Princeton Charter School

7 *Science Curriculum*

7.1 Science Program Overview

Princeton Charter School adopts a "minds-on, hands-on" approach to science education; it stresses quantitative reasoning as well as experimentation and observation. Students are encouraged to be curious about the natural world surrounding them and come to understand the importance of science in many different careers.

The PCS science curriculum is aligned with the New Jersey Student Learning Standards for Science (NJSLS-S), which are based on Next Generation Science Standards (NGSS). NGSS is structured around three dimensions: Crosscutting Concepts, Science and Engineering Practices, and Disciplinary Core Ideas (DCIs). These three dimensions are intertwined to form the standards, which are called performance expectations. A comprehensive explanation of NGSS can be found at nextgenscience.org.

Each year at PCS students develop fundamental skills and explore concepts they will continue to use for their entire science education. They investigate phenomena, argue from evidence, and evaluate the validity of scientific arguments. They develop these skills through age appropriate activities while studying physical, life, and earth science concepts.

7.2 New Jersey Core Curriculum Content Standards in Science

The Princeton Charter School science curriculum follows the New Jersey Student Learning Standards for Science. These standards are linked below.

- K-12:https://www.nj.gov/education/standards/science/Docs/NJSLS-Science_K-12.pdf
- K-5: https://www.nj.gov/education/standards/science/Docs/NJSLS-Science_K-5.pdf
- 6-8: https://www.nj.gov/education/standards/science/Docs/NJSLS-Science_6-8.pdf

7.3 Science: Kindergarten

In kindergarten, the science program centers on activities through which students:

- engage their curiosity about the world around them;
- communicate observations and comparisons;
- begin to develop a scientific vocabulary;
- observe living organisms over time;
- ask questions and make predictions;
- make and record observations.

Topics

- Five Senses and the Brain - how we perceive the world around us
- The Seasons - we can observe changes over time
- Living and Nonliving Things - what do all living things have in common?
- Solutions for Protecting our Planet
- Soil and Water
- Plants - their characteristics, structures, and life cycles

Instructional Materials

- Knowing Science Curriculum, Kindergarten
- Supplemental Online Resources

7.4 Science: Grade One

In first grade, the science program centers on activities through which students:

- conduct experiments;
- make simple measurements in the course of experiments;
- record and graph data;
- make predictions based on data and analysis; and ask questions;
- make and record observations;
- collaborate with peers

Students investigate Forces and Motion through the following activities:

- Students explore balance, counterbalance, and stability through experiments with shapes, pencils, and mobiles.
- Students look for real life examples of pushes and pulls in their school/classroom environment
- Students investigate friction by observing on which surfaces a toy car can roll the farthest and shortest distances
- Students investigate gravity as a force by measuring the speed objects of varying weight fall to the ground when dropped

Students explore how animals adapt to their environment by observing various animals in the winter and identifying various adaptation behaviors such as hibernation, migration, and change of diet. Students conduct a research study on an animal to discover how it adapts to winter weather.

Students explore how the Earth, Sun, and Moon interact in space. Students discover the reason for the seasons, the cause of day and night, the cause of tides in our oceans. They research other space objects such as other planets, comets, and asteroids. Students learn what the life of an astronaut might look like.

Students investigate air and weather through the following activities:

- Students monitor the weather and record their observations in a weather journal
- Students explore and make observations regarding the ingredients of weather: air, water, and

heat
- Students construct devices that use air to function including parachutes, propellers, balloon rockets, gliders, pinwheels, streamers, wind socks, kites, and whirligigs
- Students design an engineering solution to severe weather such as a tornado, hurricane, or earthquake.

Students investigate bugs and observe their life cycle through the following activities:

- Students observe and compare insect structures and behaviors in different stages of the life cycle, discuss and record findings, and pose questions to be resolved.
- Students observe complete insect metamorphosis
- Students classify insects, arthropods, and other types of bugs

Instructional Materials

- *Knowing Science Curriculum, Grade 1*
- *Supplemental Online Resources*

7.5 Science: Grade Two

In second grade, the science program centers on activities through which students are expected to learn how to:

- conduct experiments;
- use measurements in the course of experiments;
- record and graph data;
- use data and analysis to make predictions;
- collaborate with peers and
- write questions and observations.

Students conduct a research unit on Insects, specifically bees. During this research unit, students explore their life cycle, compare and contrast different types of bees, discover different roles within a bee colony, investigate how honey bees make their hives and honey, and create models to gain a better understanding of how bees pollinate.

Students investigate fast and slow changes of the earth through the following activities:

- Students look for examples of weathering and erosion around the school campus.
- Students conduct experiments to observe the agents of weathering and erosion at work.
- Students investigate how weathering and erosion can cause sedimentary rock to form.
- Students observe authentic fossils to help them draw connections to how the earth changes over time (aquatic fossils found in a desert indicate the land must have changed).

Students conduct a research unit on **habitats**. During this unit, students discover how different organisms thrive in different environments. Students identify traits of the seven main habitats (pond, ocean. forest, rainforest, desert, arctic, and grassland). Students compare and contrast different

types of habitats. Students describe animal adaptations that help them survive in their habitat.

Students investigate the **states of matter** through the following activities:

- They investigate the properties of solids (cornmeal, beans, rice) and liquids (water, corn syrup, oil) and compare their properties. Then, they identify properties that are true for all solids and all liquids.
- Students conduct experiments to discover how matter can change from one state to another (adding or removing energy).
- Students investigate how matter can undergo physical changes and chemical changes.

Instructional Materials

- *Full Option Science System,* Lawrence Hall of Science, University of California, Berkeley

7.6 Science: Grade Three

In third grade, the science program centers on activities through which students are expected to learn how to:

- design and conduct experiments
- use measurements and the metric system in the course of experiments
- record and graph data
- use data and analysis to make predictions
- write organized lab reports
- collaborate with peers
- organize notebook

Earth and Its Movement

Third Grade students investigate **Earth and Its Movements**. We use a variety of interactive activities, group work, independent note taking, and exploration of ideas around Earth's movements. We also explore the relationship between weather and climate.

Digestion and Body Systems

Students investigate the digestive system and other body systems including the skin, bones, and rain. We use the body as a model for how systems work, and what makes up systems.

Variation and Adaptation

Students will investigate animal adaptation and variation. Students engage in questions such as "how do animals survive and what makes some animals survive in certain regions?" Students explore shared characteristics and evidence of relatedness within animal and plant species.

- Principles of heredity and DNA
- Inherited and acquired characteristics
- Adaptations and survival
- Benefits of living in groups

- Life cycles

Energy and Magnetism

Students investigate energy and magnetism. We build circuits and explore systems of energy, electricity. Students will learn what makes a complete circuit, principles of energy, and observe various forms of energy. We also build magnets, and explore how magnets work.

Third Grade science is collaborative, and where we build skills such as note taking, studying, and synthesizing information.

Students study the **Human Digestive and Skeletal Systems** to learn about how their bodies work.

Instructional Materials

Full Option Science System, Lawrence Hall of Science, University of California, Berkeley.

7.7 Science: Grade Four

In fourth grade, the science program centers on activities through which students are expected to learn how to:

- design and conduct experiments;
- use measurements and the metric system in the course of experiments;
- record and graph data;
- work with independent and dependent variables;
- apply mathematics to analyze the experiments;
- use data and analysis to make predictions; and
- write lab reports following the scientific method.

4th Grade Science Curriculum Modules

Magnetism and Electromagnetism

- Properties of magnets
- Students will construct electromagnets and will use them as part of a simple telegraph.

Motion, Force, and Models

This unit presents key ideas about motion, force, and energy. Students will use a variety of models to explore variables and experimental design---how changing one part of an experiment could change the outcome of the experiment.

- Students will be performing experiments using pendulums, balls and ramps, catapults (flippers).
- Students will be using engineering practices to construct a device that meets certain parameters.

Soils, Rocks, and Landforms

- Students will explore Soil components/nutrients, Physical weathering, chemical weathering and the effect of acid rain.
- Students will investigate Erosion, using the NJ shoreline as a case study of the management of coastline.
- Students explore the slow vs. fast processes which change landforms, such as landslides, earthquakes and volcanic eruptions. Students then study the impact of fast Earth processes such as earthquakes, volcanic eruptions, and floods on humans

Instructional Materials

- *Full Option Science System,* Lawrence Hall of Science, University of California, Berkeley.

7.8 Science: Grade Five

The fifth-grade course includes life, and earth and space sciences. Students are expected to:

- learn scientific concepts and vocabulary in areas covered;
- design and conduct experiments;
- use measurements in the course of experiments;
- interpret and develop models;
- record and graph data;
- apply mathematics to analyze experiments;
- use data and analysis to make predictions; and
- communicate results through claim evidence reasoning (CER) statements, full laboratory reports, and presentations.

Life Sciences – Ecology

Topics: interactions among living things; cycles in nature; biological clocks; bio- geography; Earth's biomes; and wildlife conservation.

Earth and Space Sciences - Dynamic Earth

Topics: movement of the Earth's crust, earthquakes, volcanoes, plate tectonics, rocks and minerals, weathering and soil formation, erosion and deposition.

Life Sciences - Human Physiology

Topics: levels of organization, human body systems overview, human skeletal, muscular and digestive systems

Instructional Materials

- *Ecology: Earth's Living Resources ,* Prentice Hall Science, 1997.
- *Chemical Interactions,* Delta Science Modules II.
- *Dynamic Earth,* Prentice Hall Science,1997.

- *Human Biology and Health,* Prentice Hall Science, 1997.
- OpenSciEd. NGSS Instructional Materials. 2019-2021. https://www.openscied.org/
- PhET Interactive Simulations. University of Colorado, Boulder. https://phet.colorado.edu/
- CK-12 Flexbooks: Life, Physical, and Earth Science for Middle School. https://flexbooks.ck12.org/cbook/ck-12-middle-school-life-science-2.0/
- https://flexbooks.ck12.org/cbook/ck-12-middle-school-physical-science-flexbook-2.0/
- https://flexbooks.ck12.org/cbook/ck-12-middle-school-earth-science-flexbook-2.0/

7.9 Science: Grade Six

The science program includes life, physical, and Earth and space sciences. Students are expected to:

- learn scientific concepts and vocabulary in areas covered;
- design and conduct experiments;
- interpret and develop models;
- use measurements in the course of experiments;
- record and graph data;
- apply mathematics to analyze the experiments;
- use data and analysis to make predictions; and
- communicate results through claim evidence reasoning (CER) statements, full laboratory reports, and presentations.

Life Sciences: Cells

Topics: characteristics of living things; chemistry of living things; cell theory; structure and function of cells; cell growth and division; photosynthesis; respiration.

Earth and Space Sciences: Astronomy

Topics: structure of the solar system; seasons and tides; solar and lunar eclipses; space exploration; stars; galaxies; evolution of the Universe.

Physical Sciences: Electricity and Magnetism

Topics: Electric charges; current flow; series and parallel circuits; magnetic poles; magnetic field lines of force; the Earth as a magnet; charged particles in a magnetic field; electromagnetism; electronic transmission.

Life Sciences - Human Physiology

Topics: human nervous and endocrine systems.

Instructional Materials

- *Exploring the Universe,* Prentice Hall Science, 1997.
- *Cells: Building Blocks of Life,* Prentice Hall Science, 1997.
- *Electricity and Magnetism,* Prentice Hall Science, 1997.
- *Human Biology and Health,* Prentice Hall Science, 1997.
- OpenSciEd. NGSS Instructional Materials. 2019-2021.

https://www.openscied.org/

- PhET Interactive Simulations. University of Colorado, Boulder. https://phet.colorado.edu/
- Cellsalive.com
- CK-12 Flexbooks: Life, Physical, and Earth Science for Middle School. https://flexbooks.ck12.org/cbook/ck-12-middle-school-life-science-2.0/
- https://flexbooks.ck12.org/cbook/ck-12-middle-school-physical-science-flexbook-2.0/
- https://flexbooks.ck12.org/cbook/ck-12-middle-school-earth-science-flexbook-2.0/

7.10 Science: Grades Seven and Eight

The seventh- and eighth-grade program includes physical, earth, and life sciences as well as engineering applications. Students are expected to:

- learn scientific concepts and vocabulary;
- design and conduct experiments;
- use measurements in the course of experiments;
- record and graph data;
- apply mathematics to analyze the experiments;
- use data and analysis to make predictions; and
- communicate results through claim evidence reasoning (CER) statements, full laboratory reports, and presentations.

The seventh and eighth grade science curriculum operates on a two-year rotation. In a given year, students in both grades cover the same topics. The topics were ordered in a way to build on each other throughout a given year, but there is no advantage to completing Year A or Year B first.

Year A

1. Rocks and Fossils - the rock cycle, types of rocks, the fossil record, the geological timeline

2. Matter - general properties of matter: mass, weight, volume, and density; phases of matter; phase changes; mixtures, elements, and compounds; atomic model of matter; structure of atoms; forces within atoms; the periodic table; periodic properties of the elements

3. Plate Tectonics - layers of the Earth, types of faults, earthquakes, volcanoes

4. Chemistry - atoms and bonding; ionic, covalent, and metallic bonds; chemical reactions; equations for chemical reactions; energy changes during phase changes and reactions; reaction rates; acids, bases, and salts; hydrocarbons; radioactivity; nuclear reactions

5. Climate Change - weather and climate system, earth's energy balance, greenhouse gases, impact of climate change, mitigation, adaptation

6. Sound and Light - characteristics of waves includingfrequency, wavelength, and amplitude; mechanical waves and sound waves, electromagnetic waves and light the electromagnetic spectrum; diffraction, reflection, and refraction; ; lenses and focal length

Year B

1. Motion and Forces - frames of reference; speed, velocity, acceleration; position vs. time graphs;; contact forces such as normal force and friction; non-contact forces such as electromagnetism and gravity; Newton's three laws of motion; freebody diagrams; freefall;; work,power, andsimple machines;

2. Energy - kinetic and potential energy, energy conversions, and conservation of energy

3. Engineering Design Projects - students are challenged to build devices that can accomplish a specific goal; students research, plan, create, test, improve, and repeat

4. Heredity - Plant reproduction; Medelian genetics; traits and heredity; Punnett squares; codominance and incomplete dominance, DNA, RNA, and protein synthesis; mitosis, chromosomes, and meiosis; microscopy; blood types; ; mutations;; human genetics; sex-linked traits

5. Evolution - evidence supporting change over time; biological evolution; natural selection; Darwin; human evolution

6. Classification - biological classification, three domain/six kingdom systems, binomial nomenclature

Instructional Materials

A variety of different resources are used at each grade level as opposed to one packaged curriculum program or textbook. This is standard best practice for teaching science at all levels, from K-8 through college. The materials are chosen in a thoughtful manner to support the Princeton Charter School science curriculum and are prepared and used purposefully.

Byway of example, the list of resources used at the 7-8th grade level includes but is not limited to:

- CK-12 Flexbooks: Life, Physical, and Earth Science for Middle School.
    - https://flexbooks.ck12.org/cbook/ck-12-middle-school-physical-science-flexbook-2.0/
    - https://flexbooks.ck12.org/cbook/ck-12-middle-school-life-science-2.0/

https://flexbooks.ck12.org/cbook/ck-12-middle-school-earth-science-flexbook-2.0/

- Middle School Chemistry Curriculum. American Chemical Society. 2010-2024. https://www.middleschoolchemistry.com/
- Gizmos Math and Science Simulations. https://gizmos.explorelearning.com/
- POGIL Activities for Earth & Space Science, Life Science, High School Biology, and High School Chemistry https://www.flinnsci.com/pogil/
- American Association of Chemistry Teachers. https://teachchemistry.org/
- PhET Interactive Simulations. University of Colorado, Boulder. https://phet.colorado.edu/
- Dig Field School and Burke Museum. Dig: Foundations and Dig: Microfossils Curricular Materials. https://www.burkemuseum.org/education/educators-and-schools/dig-field-school/dig-resources
- Stanford Climate Change Education Project. The Science and Policy of Global Climate Change Curriculum Unit. https://climatechange.stanford.edu/curriculum

- Prentice Hall Science Explorer series. 1994-2009.
- OpenSciEd. NGSS Instructional Materials. 2019-2024. https://www.openscied.org/
- Howard Hughes Medical Institute BioInteractive. https://www.biointeractive.org/
- The Concord Consortium. STEM Resources, including Geniventure and Plate Tectonics modules. https://concord.org/
- WISE: Web-based Inquiry Science Environment. Plate Tectonics, Graphing Stories: Amusement Park Challenge, Musical Instruments and the Physics of Sound, and Global Climate Change Units. https://wise.berkeley.edu/
- American Modeling Teachers Association. 8th Grade Unit – Motion, Force, and Energy.
- National Science Teaching Association. https://www.nsta.org/resources