Science Grade-Level Expectations: Physical Science (Recommended for Grade 9)

Science as Inquiry

The Abilities Necessary to Do Scientific Inquiry

- 1. Write a testable question or hypothesis when given a topic (SI-H-A1)
- 2. Describe how investigations can be observation, description, literature survey, classification, or experimentation (SI-H-A2)
- 3. Plan and record step-by-step procedures for a valid investigation, select equipment and materials, and identify variables and controls (SI-H-A2)
- 4. Conduct an investigation that includes multiple trials and record, organize, and display data appropriately (SI-H-A2)
- 5. Utilize mathematics, organizational tools, and graphing skills to solve problems (SI-H-A3)
- 6. Use technology when appropriate to enhance laboratory investigations and presentations of findings (SI-H-A3)
- 7. Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations) (SI-H-A4)
- 8. Give an example of how new scientific data can cause an existing scientific explanation to be supported, revised, or rejected (SI-H-A5)
- 9. Write and defend a conclusion based on logical analysis of experimental data (SI-H-A6) (SI-H-A2)
- 10. Given a description of an experiment, identify appropriate safety measures (SI-H-A7)

Understanding Scientific Inquiry

- 11. Evaluate selected theories based on supporting scientific evidence (SI-H-B1)
- 12. Cite evidence that scientific investigations are conducted for many different reasons (SI-H-B2)
- 13. Identify scientific evidence that has caused modifications in previously accepted theories (SI-H-B2)
- 14. Cite examples of scientific advances and emerging technologies and how they affect society (e.g., MRI, DNA in forensics) (SI-H-B3)
- 15. Analyze the conclusion from an investigation by using data to determine its validity (SI-H-B4)
- 16. Use the following rules of evidence to examine experimental results:
 - (a) Can an expert's technique or theory be tested, has it been tested, or is it simply a subjective, conclusive approach that cannot be reasonably assessed for reliability?
 - (b) Has the technique or theory been subjected to peer review and publication?
 - (c) What is the known or potential rate of error of the technique or theory when applied?
 - (d) Were standards and controls applied and maintained?
 - (e) Has the technique or theory been generally accepted in the scientific community? (SI-H-B5) (SI-H-B1) (SI-H-B4)

Physical Science

Measurement and Symbolic Representation

- 1. Measure the physical properties of different forms of matter in metric system units (e.g., length, mass, volume, temperature) (PS-H-A1)
- 2. Gather and organize data in charts, tables, and graphs (PS-H-A1)
- 3. Distinguish among symbols for atoms, ions, molecules, and equations for chemical reactions (PS-H-A2)

Science Grade-Level Expectations: Physical Science (Recommended for Grade 9)

4. Name and write chemical formulas using symbols and subscripts (PS-H-A2)

Atomic Structure

- 5. Identify the three subatomic particles of an atom by location, charge, and relative mass (PS-H-B1)
- 6. Determine the number of protons, neutrons, and electrons of elements by using the atomic number and atomic mass from the periodic table (PS-H-B1)
- Describe the results of loss/gain of electrons on charges of atoms (PS-H-B1) (PS-H-C5)
- 8. Evaluate the uses and effects of radioactivity in people's daily lives (PS-H-B2)
- 9. Compare nuclear fission to nuclear fusion (PS-H-B2)
- 10. Identify the number of valence electrons of the first 20 elements based on their positions in the periodic table (PS-H-B3)

The Structure and Properties of Matter

- 11. Investigate and classify common materials as *elements*, *compounds*, or *mixtures* (heterogeneous or homogeneous) based on their physical and chemical properties (PS-H-C1)
- 12. Classify elements as *metals* or *nonmetals* based on their positions in the periodic table (PS-H-C2)
- 13. Predict how factors such as particle size and temperature influence the rate of dissolving (PS-H-C3)
- 14. Investigate and compare methods for separating mixtures by using the physical properties of the components (PS-H-C4) (PS-H-C1)
- 15. Using selected elements from atomic numbers 1 to 20, draw Bohr models (PS-H-C5) (PS-H-B3)
- 16. Name and write the formulas for simple ionic and covalent compounds (PS-H-C5)
- 17. Name and predict the bond type formed between selected elements based on their locations in the periodic table (PS-H-C5)
- 18. Diagram or construct models of simple hydrocarbons (four or fewer carbons) with single, double, or triple bonds (PS-H-C6)
- 19. Analyze and interpret a graph that relates temperature and heat energy absorbed during phase changes of water (PS-H-C7)
- 20. Predict the particle motion as a substance changes phases (PS-H-C7) (PS-H-C3)

Chemical Reactions

- 21. Classify changes in matter as physical or chemical (PS-H-D1)
- 22. Identify evidence of chemical changes (PS-H-D1)
- 23. Classify unknowns as acidic, basic, or neutral using indicators (PS-H-D2)
- 24. Identify balanced equations as neutralization, combination, and decomposition reactions (PS-H-D3)
- 25. Determine the effect of various factors on reaction rate (e.g., temperature, surface area, concentration, agitation) (PS-H-D4)
- 26. Illustrate the laws of conservation of matter and energy through balancing simple chemical reactions (PS-H-D5) (PS-H-D3) (PS-H-D7)
- 27. Distinguish between endothermic and exothermic reactions (PS-H-D6)
- 28. Identify chemical reactions that commonly occur in the home and nature (PS-H-D7)

Forces and Motion

29. Differentiate between *mass* and *weight* (PS-H-E1)

Science Grade-Level Expectations: Physical Science (Recommended for Grade 9)

- 30. Compare the characteristics and strengths of forces in nature (e.g., gravitational, electrical, magnetic, nuclear) (PS-H-E1)
- 31. Differentiate between speed and velocity (PS-H-E2)
- 32. Plot and compare line graphs of acceleration and velocity (PS-H-E2)
- 33. Calculate velocity and acceleration using equations (PS-H-E2)
- 34. Demonstrate Newton's three laws of motion (e.g., inertia, net force using F = ma, equal and opposite forces) (PS-H-E3)
- 35. Describe and demonstrate the motion of common objects in terms of the position of the observer (PS-H-E4)

Energy

- 36. Measure and calculate the relationships among energy, work, and power (PS-H-F1)
- 37. Model and explain how momentum is conserved during collisions (PS-H-F2)
- 38. Analyze diagrams to identify changes in kinetic and potential energy (PS-H-F2)
- 39. Distinguish among thermal, chemical, electromagnetic, mechanical, and nuclear energy (PS-H-F2)
- 40. Demonstrate energy transformation and conservation in everyday actions (PS-H-F2)

Interactions of Energy and Matter

- 41. Identify the parts and investigate the properties of transverse and compression waves (PS-H-G1)
- 42. Describe the relationship between wavelength and frequency (PS-H-G1)
- 43. Investigate and construct diagrams to illustrate the laws of reflection and refraction (PS-H-G1)
- 44. Illustrate the production of static electricity (PS-H-G2)
- 45. Evaluate diagrams of series and parallel circuits to determine the flow of electricity (PS-H-G2)
- 46. Diagram a magnetic field (PS-H-G2)
- 47. Explain how electricity and magnetism are related (PS-H-G2)
- 48. Compare properties of waves in the electromagnetic spectrum (PS-H-G3)
- 49. Describe the Doppler effect on sound (PS-H-G3)
- Identify positive and negative effects of electromagnetic/mechanical waves on humans and human activities (e.g., sound, ultraviolet rays, X-rays, MRIs, fiber optics) (PS-H-G4) (PS-H-G3)