



Science Department Curriculum Guide

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Science at Gateway

What is the approach to science teaching and learning at Gateway?

Gateway's science curriculum is aligned with the Next Generation Science Standards (Common Core), and utilizes an inquiry-based approach: Students will develop an understanding of the relationships and laws of science through hands-on activities. Students will see, hear and touch the content material in a context that allows deep understanding. We focus on teaching the scientific process through building the following skills:

- Experimental design and research
- Data analysis and interpretation
- Lab skills and teamwork

What are the power standards emphasized in all grades?

GATEWAY SCIENCE STANDARD A: Investigations and Experimentation (NGSS - SP3)

- | | |
|----------------------|------------------------|
| a. Model with math | c. Use tools |
| b. Follow procedures | d. Attend to precision |

GATEWAY SCIENCE STANDARD B: Interpreting Data (NGSS - SP 4)

- | | |
|--|----------------------|
| a. Analyze multiple sources | c. Interpret data |
| b. Represent information in multiple forms | d. Evaluate evidence |

GATEWAY SCIENCE STANDARD C: Communicating Information (NGSS - SP 8)

- | | |
|------------------------|-----------------------|
| a. Construct arguments | b. Critique reasoning |
|------------------------|-----------------------|

- c. Reason abstractly and quantitatively
- d. Analyze multiple sources

- e. Evaluate evidence

What are the key practices across all grades?

All science classes involve a team approach in which each group member has a specific role. The overall learning arch includes a process of introducing a concept, carrying out an investigation (lab) and then analyzing the results to build a model they use to solve a problem, test a hypothesis, or answer a question. This model may be extended with graphic or mathematical analysis depending on the grade level.

Environmental Science

Unit 1: Intro to Environmental Science

Key Learning Goals:

- Using claim, evidence, reasoning to construct a scientific argument
- Practice lab procedures and relevant calculations
- Using cost/benefit analysis to propose sustainable solutions to environmental issues

Unit 2: Ecology

Essential Question: How is nature organized?

Key Learning Goals:

- Distribution of biomes and their climates
- Roles within ecosystems
- Symbiotic relationships

Unit 3: Water

Essential Question: How does water move on Earth? Why is water polar and how does polarity give water its properties? What types of pollution impact water quality?

Key Learning Goals:

- Water cycle
- Properties of water
- Water Quality

Unit 4: Climate

Essential Question: Why do we have varying climates/seasons on Earth? How is our climate changing?

Key Learning Goals:

- What determines Earth's seasons/climate zones
- Greenhouse effect
- Climate change

Unit 5: Energy

Essential Question: What is energy? How does energy transform?

Key Learning Goals:

- Basic principles of energy
- First and second laws of thermodynamics
- Energy transformations

Demonstrate the following scientific skills in all units...

- | | |
|--------------------------------------|------------------------------------|
| ➤ Plan and carry out investigations. | ➤ Graphing |
| ➤ Analyze and interpret data. | ➤ Construct scientific explanation |
| ➤ Engage in argument from evidence. | |

Students will read, watch and explore a variety of sources of information about each unit topic. Students become acquainted with scientific principles and how they can be applied to our environment through a series of labs, activities and group tasks, focusing on the following:

- Connecting science content to real world events in order to better understand the world around us
- Inquiry
- Team problem-solving

Biology

In this course, we will work to understand life on planet Earth. We work together to understand the core concepts of life on Earth and how these biological concepts relate to our bodies and environment. We then use this knowledge to answer the question: **How do I use science to understand the world around me and solve the problems that I find?**

Core Science Practices

By the end of the school year, all Biology students should be able to ...

- ☑ Plan and carry out investigations.
- ☑ Analyze and interpret data.
- ☑ Engage in argument from evidence.
- ☑ Obtain, evaluate, and communicate information.
- ☑ Construct explanations.

Units of Study

- Unit 1: Plants
- Unit 2: Cells & DNA
- Unit 3: Genetics
- Unit 4: Evolution

Resources, Texts, Approaches

Through “hands-on” and “minds-on” work, students will be immersed in a variety of independent, small group, and whole class activities that develop students’ understanding of how biology works.

Rather than relying on one textbook, we utilize a wide variety of resources, which include the textbook Prentice Hall: *Biology* by Kenneth Miller & Joseph Levine, excerpts from books (for example: *The Immortal Life of Henrietta Lacks* by Rebecca Skloot), and online video resources (for example: CrashCourse Biology).

Chemistry

Key Learning Goals

By the end of the school year, all Chemistry students should be able to ...

- ☑ Demonstrate the ability to select and apply contemporary forms of technology to solve problems and to compile and present information in the study of chemistry.
- ☑ Know and apply the processes of scientific inquiry.
- ☑ Observe and record data to create and use scientific models to explain what is happening.
- ☑ Apply modern atomic theory to the periodic table to explain chemical principles and concepts and perform chemical calculations and understand the relationship between the elements.
- ☑ Differentiate between ionic and covalent bonds, including use of Lewis dot structures to predict physical and chemical properties.
- ☑ Evaluate the different states of matter in terms of intermolecular forces of attraction.
- ☑ Use the Law of Conservation of Mass to write balanced chemical reactions and predict the products for a given set of reactants.
- ☑ Provide evidence of understanding the chemistry of acids, bases, and the pH scale.
- ☑ Conceptually and graphically illustrate the relationship between pressure, volume, mole quantity and temperature for a gas at ideal conditions.

Units of Study

- Scientific Process including Measurement and Graphing
- Atomic Structure and Periodic Table
- Ionic Bonding
- Covalent Bonding
- Chemical Reactions
- Solutions Chemistry
- States of Matter
- Acid/Base Chemistry

Resources, Texts, Approaches

Through “hands on” and “minds on” work, students will be immersed in a variety of independent, small group, and whole class activities that develop students’ understanding of how science works and what science thinking is. Texts include:

Living By Chemistry, Second Edition, Angelica M. Stacy

Online: Crash Course Chemistry, Khan Academy

Chemistry Honors

Chemistry Honors follows the same course outline and teaching strategies as regular Chemistry. The difference is that the course runs at a slightly faster pace, and so covers more material. Additional topics of study include:

- Additional Scientific Computation
- Aspects of Acid/Base Chemistry
- Stoichiometry

Key Learning Goals

By the end of the school year, all Chemistry Honors students should be able to ...

- ☑ Demonstrate the ability to select and apply contemporary forms of technology to solve problems and to compile and present information in the study of chemistry.
- ☑ Know and apply the processes of scientific inquiry.
- ☑ Observe and record data to create and use scientific models to explain what is happening.
- ☑ Explain and examine the development of classical models of atomic structure.
- ☑ Apply modern atomic theory to the periodic table to explain chemical principles and concepts and perform chemical calculations and understand the relationship between the elements.
- ☑ Differentiate between ionic and covalent bonds, including use of Lewis dot structures to predict physical and chemical properties.
- ☑ Demonstrate understanding of molarity and other units of concentration.
- ☑ Evaluate the different states of matter in terms of intermolecular forces of attraction.
- ☑ Use the Law of Conservation of Mass to write balanced chemical reactions and predict the products for a given set of reactants.
- ☑ Provide evidence of understanding the chemistry of acids, bases, and the pH scale.
- ☑ Conceptually and graphically illustrate the relationship between pressure, volume, mole quantity and temperature for a gas at ideal conditions.

Units of Study

- | | |
|---|-----------------------|
| • Scientific Process including Measurement and Graphing | • Chemical Reactions |
| • Atomic Structure and Periodic Table | • Stoichiometry |
| • Ionic Bonding | • Solutions Chemistry |
| • Covalent Bonding | • States of Matter |
| | • Acid/Base Chemistry |

Resources, Texts, Approaches

Through “hands on” and “minds on” work, students will be immersed in a variety of independent, small group, and whole class activities that develop students’ understanding of how science works and what science thinking is. Texts include:

Online: Crash Course Chemistry, Khan Academy

Physics

Key Learning Goals

Gateway's Physics course will help students understand the basic nature of matter and energy and how they are related. The major concepts covered will **be mechanics and energy**. To enhance understanding of the material, students will get to apply their knowledge by performing qualitative and quantitative hands-on experiments. The lab work will have a variety of formats, and one formal technical lab report is required each quarter.

Essential Question: How does energy underlie physical interactions?

Units of Study

- Linear Motion
- Newton's Laws and Forces
- Two Dimensional Motion
- Momentum
- Energy
- Waves
- Electricity
- Light

Resources, Texts, Approaches

Conceptual Physics by Hewitt is the central text, and lab-work is the central practice. There are three types of labs:

1. **Investigations** – These are often conceptual and are used to help students understand a key concept. They are usually completed entirely as a group in class.
2. **Data-Gathering Labs** – These labs require collection of data and analysis, they are completed as a group but will have an individual closure which must be completed independently and in class.
3. **Formal Lab Reports** – These are also data-gathering labs, but are more complex and require an individual lab report, which will be completed and submitted on Google Classroom.

AP Physics

Key Learning Goals

Each unit has guiding questions that directly correlate to the AP Physics 1 Big Ideas. These seven principles are the core scientific principles, theories and processes of physics:

- ☑ **Big Idea 1:** Objects and systems have properties such as mass and charge.
- ☑ **Big Idea 2:** Fields existing in space can be used to explain interactions.
- ☑ **Big Idea 3:** The interactions of an object with other objects can be described by forces.
- ☑ **Big Idea 4:** Interactions between systems can result in changes in those systems.
- ☑ **Big Idea 5:** Changes that occur as a result of interactions are constrained by conservation laws.
- ☑ **Big Idea 6:** Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.
- ☑ **Big Idea 7:** The mathematics of probability can be used to describe the behavior of complex systems and to interpret the behavior of quantum mechanical systems.

Essential Questions

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Big Idea 2: Fields existing in space can be used to explain interactions.
- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.
- Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.
- Big Idea 7: The mathematics of probability can be us

Units of Study

Unit 1: Kinematics 10–15%

Unit 2: Force and Translational Dynamics 18–23%

Unit 3: Work, Energy, and Power 18–23%

Unit 4: Linear Momentum 10–15%

Unit 5: Torque and Rotational Dynamics 10–15%

Unit 6: Energy and Momentum of Rotating Systems
5–8%

Unit 7: Oscillations 5–8% Unit 8: Fluids 10–15%

Resources, Texts, Approaches

AP Physics is a non-calculus based comprehensive course covering the core concepts in physics, and gives students a deeper insight into how the world around them works and how the math that they have studied is applied to practical problems. Passing the AP exam and potentially earning college credit is a key goal for all students enrolled in the class, but the overall experience is more important. The process of students challenging themselves while working closely with their peers ultimately prepares them for future success.

Print Text - *AP Physics 1* - Fullerton

Online Text - OpenStax - College Physics for AP
Courses

Online Course - edX - Challenging Concepts in AP
Physics

AP Biology

Key Learning Goals

AP Biology is structured around four **Big Ideas**, which encompass the core scientific principles, theories, and processes governing living organisms and biological systems:

Big Idea 1: The process of evolution drives the diversity and unity of life.

Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.

Big Idea 3: Living systems store, retrieve, transmit and respond to information essential to life processes.

Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.

The AP Biology course is also structured around six **Science Practices**, which stress inquiry-based approaches to laboratory investigations. Students are given the opportunity to engage in at least eight inquiry-based, student-directed laboratory investigations throughout the course for at least 25% of class time.

1. Concept Explanation
2. Visual Representations
3. Questions & Methods
4. Representing & Describing Data
5. Statistical Tests & Data Analysis
6. Argumentation

Essential Questions

Semester 1:

What makes a cell able to survive on its own & how do cells communicate vital information to maintain dynamic homeostasis?

Semester 2:

How is genetic information passed from parents to offspring?

How have Earth's ecosystems (and populations of species within them) changed over time?

Units of Study

Unit 1: Cells: Structure, Transport, & Reproduction

Unit 2: Molecules, Energy, Metabolism, & Communication

Unit 3: Heredity & Molecular Genetics

Unit 4: Evolution & Ecology

Resources, Texts, Approaches

Core Text: Urry, Lisa A., Cain, Michael L., Wasserman, Steven A., Minorsky, Peter V., Jackson, Robert B., and Reece, Jane B. *Campbell Biology in Focus, AP edition*. 1st ed. Upper Saddle River, NJ: Pearson Education, Inc., 2014.

AP Environmental Science

Key Learning Goals

By the end of the school year, all AP Environmental Science should be able to ...

- ☑ Develop a deeper scientific understanding of the intricacy and interconnectedness of Earth's systems, specifically identifying the causes and effects of natural and human phenomena, and the importance of feedback loops in Earth's natural processes.
- ☑ Compare the rates of consumption and standard of living among communities around the world using the latest data and technologies.
- ☑ Develop an ability to convert data into strong visual representation to create meaning. Identify patterns and trends in data and make inferences and predictions about the future based on these graphical models.
- ☑ Develop Internet research skills, specifically the ability to identify reliable sources from the plethora of available information and disseminate the information into useful evidence to create an argument.
- ☑ Reflect on the impact your own lives have on other cultures and on Earth's systems, and ways to reduce negative impacts and increase positive impacts through the choices you make everyday.
- ☑ Become informed about environmental issues, become advocates for healthy communities and become exposed to the power of activism and scientific inquiry.

Essential Questions

- How do the different natural systems of Earth work and interact with one another?
- Why, how, and to what extent do humans use Earth's resources?
- How does humans' resource use impact Earth's systems, and in turn the quality of human life?
- How can we effectively manage Earth's systems and humans' resource use to maintain (and improve) life around the planet?

Units of Study

- Ecology
- Physical Earth Systems
- Population Dynamics
- Food Production
- A Changing Climate
- The Quest for Energy
- Waste and Pollution
- Ecological Design and Sustainable Solution

Key Assignments:

Lecture Notes: Lectures are modeled on college lectures, with interactive slideshows that include text and pictures.

Research Projects and Presentations: Students work both in groups and individually to research certain aspects of the current unit of study, then compile their research findings into a slideshow presentation.

Labs: Labs allow students the hands-on experience that help them with lab science skills and demonstrate how the physical laws of nature operate.

Film Analysis: Documentaries allow students a real-life, visual panoply of the issues discussed in class.

Reflection Papers: Four personal reflection papers allow students to demonstrate understanding of a topic while encouraging them to form their own conclusions and opinions about the topic, tie the topic to their own lives, and foster critical thinking skills.

Field Trips: Students explore the world through short field trips that bring us into the community to view the intersection of the natural and human-made world.

Guest Speakers: Throughout the year students hear from scientists, activists, and other professionals working in the environmental sciences.

Reading and Questions: In-class and homework reading are taken from textbooks, news and other current media, journal articles, and research abstracts.

Quizzes and Exams: During each unit students are asked to demonstrate understanding of the learning goals on quizzes and exams. Quizzes can be revised, exams cannot.

Gardening & Horticulture

Key Learning Goals

By the end of the school year, all Gardening students should be able to ...

- ☑ Explain why people grow plants and how gardening connects to culture, identity, and community.
- ☑ Explain what plants need to grow and how to support them in different environments.
- ☑ Build and maintain healthy soil and explain how it supports plants and ecosystems.
- ☑ Observe and respond to garden problems using data and sustainable practices.
- ☑ Grow plants from seed to harvest using safe and effective gardening techniques.
- ☑ Prepare and use harvested plants for food, medicine, and other purposes in ways that are safe, respectful, and culturally informed.
- ☑ Care for a garden as part of a team and take responsibility for shared work.
- ☑ Communicate what I've learned through observation, writing (CER), discussion, and reflection.

Essential Questions

- Why do people grow plants, and what can we learn about ourselves and our communities through gardening?
- What makes soil healthy, and how does it support the life of a garden?
- How do plants grow, and how do their structures and functions help them survive, reproduce, and interact with their environment?
- How do gardeners and farmers start new plants, and how do plants reproduce in nature and cultivation?
- How do growers create the right conditions for plants to thrive indoors and in controlled environments?
- How do gardeners manage pests and diseases while protecting the health of plants, people, and the environment?
- Why are pollinators and biodiversity essential to healthy ecosystems and gardens?
- How can we design and maintain gardens that are sustainable, regenerative, and supportive of community well-being?

Units of Study

- | | | |
|-------------------------------------|---------------------------------------|---|
| - Unit 1: "Roots" & Relationships | - Unit 4: Plant Propagation | - Unit 7: Pollinators & Biodiversity |
| - Unit 2: Soil Science & Composting | - Unit 5: Greenhouse & Indoor Growing | - Unit 8: Sustainable Gardening Practices |
| - Unit 3: Botany | - Unit 6: Integrated Pest Management | - Garden Final Project |

Resources, Texts, Approaches

Through "hands on" work in our school garden under a "master gardener," our gardening class focuses on teaching the skills of organic gardening and educating youth about the importance of eating healthy food,

using resources sustainably, and creating regenerative natural systems that help keep our community and the planet healthy. We survey a variety of fiction and non-fiction texts to understand gardening as a way people connect with their roots, their traditions and each other.

Biotechnology

Key Learning Goals

By the end of the school year, all Biotechnology students should be able to ...



Essential Questions

Major Units of Study

Resources, Texts, Approaches

Introduction to Computer Science

Key Learning Goals

By the end of the school year, all Computer Science students should be able to ...

- ☑ Create code in visual (JavaScript, Make Code) and scripted (Python) computer languages.
- ☑ Write basic programs to complete a variety of functions.
- ☑ Know how to construct data structures that are used in professional computer science applications.
- ☑ Understand the variety of applications that computer programs can be used for.
- ☑ Consider the societal impacts of the growth of computer use in the information age.

Essential Questions

- How do computers work?
- What types of languages do computers use, and what are the similarities and differences?
- What is the Internet? How is it built? How does it function?
- How is cyber-security impacting the ever increasing number of Internet users?
- How are programs developed to help people, organizations, or society to solve problems?
- How can computing and the use of computational tools foster creative expression?

Units of Study

- Computer Language Basics
- Loops and Conditions
- Variables and Custom Functions
- Lists and List Modification
- Python Scripted Language
- Global/Personal Issues in the Information Age

Resources, Texts, Approaches

Curriculum: Introduction to Computer Science,

Code.org CS Discoveries GameLab. Microbit: Make Code, CMU Python.

Technology: chromebooks

This course is a year-long exploratory study of the basics of computer programming languages. Every student works on their own Chromebook computer to complete in-class computer labs that reinforce principles presented in lecture. Students work independently or paired with instructor support. Students also have “computer culture” days, where they explore the state-of-the-art in computer science, types of careers in computing, and connections between current global issues and computer science.

AP Computer Science Principles

Key Learning Goals

By the end of the school year, all AP Computer Science Principles students should be able to ...

- ☑ Create code in a scripted programming languages (PYTHON)
- ☑ Write basic programs to complete a variety of functions.
- ☑ Know how to construct data structures that are used in professional computer science applications.
- ☑ Understand the variety of applications that computer programs can be used for.
- ☑ Consider the societal impacts of the growth of computer use in the information age.

Essential Questions

- What is Computer Science?
- What is the Internet and how does it work?
- What are algorithms and how do we make basic computer programs?
- What is data? How is data shared and interpreted?
- What is Cybersecurity and what are the impacts of it?

Major Units of Study

- Digital Information
- The Internet
- Intro to CMU Graphics and Programming
- Functions, Mouse Events, and Conditionals
- Data
- Groups, Lists, and Loops
- Complex Events, More Conditionals, and Libraries
- Cybersecurity and Global Impacts
- Creating a Performance Task
- Algorithms

Resources, Texts, Approaches

Curriculum: AP Computer Science Principles Code.org and CMU Academy (24'-25')

Technology: Gateway Tech Center

This course is a year-long exploratory study of the basics of computer programming languages. Every student works on their own Chromebook computer to complete in-class computer labs that reinforce principles presented in lecture. Students work independently or paired with instructor support. Students also have “computer culture” days, where they explore the state-of-the-art in computer science, types of careers in computing, and connections between current global issues and computer science.