GATEWAY HIGH SCHOOL
measuring success one student at a time

**Science Department Curriculum Guide 2017-2018**

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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: Planning and Carrying Out Investigations-SP3)

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

**GATEWAY SCIENCE STANDARD B: Interpreting Data**

(NGSS - Analyzing and Interpreting Data- SP 4)

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

**GATEWAY SCIENCE STANDARD C: Communicating Information**

(NGSS - Obtain, Evaluate, and Communicate Information- 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

**Key Learning Goals**

***By the end of the school year, all Environmental Science students should be able to…***

***A) Explain and give examples of the following California's Environmental Principles and Concepts (http://www.californiaeei.org/curriculum/whatistaught/epc/).***

- Principle I: The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services.
- Principle II: The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.
- Principle III: Natural systems proceed through cycles that humans depend upon, benefit from, and can alter.
- Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.
- Principle V: Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes.

***B) Demonstrate the following scientific skills…***

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

**Essential Questions**

- Environmental Science Foundations: What's our relationship to the environment?
- Water: How do water's natural properties affect weather, climate, and human development?
- Energy: What is energy, and how can we use it safely to power our civilization?
- Biodiversity: Why do some places have more biodiversity than others and how do humans impact that biodiversity?

**Units of Study**

- Environmental Science Foundations
- Water
- Energy
- Biodiversity

**Resources, Texts, Approaches**

Rather than relying on textbooks, students 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

•Presenting information to a group

•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 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.

**Essential Questions**

Unit 1: How do living things get energy?
Unit 2: How does changing an organism's DNA change its traits?
Unit 3: How are traits passed down from parents to offspring?
Unit 4: How do populations and life on Earth change over time?

**Units of Study**

- Unit 1: Energy
- Unit 2: Molecular Genetics
- Unit 3: Heredity
- 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.
- ☑ 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 sent 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
- Bonding
- Chemical Equations
- Chemical Reactions
- Stoichiometry
- Solutions Chemistry
- States of Matter
- Gas Laws
- 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 units of study include:

- Energy, Thermodynamics, and Oxidation-Reduction Reactions
- Reversible Reaction and Chemical Equilibrium

**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.
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**Units of Study**

- Scientific Process including Measurement and Graphing
- Atomic Structure
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**Resources, Texts, Approaches**

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# 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, waves, light, electricity and magnetism**. 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**

- How can we represent motion with a graph and analyze motion in both one and two dimensions?
- How do Newton's laws apply to objects at rest and in motion? How can forces be represented using a free body diagram? How do Newton's Laws apply to two or more objects?
- What is a fundamental force and how does it vary with distance?
- How is energy transformed within a system and how does work relate to energy?
- What are the relationships among angular momentum, angular velocity, angular acceleration, rotational inertia, and torque?
- What determines Simple Harmonic Motion and how is it connected to circular motion?
- What is charge and how can it be determined? What determines the force between charged objects and how is it related to gravitational force?

**Units of Study**

Unit 0: Introduction to Physics Basics
Unit 1: Kinematics
Unit 2: Newton's Laws of Motion
Unit 3. Gravitation and Circular Motion
Unit 4. Work, Energy, Power and Linear Momentum
Unit 5. Torque and Rotational Momentum
Unit 6. Simple Harmonic Motion, Waves and Sound
Unit 7. Electrostatics and Simple Electric Circuits

**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 seven **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. The student can use representations and models to communicate scientific phenomena and solve scientific problems.
2. The student can use mathematics appropriately.
3. The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.
4. The student can plan and implement data collection strategies appropriate to a particular scientific question.
5. The student can perform data analysis and evaluation of evidence.
6. The student can work with scientific explanations and theories.
7. The student is able to connect and relate knowledge across various scales, concepts and representations in and across domains.

**Essential Questions**

***Quarter One:*** What makes a cell able to survive on its own?
***Quarter Two:*** How do living things communicate, store, and replicate vital information for life?
***Quarter Three:*** How is genetic information passed from parents to offspring?
***Quarter Four:*** How have Earth's ecosystems (and populations of species within them) changed over time?

**Units of Study**

Unit 1: Molecules, Cells, & Transport
Unit 2: Energy
Unit 3: Communication and Interactions Within Organisms
Unit 4: Cell Reproduction
Unit 5: Molecular Genetics
Unit 6: Heredity
Unit 7: Evolution
Unit 8: 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**

- A Sustainable Earth
- 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

**Key Learning Goals**

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

- ☑ Understand the anatomy and the life cycle of different types of plants, and their many uses to humans and other animals.
- ☑ Experiment with different horticultural growing methods.
- ☑ Learn the principles of permaculture gardening and the benefits of urban gardening.
- ☑ Design, construct, and maintain sustainable systems including rainwater harvesting, drip irrigation, composting, and solar and wind power.
- ☑ Learn how to successfully maintain a thriving school garden throughout the year.
- ☑ Develop skills in wood construction, irrigation installation, and other technical areas.
- ☑ Prepare harvested plants for a number of different uses, including cooking, tincturing, and selling.

**Essential Questions**

- How do gardeners and farmers grow plants?
- How are different plants used by humans and other animals, and what is required to make them useful?
- How are sustainable systems designed and constructed?
- What is needed to maintain a healthy garden ecosystem all year long?
- What are the benefits of urban gardening?

**Lessons include:**

- Plant anatomy
- Seed harvesting
- Growing plants from seed
- Plant propagation
- Harvesting fruits & veggies
- Fertilizers
- Pests in the garden
- Soil food web
- Mycelium & mushrooms
- Composting
- Rainwater harvesting
- Aquatic ecosystems
- Solar energy systems
- Wind energy systems
- Water irrigation systems
- Wood construction
- Cooking vegetables
- Permaculture principle

**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 health.

# Computer Science

**Key Learning Goals**
***By the end of the school year, all Computer Science students should be able to …***

- ☑ Create code in visual (Snap) 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 will computing and automation change the structure of our economy?
- 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
- Cloning
- Python Scripted Language
- Global/Personal Issues in the Information Age

**Resources, Texts, Approaches**
***Curriculum: Introduction to Computer Science,*** Microsoft TEALS Foundation (2017)
***Technology***: Gateway Tech Center
***Additional Instructors***: Adult volunteers through the TEALS program (local industry professionals from Google, Microsoft, etc).

This course is a year-long exploratory study of the basics of computer programming languages. Every student works on their own iMac computer in the Tech Center 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.