analyze, and evaluate data PH.1.B.III
- c interpreting, analyzing, and evaluating data PH.1.C
  - i record and present data in an organized format that communicates relationships and quantities in appropriate mathematical or algebraic forms PH.1.C.I
  - ii use data in building and revising models, supporting an explanation for phenomena, or testing solutions to problems PH.1.C.II
  - iii analyze data using tools, technologies, and/or models (e.g., computational, mathematical, statistical) in order to make valid and reliable scientific claims or determine an optimal design solution PH.1.C.III
  - iv analyze data graphically and use graphs to make predictions PH.1.C.IV
  - v consider limitations of data analysis when analyzing and interpreting data PH.1.C.V
  - vi evaluate the effects of new data on a working explanation and/or model of a proposed process or system PH.1.C.VI
  - vii analyze data to optimize a design PH.1.C.VII
- d constructing and critiquing conclusions and explanations PH.1.D
  - i make quantitative and/or qualitative claims based on data PH.1.D.I
  - ii construct and revise explanations based on valid and reliable evidence obtained from a variety of sources PH.1.D.II

iii apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena or design solutions PH.1.D.III

iv compare and evaluate competing arguments in light of currently accepted explanations and new scientific evidence PH.1.D.IV

v construct arguments or counterarguments based on data and evidence PH.1.D.V

vi differentiate between scientific hypothesis, theory, and law PH.1.D.VI

e developing and using models PH.1.E

i evaluate the merits and limitations of models PH.1.E.I

ii identify and communicate components of a system orally, graphically, textually, and mathematically PH.1.E.II

iii develop and/or use models (including mathematical and computational) and simulations to visualize, explain, and predict phenomena and to interpret data sets PH.1.E.III

f obtaining, evaluating, and communicating information PH.1.F

i compare, integrate, and evaluate sources of information presented in different media or formats to address a scientific question or solve a problem PH.1.F.I

ii gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and credibility of each source PH.1.F.II

iii communicate scientific and/or technical information about phenomena and/or a design process in multiple formats PH.1.F.III

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2 **The student will investigate and understand, through mathematical and experimental processes, that there are relationships between position and time. Key topics include** PH.2

a displacement, velocity, and uniform acceleration; PH.2.A

b linear motion; PH.2.B

c uniform circular motion; and PH.2.C

d projectile motion PH.2.D

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3 **The student will investigate and understand, through mathematical and experimental processes, that there are relationships among force, mass, and acceleration. Key laws include** PH.3

a Newton’s laws of motion; and PH.3.A

b Newton’s law of universal gravitation PH.3.B

4 **The student will investigate and understand, through mathematical and experimental processes, that conservation laws govern all interactions. Key ideas include** PH.4

- a momentum is conserved unless an impulse acts on the system; and PH.4.A
- b mechanical energy is conserved unless work is done on, by, or within the system PH.4.B

5 **The student will investigate and understand, through mathematical and experimental processes, that waves transmit energy and move in predictable patterns. Key ideas include** PH.5

- a waves have specific characteristics; PH.5.A
- b wave interactions are part of everyday experiences; and PH.5.B
- c light and sound transmit energy as waves. PH.5.C

6 **The student will investigate and understand, through mathematical and experimental processes, that optical systems form a variety of images. Key ideas include** PH.6

- a the laws of reflection and refraction describe light behavior; and PH.6.A
- b ray diagrams model light as it travels through different media. PH.6.B

7 **The student will investigate and understand, through mathematical and experimental processes, that fields provide a unifying description of force at a distance. Key ideas include** PH.7

- a gravitational, electric, and magnetic forces can be described using the field concept; and PH.7.A
- b field strength diminishes with increased distance from the source PH.7.B

8 **The student will investigate and understand, through mathematical and experimental processes, that electrical circuits are a system used to transfer energy. Key ideas include** PH.8

- a circuit components have different functions within the system PH.8.A
- b Ohm’s law relates voltage, current, and resistance; PH.8.B
- c different types of circuits have different characteristics and are used for different purposes; PH.8.C
- d electrical power is related to the elements in a circuit; and PH.8.D
- e electrical circuits have everyday applications. PH.8.E

9 **The student will investigate and understand that extremely large and extremely small quantities are not necessarily described by the same laws as those studied in Newtonian physics. Topics, such as these listed, may be included** PH.9

a wave/particle duality; PH.9.A

b quantum mechanics and uncertainty PH.9.B

c relativity; PH.9.C

d nuclear physics; PH.9.D

e solid state physics PH.9.E

f nanotechnology; PH.9.F

g superconductivity PH.9.G

h the standard model; and PH.9.H

i dark matter and dark energy. PH.9.I