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)

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)
7. 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)

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)
50. 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)