HINGHAM HIGH SCHOOL
SCIENCE

Curriculum Overview

The science curriculum at Hingham High School is a multi-faceted program designed to provide a wide variety of learning opportunities through a number of pathways for students to follow during their high school years. Building on the strong foundations set in the Hingham Middle School, the curriculum at the high school includes the traditional core courses which are offered at several levels. Additionally, several electives are offered that allow students to apply knowledge gained in core courses and pursue specific interests and applications of technology such as in Electronics, Oceanography, Environmental Science and Anatomy and Physiology. AP courses are currently offered in Biology, Chemistry and Physics for those students with a strong interest and success in science.

All science courses reflect the Massachusetts State Science Frameworks. One of the immediate goals of the Science curriculum is to offer students a solid foundation for their successful completion of a passing score on the State MCAS exam in Science, which is a State mandated graduation requirement. The curriculum is currently set up for all students to take the Science MCAS upon the completion of Biology I. Students should take a course in Physical Science either through grade 8 IPS or grade 9 Physical Science prior to taking Biology, which will help in this endeavor.

All courses offered at the high school are lab based courses and have new technology infused into their curricula. Students will continue to develop their critical thinking skills as they opt to take science courses that reflect science inquiry as a primary method of instruction. Our new biotechnology lab has applications in several of our courses.

In addition to meeting general graduation requirements, our goals include the development of scientifically literate citizens with a concern for our natural environment, the fostering of a natural curiosity, and the building a solid knowledge base to prepare students for future study in science and help students develop sound scientific reasoning that will all them to understand current societal issues that challenge our global community.

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

ADVANCED PLACEMENT BIOLOGY

DESCRIPTIVE OVERVIEW

This course is equivalent to a freshman college course in biology and students are required to take the CEEB Examination in Advanced Placement Biology at the culmination of the course. Also, students are required to attend two extra laboratory periods per seven-day cycle to conduct labs required by the College Board curriculum. The course aims to provide students with a conceptual framework, factual knowledge, and analytical skills necessary to deal critically with the rapidly changing science of biology. The laboratory component allows students the opportunity to become proficient with the scientific method as an approach to inquiry by performing experiments that demonstrate the key biological concepts. As a result, students are expected to develop attitudes and methods of study to not only succeed in the course but also prepare them for college-level work.

GOALS AND OBJECTIVES

The **general** goals or themes of this course are as follows:

1. Students will evaluate science as a process in becoming adept at the scientific method and analyzing classic experiments in biology.
2. Students will understand the concept of evolution and biological change driven by natural selection.
3. Students will understand how energy is used in living things and energy transfer in cellular respiration and photosynthesis.
4. Students will evaluate how species maintain themselves from generation to generation using the genetic code, but also mechanisms leading to change over time.
5. Students will understand the relationship of structure and function ranging from the molecular level through living systems.
6. Students will analyze the regulation of cells, organisms, and systems and the dynamic balance of positive and negative feedback mechanisms.
7. Students will understand the interdependence in nature.
8. Students will evaluate the effect of science, technology, and society.

The College Board publishes 12 laboratory exercises to perform within the AP Biology curriculum:

1. Diffusion and Osmosis
2. Enzyme Catalysis
3. Mitosis and Meiosis
4. Plant Pigments and Photosynthesis
5. Cell Respiration
6. Molecular Biology
7. Genetics of Organisms
8. Population Genetics and Evolution
9. Transpiration
10. Physiology of the Circulatory System
11. Animal Behavior
12. Dissolved Oxygen and Aquatic Primary Productivity

INSTRUCTIONAL MODEL

In keeping with a college experience, structured discussion using a variety of visuals, models, and specimens will be the primary instructional method. Occasional student-centered projects help to motivate students and enrich a given topic. Cooperative learning is used extensively in the laboratory periods.

TEXT

Campbell, Neil A., Reece, Jane B. (2005). Biology. Seventh Edition, Benjamin/Cummings Publishing Company.

ASSESSMENT

Since the purpose of the course is to prepare for the AP examination, multiple choice and essay questions modeled by ETS will be the primary forms of assessment. Homework assignments emphasize using the text as a resource while constructing usable study guides. Regular quizzes consisting of multiple choice, matching, or short answer essays will help to pace student learning. Laboratory reports emphasizing the analysis of results, writing a comprehensive conclusion, and the analysis of laboratory questions are also an important component to student assessment. In addition to course-specific rubrics for open-response questions and laboratory reports, rubrics are also designed to address the school-wide student expectations for learning according to the mission statement.

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

ENVIRONMENTAL SCIENCE

DESCRIPTIVE OVERVIEW

Environmental science is a full year course offered at the upper standard and honors level for students in the eleventh and twelfth grades. This course offers students an introduction to basic physical, ecological, and environmental concepts underlying the relationship between human society and the natural environment. This course evaluates the problems and options available in dealing with the areas of natural resources, pollution, environmental degradation, and population growth.

As a means to examine the student's environment, many labs are done outside the classroom, in the surrounding natural environment. As well, trips to local organic farms, as well as the Deer Island Wastewater Treatment Facility provide students with hands-on experiential learning opportunities. Term projects allow students to deeply examine an environmental issue of their choice, and work to educate others and themselves by presenting the information they've learned to other classmates and potentially the greater Hingham High School community. By the end of the course, students will have critically analyzed many problems associated with current environmental issues, and be able to effectively communicate their ideas for potential solutions. This course encourages students to be productive, responsible members of a democratic and ever-changing global society.

GOALS AND OBJECTIVES

The **general** goals of this course are as follows:

1. Enhance students' understanding of environmental science concepts and issues and inquiry skills for investigating the environment.
2. Enhance students' curricular, pedagogical, and assessment knowledge and skills.
3. Prepare students to implement what they've learned in their role as a member of the local and global community.

INSTRUCTIONAL MODEL

Teacher uses a combination of collaborative learning techniques, lecture, discussion and independent study strategies. Student-designed experiments and projects, as well as field-based and classroom laboratory studies are done on a consistent basis.

TEXT

Raven, P., Berg, L., Hassenzahl, D. (2008) Environment, 6th Edition. John Wiley and Sons, Inc., Jefferson City.

ASSESSMENT

Varied assessment is used to evaluate student learning. Teacher uses tests, quizzes, homework, term projects, presentations, class discussions and class participation to evaluate a student's learning and assign grades. In addition to these methods, honors level students are required to write an additional research paper each term.
Departmental midyear and final exams are given to all students. Each counts as 10% of the overall grade.

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

PHYSICS (LEVEL 2)

DESCRIPTIVE OVERVIEW

This course is designed to provide eleventh and twelfth grade students with an effective introduction to classical physics. The subject matter includes mechanics, thermodynamics, electricity and magnetism, wave motion, optics, quantum and atomic physics. The material is presented through lecture, discussion, demonstration, and lab activities. There is an emphasis on problem solving and problem-solving skills.

GOALS AND OBJECTIVES

At the end of the course the student will

- Perform a dimensional analysis of an equation containing physical quantities whose individual units are known.
- Demonstrate the ability to calculate average velocity and to solve an equation involving velocity, distance, and time.
- Be able to solve problems of the motion of objects uniformly accelerated by gravity.
- State Newton's three laws of motion and display and understanding of their applications.
- Understand the addition of vectors and be able to solve vector addition problems.
- Demonstrate an understanding of the independence of vertical and horizontal velocities by solving problems of projectiles launched horizontally and at an angle.
- Show an understanding of the centripetal acceleration of objects in circular motion and be able to apply Newton's laws to such motion.
- Be able to calculate periods and velocities of orbiting objects by using Kepler's Laws.
- Define momentum and impulse and use the momentum-impulse theorem to calculate changes in momentum.
- State the law of conservation of momentum and use it, especially in collision problems.
- Be able to calculate kinetic and potential energy and apply the work-energy theorem.
- State the law of conservation of energy and solve problems using the law.
- Be able to calculate heat transfer.
- State the first and second law of thermodynamics and solve problems using the laws. Define a heat engine, refrigerator, and heat pump.
- Recognize that light is an electromagnetic wave, and know its wavelength range.
- Describe reflection, refraction and diffraction of a wave.
- State Coulombs law and use the law to solve problems.
- Solve problems involving current, potential difference, and power, by applying Ohm's Law.
- Explain how a changing magnetic field produces a current.
- List the factors that determine the magnitude of the force on a moving charge in a magnetic field.
- Define the photoelectric effect.
- Define the Compton Effect.
- Describe the quantum model of the atom.

Resources/References

Text: *Physics,* Cutnell & Johnson, 6th Edition (2004), Wiley & Sons, Inc
Laboratory Manuals: *Physics Lab Manual*
Physics with Computers, Vernier Software and Technology, 2003
Demonstration material
Electronic Data Collection by Vernier Software and Technology
Hand calculator Ti-85

INSTRUCTIONAL MODEL

This course uses a variety of instructional techniques. These include, but are not limited to, lecture, discussion, problem solving sessions, group work on problems, lab work in groups of two-four students, and demonstrations.

ASSESSMENT

Grades are based on tests, quizzes, homework and lab reports. Tests are both "free response" questions and multiple choice questions. Routinely, quizzes consist of "free response" questions only. Students must show all work and problem solving steps in the "free response" questions. The laboratory is an integral part of the problem solving method.

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

PHYSICS (LEVEL 3)

DESCRIPTIVE OVERVIEW

This course is designed to introduce eleventh and twelfth grade students to classical physics. An understanding of how and why things move, what energy is and how energy transforms will be developed in an effort to move students toward an appreciation of the physics they encounter on a daily basis. In particular, students will study kinematics, Newton's laws, conservation of momentum and energy, wave behavior, including sound and light, and electricity and magnetism. Physics concepts are presented through lecture, discussion, demonstration, and lab activities. There is an emphasis on developing problem-solving strategies and reasoning skills.

GOALS AND OBJECTIVES

The general goals of this course are as follows:

- to encourage an appreciation of the physical world.
- to develop problem-solving strategies and reasoning skills.
- to make students more independent thinkers through open ended labs and application questions.
- to provide the college-bound student intending to pursue additional study of science with a sound background in classical physics.

INSTRUCTIONAL MODEL

This course uses a variety of instructional techniques. These include, but are not limited to lecture, discussion, problem-solving sessions, group presentations of solutions, lab work in groups of two to four students, demonstrations and use of computer simulations. Students are asked to apply what they learn to a variety of new situations and given ample time in class to practice with guidance from the teacher.

TEXT

Physics: Principles and Problems (2009) Glencoe Div., Macmillan/McGraw Hill

ASSESSMENT

Homework assignments are graded on the quality of the students' effort. Specifically, organization, use of relevant problem-solving strategies and completeness is considered. Quizzes will be given of the same level of difficulty and covering the same material as recent homework and in-class assignments. The purpose of a quiz is to ensure students are keeping up with the work and to determine if more coverage of a topic is necessary. Grading of labs and activities is focused largely on how well students demonstrate their understanding of the concepts and the "why" behind what they did and observed. Tests will take a full class period and may cover all the material from the current topic of study. Tests will usually include a combination of question types – multiple choice, short answer questions, calculation problems, graph interpretation, etc. Tests are specifically designed to assess how well students understand the concepts and their ability to put the concepts to use correctly. Tests draw on the work done in class and on homework, and almost always require students to think through slightly new situations.

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

OCEANOGRAPHY (LEVELS 3 and 4)

DESCRIPTIVE OVERVIEW

Oceanography (Levels 3, 4) is a heterogeneously grouped science elective that provides students with an introduction to the fundamental components of studying the global oceans. There is a great variety of topics, projects, labs, and activities suited to various interests and ability levels. Students are exposed to biological, chemical, physical, and geological principles and processes concerning the ocean environment. The course emphasizes the interactions among the different components of the ocean. Human-related activities that result in marine exploitation and insults to various marine ecosystems are also evaluated. The intent is to foster a better comprehension of economic and sociological problems concerning the ocean environment. Synthesis of such issues will assist students in evaluating future questions evolving from how we regard our oceans. Although there is no formal prerequisite for this course, all students have completed physical science and biology. Some students may also be concurrently enrolled in chemistry or physics.

GOALS AND OBJECTIVES

The **general** goals of this course are as follows:

1. To interrelate biology, chemistry, physics, and geology using the global ocean as a theme.
2. To develop awareness and a sense of stewardship of the local and global oceans.
3. To enable students to consider how new technology utilizes ocean resources but may endanger those resources and create international conflict on usage rights.
4. To provide ongoing opportunities for students to interact with marine issues and topics through class labs and activities, readings and projects, advanced visuals and technology, and the use of actual materials and samples from the global oceans.
5. To draw inferences about marine issues in a logical manner as a result of class and laboratory experiences.
6. To enhance observation and information gathering skills in a laboratory environment.
7. To increase proficiency in organizing and comparing information obtained in classroom and laboratory activities.
8. To enhance the communication of information through the production of graphs, data tables, maps, models, presentations, and structured discussion.

TEXT

Greene, Thomas F. (2004). Marine Science. Marine Biology and Oceanography. Second Edition. AMSCO School Publications, Inc.

INSTRUCTIONAL MODEL

In a heterogeneously grouped classroom, varied instructional techniques are needed to meet the needs of all learners. The variety of choices of activities and projects which vary in complexity allows for the individual learning styles of students. Some examples include: whole class discussions, single or multiple-period lab activities and in-class or extended term projects that require research. There are numerous activities that require students to transfer skills across academic disciplines and apply knowledge to new situations. Certain topics or lab activities require students to use technologies incorporated into research (Internet) or simulation studies in a lab environment (hands-on). Selected class activities and assigned group projects provide cooperative learning which serve as both an instructional and assessment tool. Interested students can also participate in co-curricular activities and directed-study experiences.

ASSESSMENT

Varied assessment is used to evaluate student learning. Students construct a portfolio of work for each unit that includes notes, homework, lab reports, individual and group activities, and term projects. Quizzes and tests are also used to ensure that portfolio work has been synthesized by the learner. In addition to course-specific rubrics for projects and some laboratory assignments, rubrics are also designed to address the school-wide student expectations for learning according to the mission statement.

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

CHEMISTRY (LEVEL 2)

DESCRIPTIVE OVERVIEW

This course lays the foundation for topics generally taught in a college introductory chemistry course. Students are expected to master the basics of atomic theory and stoichiometry (chemical arithmetic) and become familiar with reactions and properties of inorganic compounds. They also learn the basics of chemical bonding, kinetics, equilibrium, and simple thermodynamics.

GOALS AND OBJECTIVES

At the end of the course the student will

1. Understand the scientific method, solve problems using dimensional analysis, express measurements with uncertainty, express calculations to the correct number of significant figures, do all kinds of density problems, and convert between centigrade and Kelvin temperature scales.
2. Recognize chemical and physical properties and changes, describe methods to separate mixtures, do calculations involving specific heat, know symbols for common elements, understand basic atomic theory, complete nuclear transformation equations, do calculations involving radioactive decay, and understand the difference between fission and fusion.
3. Write names and formulas for ionic and molecular compounds, common acids and bases, and common polyatomic ions, describe evidence for chemical equations, write and balance chemical equations.
4. Write chemical reactions for reactions in aqueous solution, classify reactions, predict whether certain reactions will occur, understand the mole concept and calculate percent composition, and determine empirical and molecular formulas.
5. Use stoichiometry to calculate mass, mole, volume for a given reaction and do calculations involving limiting reactant and percent yield.
6. Understand basics of modern atomic theory including the wave-mechanical model of the atom, know periodic trends for common properties such atomic size, ionization energy, electronegativity, and write an electron configuration for any element in the chart.
7. Distinguish ionic, molecular, metallic and network bonding and correlate types of bonds with crystal properties such as melting point. Write dot structures and predict shapes of molecules using VSEPR theory, and use electronegativity to predict polarity of a molecule.
8. Calculate volume, pressure, temperature and moles using gas law equations. Understand implications of kinetic molecular theory at a basic level, and calculate stoichiometry problems involving gases.
9. Describe intra-molecular and intermolecular forces in solids and liquids and how these account for properties. Calculate energy requirements for changes of state.
10. Express solution concentrations in terms of mass or volume percent, molarity and molality. Do stoichiometry problems involving solution concentrations. Do calculations involving colligative properties such as freezing point depression.
11. Write acid-base equations, calculate pH, understand buffers, calculate concentrations from titration data, and understand the difference between strong and weak acids and bases.
12. Apply Le Chatelier's Principle to equilibrium systems, calculate equilibrium constants and molar concentrations, including solubility product calculations, describe factors that affect rates of reactions. Calculate quantities in electrochemical cells and oxidation reduction reactions, and understand the basic equations for electrolysis, batteries and corrosion.

INSTRUCTIONAL MODEL

Students learn chemical facts and principles from lecture and the text. Laboratory work in groups gives students a chance to verify the truth of what is being presented, and to note any discrepancies that arise from oversimplification. Evidence from lab work is supplemented by teacher demonstrations, films, and experiments shown in audio-visual materials (video, DVD, CD). Laboratory work provides students with direct experience with chemicals, apparatus, and manipulations. Labs are drawn from a variety of sources and modified to fit the time available. New labs are added and some discarded each year. Generally there are five to eight labs done each term. Laboratory exercises originally designed for a double lab period have been scaled back to fit in a 40-45 minute period.

TEXT / RESOURCES

Wilbraham, Antony C., et. al., *Prentice-Hall Chemistry*, Pearson/ Prentice-Hall, Needham, MA, 2005.
Zumdahl, Steven S., *Introductory Chemistry: A Foundation*. 4th Edition, Houghton Mifflin Co., Boston, 2000.
Hall, James F., *Zumdahl: Solutions Guide*. 4th Edition, Houghton Mifflin Co., Boston, 2000.

ASSESSMENT

Teachers use tests, quizzes, lab reports and homework to assess learning and to assign grades. Points are assigned to each item and the grade is calculated according to a total points system. First, total number of points for a given term is calculated. The sum of points earned by a student divided by the total possible is expressed as a percent: this is the term grade. Departmental midyear and final exams are given to all students and graded in a standardized way. Each counts 10% of the course grade.

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

ELECTRONICS I
(LEVELS 2, 3, and 4)

DESCRIPTIVE OVERVIEW

Through the use of experimentation, the beginning student is introduced to learning experiences which should help develop a sound practical understanding of basic electrical and electronic concepts. These concepts provide sufficient background for students to gain an intelligent understanding of electricity and electronics.

PHILOSOPHY

In this course the students are presented principles and use laboratory work to reinforce concepts. Students learn from listening and taking notes in lecture and by reading and doing problems from the text. Hands-on/laboratory work gives students a chance to verify the validity of what is being presented. The evidence from lab work is supplemented by teacher demonstrations, films, and other audio-visual materials. Learning standards for electronics fall under the following subtopics in the Massachusetts Frameworks in Science and Technology: *Electromagnetism;* and *Electromagnetic Radiation; Energy and Power Technologies—Electrical Systems;* and *Communication Technologies.*

AREAS COVERED IN THIS COURSE

Introduction: In this section, the student is introduced to electrical safety, the language of electronics, basic instrumentation, switches, and sources of electricity.

Ohm's Law: Investigated under this section are: The relationship of resistance, voltage, amperage, and power to series and parallel circuits, function and use of combination circuits.

Instrumentation: In this section, the student studies the operation of a voltmeter, ammeter, and ohmmeter.

Magnetism: The student investigates permanent magnets, electromagnets, and the general characteristics of electromagnetism and their uses.

Direct and Alternating Current: This section includes a comparison of direct and alternating current.

Inductance: The student studies the effect of inductance in a.c. and d.c. circuits.

Capacitance: In this section, the student studies the capacitor and the effects of capacitance in a.c. and d.c. circuits.

Resonance: The student studies the relationship of inductance and capacitance in a series and parallel resonant circuit.

Motors: In this section, the student studies the permanent magnet d.c. motors.

Semiconductors: The student studies the general characteristics of semiconductors. ie: diodes, LEDs, transistors.

GOALS AND OBJECTIVES

The course is designed to meet the needs of students who are interested in the field of electricity-electronics. The general objectives are the following:

- To provide background material for students who plan to make electricity-electronics their career.
- To provide an opportunity for students to gain a basic understanding of electricity-electronics, this will be of benefit in the present and future.
- To provide students an opportunity to perform in a laboratory oriented atmosphere.
- To provide students with an opportunity to expand their present knowledge of electricity-electronics so as to properly and safely make basic repairs and construct electrical instruments and devices.

TEXT - (Various texts are used for different units.)

Basic Electronics, McWhorten and Evans, 2000, Master Publishing, Inc.

Lab Manuals:

Gerrish. Practical Electricity & Electronics: Fundamentals for A.F. Communication. Volumes 1, 2, 3 and 4, Buck Engineering Co., Inc., Farmingdale, New Jersey 1982

Gerrish/Dugger. Transistor Electronics (1st ed.) The Goodheart-Willcox Co., Inc. 1979 (Primary Text)

Gerrish. Fundamentals for Instrumentation, Buck Engineering Co., Inc., Farmingdale, New Jersey 1982

Libes. Digital Electronics Concepts and Applications (1st ed.) 1983 Buck Engineering Co., Inc., Farmingdale, New Jersey

Libes. Advanced Digital Logic Concepts (1st ed.) 1983 Buck Engineering Co., Inc., Farmingdale, New Jersey

Libes. Microprocessor Concepts and Application 1983 Buck Engineering Co., Inc., Farmingdale, New Jersey

Gates. Introduction to Electronics (3rd ed.) Delmar Publishing 1997

Basic Electronic Experiments (Mode/PK101) Elenco Electronics, Inc. USA 1999

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

COURSE 533, 534: PHYSICAL SCIENCE
LEVELS 3, 4

DESCRIPTIVE OVERVIEW

This course is a one-year introductory physical science that is the preparatory course for later courses in biology, chemistry, physic and is designed for a L-3 college bound students that have completed Life Science in grade 7 and Earth Science in Grade 8.. Modifications in the program may be made for students opting to take the course at level 4. The course consists of seven (7) major units that progressively develop and apply fundamental mathematical and scientific reasoning techniques. The seven major units are:

1. Physical Science Skills
2. Properties of Matter
3. Atomic Structure
4. Solutions, Acids, Bases
5. Motion and Forces
6. Work, Power, Machines
7. Electricity, Magnetism, Waves, Optics and Sound

GOALS AND OBJECTIVES

The general goals and objectives of the course are

1. To prepare the student for further study in the sciences.
2. To learn and apply organizational and study skills.
3. To find and use appropriate references in problem solving.
4. To understand that science is a process of formal inquiry, with recognition of its potential, usefulness, limitations, and social implications.
5. To realize the value of group activities and recognize the importance of individual input.
6. To define and outline problems so that they may be analyzed by a logical sequence of steps (the Scientific Method).
7. To increase the use of the communication arts – reading with perception and understanding, critical listening, effective speaking and writing, and effective participation in group discussion and laboratory activities.
8. To encourage individual "hands-on" activities – projects.
9. To support other programs in the curriculum through writing lab reports, presenting oral topics, mastering the skills involved in reading and interpreting a science text (mathematical skills such as the use of the metric system, graphing, and scientific notation are emphasized).
10. To become aware of careers in the physical sciences and appreciate technology and technological development

INSTRUCTIONAL MODEL

For the most part students learn from interactive lecture and the text complemented by labs, projects and in class discussions. Generally, there is a project presented by the students each semester and as time permits. Students will develop their ability able to read and follow lab procedure during the course of the progressive units .The first six units are covered extensively and the seventh unit is touched upon as time permits. Labs are used to give students a chance to reinforce concepts and utilize the inquiry process. The evidence from lab work is used to supplement a student's conceptual framework. .

ASSESSMENT

Assessment is done through student labs, homework, quizzes, tests, group and individual projects.

TEXT

Text book used is Prentice Hall *Physical Science, Concepts in Action*. It has on line capabilities for students review at home.

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

COURSES 542, 543, 544: BIOLOGY I
LEVELS 2, 3, 4

DESCRIPTIVE OVERVIEW

This course is designed for all students that have successfully completed courses in life science and physical science while in grades 7, 8 or 9. It assumes prior knowledge from these courses and builds on the concepts and scientific inquiry process as taught therein. All levels of the course cover the same units as outlined in the State Frameworks of Massachusetts, with each level modified to allow for individual learning styles. Level 2, in particular, is designed for the student that can read independently for content meaning and is ready to utilize higher order thinking skills while pursuing a study that leads up to both the successful passing of the state MCAS exam and the possible participation in the SATII in Biology at the end of the year. All students will pursue a study which covers units in cell biology, ecology, plant and animal systems, evolution, genetics and human systems. All students taking Biology I will participate in the state MCAS exam given in June.

GOALS AND OBJECTIVES

General: Students who complete this course successfully will demonstrate their ability to meet the following school-wide expectations as measured by the indicators listed below.

1. **Read purposefully as indicated by their ability to**
   - Use the textbook as a source of information and preparation for material to be covered in class.
   - Show understanding of the reading of directions for activities in the classroom and lab.
   - Use current internet articles to relate to concepts studied in the classroom.
2. **Write effectively as indicated by their ability to**
   - Present logical and well written explanations of concepts in open response questions on exams.
   - Write clear explanations of observations in activities in lab reports.
3. **Communicate effectively as indicated by their ability to**
   - Show ability to share information obtained in lab with other students.
   - Demonstrate ability to communicate findings of a major project and present it to an audience.
4. **Identify, analyze, and solve problems as indicated by their ability to**
   - Solve problems throughout the year on various topics including genetics, osmosis, DNA transcription, etc.
   - Demonstrate the ability to construct a controlled experiment to test a hypothesis.
   - Interpret quantitative data in the construction of graphs and charts.
   - Analyze data obtained in the laboratory and relate it to concepts learned in the text.

Specific:

Using the indicators above, students will demonstrate scientific literacy and understanding of the common concepts in the broad areas below as defined by the Massachusetts Department of Education Standards (as outlined in the standards for a high school biology course as of January 2006.)

1. Chemistry of Life
2. Cell Biology
3. Genetics
4. Anatomy and Physiology
5. Evolution and Diversity
6. Ecology

INSTRUCTIONAL MODEL

This course is a lab based course with extensive use of technology and hands on experiences. Class discussions, projects, instructive PowerPoint lessons and lab inquiry experiences form the basis of instructional for this course. An interactive, on line text is used in conjunction with SmartBoard activities, PowerPoint lessons and note taking. Students will be encouraged to use the most current technology and their own learning styles to enhance the learning process. Extensive lab experiences will include in-school lab studies and progressive research projects both in the lab and the field. The use of internet web sites as described in the text, tutorial and model lab exercises provided will enhance the basic core units of the course. It is hoped that students will seize the opportunity of many open-ended labs to tailor the course to their own areas of high interest. The course is tailored for student success in the MCAS exam in Biology and the most successful students are encouraged to take the SAT II Biology Test (Type E) provided by the CEEB in June.

ASSESSMENT

Assessment is done through student labs, homework, quizzes, tests, group and individual projects.

TEXT

Biology, Miller and Levine, 2006.

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

COURSE 552: CHEMISTRY
LEVEL 2

DESCRIPTIVE OVERVIEW

This course lays the foundation for topics generally taught in a college introductory chemistry course. Students are expected to master the basics of atomic theory and stoichiometry (chemical arithmetic) and become familiar with reactions and properties of inorganic compounds. They also learn the basics of chemical bonding, kinetics, equilibrium, and simple thermodynamics.

GOALS AND OBJECTIVES

At the end of the course the student will

1. Understand the scientific method, solve problems using dimensional analysis, express measurements with uncertainty, express calculations to the correct number of significant figures, do all kinds of density problems, and convert between centigrade and Kelvin temperature scales.
2. Recognize chemical and physical properties and changes, describe methods to separate mixtures, do calculations involving specific heat, know symbols for common elements, understand basic atomic theory, complete nuclear transformation equations, do calculations involving radioactive decay, and understand the difference between fission and fusion.
3. Write names and formulas for ionic and molecular compounds, common acids and bases, and common polyatomic ions, describe evidence for chemical equations, write and balance chemical equations.
4. Write chemical reactions for reactions in aqueous solution, classify reactions, predict whether certain reactions will occur, understand the mole concept and calculate percent composition, and determine empirical and molecular formulas.
5. Use stoichiometry to calculate mass, mole, volume for a given reaction and do calculations involving limiting reactant and percent yield.
6. Understand basics of modern atomic theory including the wave-mechanical model of the atom, know periodic trends for common properties such atomic size, ionization energy, electronegativity, and write an electron configuration for any element in the chart.
7. Distinguish ionic, molecular, metallic and network bonding and correlate types of bonds with crystal properties such as melting point. Write dot structures and predict shapes of molecules using VSEPR theory, and use electronegativity to predict polarity of a molecule.
8. Calculate volume, pressure, temperature and moles using gas law equations. Understand implications of kinetic molecular theory at a basic level, and calculate stoichiometry problems involving gases.
9. Describe intra-molecular and intermolecular forces in solids and liquids and how these account for properties. Calculate energy requirements for changes of state.
10. Express solution concentrations in terms of mass or volume percent, molarity and molality. Do stoichiometry problems involving solution concentrations. Do calculations involving colligative properties such as freezing point depression.
11. Write acid-base equations, calculate pH, understand buffers, calculate concentrations from titration data, and understand the difference between strong and weak acids and bases.
12. Apply Le Chatelier's Principle to equilibrium systems, calculate equilibrium constants and molar concentrations, including solubility product calculations, describe factors that affect rates of reactions. Calculate quantities in electrochemical cells and oxidation reduction reactions, and understand the basic equations for electrolysis, batteries and corrosion.

INSTRUCTIONAL MODEL

Students learn chemical facts and principles from lecture and the text. Laboratory work in groups gives students a chance to verify the truth of what is being presented, and to note any discrepancies that arise from oversimplification. Evidence from lab work is supplemented by teacher demonstrations, films, and experiments shown in audio-visual materials (video, DVD, CD). Laboratory work provides students with direct experience with chemicals, apparatus, and manipulations. Labs are drawn from a variety of sources and modified to fit the time available. New labs are added and some discarded each year. Generally there are five to eight labs done each term. Laboratory exercises originally designed for a double lab period have been scaled back to fit in a 40-45 minute period.

ASSESSMENT

Teachers use tests, quizzes, lab reports and homework to assess learning and to assign grades. Points are assigned to each item and the grade is calculated according to a total points system. First, total number of points for a given term is calculated. The sum of points earned by a student divided by the total possible is expressed as a percent: this is the term grade. Departmental midyear and final exams are given to all students and graded in a standardized way. Each counts 10% of the course grade.

TEXT / RESOURCES

Wilbraham, Antony C., et. al., *Prentice-Hall Chemistry*, Pearson/ Prentice-Hall, Needham, MA, 2005.
Zumdahl, Steven S., *Introductory Chemistry: A Foundation*. 4th Edition, Houghton Mifflin Co., Boston, 2000.
Hall, James F., *Zumdahl: Solutions Guide*. 4th Edition, Houghton Mifflin Co., Boston, 2000.

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

COURSE 553: CHEMISTRY
LEVEL 3

DESCRIPTIVE OVERVIEW

Level 3 Chemistry, for students in grades ten, eleven, and twelve, combines traditional topics in chemistry with a curriculum that is more student-centered, inquiry-based and activity-oriented to better meet the needs of students with varied abilities and interest in the subject. The course emphasizes decision-making, critical thinking, and problem solving skills. The topics covered include: Properties of Matter, Atomic Structure and Bonding, Chemical Formulas & Reactions, Chemical Quantities, States of Matter, Thermodynamics, Equilibrium, Acid/Base and Redox reactions.

GOALS AND OBJECTIVES

1. Read purposefully
- Show understanding of the textbook by completion of Reading Guides and Section Review questions
- Read lab purpose and procedures and answer pre-lab and post-lab questions

2. Write effectively
- Complete open response questions on worksheets and tests
- Answer questions on lab reports

3. Communicate effectively
- Ask and answer questions during class discussion
- Discuss procedures and questions with lab partners
- Make contributions to group work/activities

4. Identify, analyze, and solve problems
- List knowns and unknowns in chemistry problems
- Find the right equation to solve problems
- Use calculator correctly to solve problems
- Evaluate the answer to see if makes sense
- Analyze data from Vernier computer-based labs

5. Demonstrate self-respect and respect for others
- Show courtesy to lab partners
- Adhere to safety guidelines in lab
- Display academic integrity on tests, quizzes, homework and lab reports

6. Work both independently and cooperatively with others
- Participate cooperatively in lab with one or more partners
- Contribute positively to group activities
- Work independently on tests, quizzes, homework and lab reports

7. Fulfill their responsibilities and exercise their rights as members of local and global communities.
- Exercise proper use and disposal of chemicals, both in school and at home
- Encourage conservation of chemical resources (i.e. recycling plastics)

INSTRUCTIONAL STRATEGIES

The goal of Level 3 Chemistry is to achieve student learning by means of a number of different activities. Traditional activities include lecture/discussion classes using PowerPoint presentations, teacher provided examples, demonstrations, and chemical models. Selected programs from the Anneberg World of Chemistry video series are shown where appropriate. The balance of class time is used for student-centered activities involving the problem solving, decision-making, and critical thinking which are inherent in the curriculum. These activities, usually done in small groups, include lab experiments (both traditional and computer-based), worksheets, and short-term projects.

ASSESSMENT

Assessment is done through student labs, homework, quizzes, tests, group and individual projects.

TEXT AND REFERENCES

Textbook: Prentice Hall Chemistry, Wilbraham, Staley, Matta & Waterman, Pearson Prentice Hall, Upper Saddle River, New Jersey, 2005

Online Textbook: http://www.pearsonsuccessnet.com

Laboratory Manuals:

Prentice Hall Chemistry Lab Manual, Wilbraham, Staley, Matta & Waterman, Pearson Prentice Hall, Upper Saddle River, New Jersey, 2005

Prentice Hall Chemistry Small-Scale Lab Manual, Wilbraham, Staley, Matta & Waterman, Pearson Prentice Hall, Upper Saddle River, New Jersey, 2005

Chemistry: Connections to Our Changing World, Prentice-Hall, Inc., Upper Saddle River, New Jersey, 1996

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

COURSE 562: PHYSICS
LEVEL 2

DESCRIPTIVE OVERVIEW

This course is designed to provide eleventh and twelfth grade students with an effective introduction to classical physics. The subject matter includes mechanics, thermodynamics, electricity and magnetism, wave motion, optics, quantum and atomic physics. The material is presented through lecture, discussion, demonstration, and lab activities. There is an emphasis on problem solving and problem-solving skills.

GOALS AND OBJECTIVES

At the end of the course the student will

- Perform a dimensional analysis of an equation containing physical quantities whose individual units are known.
- Demonstrate the ability to calculate average velocity and to solve an equation involving velocity, distance, and time.
- Be able to solve problems of the motion of objects uniformly accelerated by gravity.
- State Newton's three laws of motion and display and understanding of their applications.
- Understand the addition of vectors and be able to solve vector addition problems.
- Demonstrate an understanding of the independence of vertical and horizontal velocities by solving problems of projectiles launched horizontally and at an angle.
- Show an understanding of the centripetal acceleration of objects in circular motion and be able to apply Newton's laws to such motion.
- Be able to calculate periods and velocities of orbiting objects by using Kepler's Laws.
- Define momentum and impulse and use the momentum-impulse theorem to calculate changes in momentum.
- State the law of conservation of momentum and use it, especially in collision problems.
- Be able to calculate kinetic and potential energy and apply the work-energy theorem.
- State the law of conservation of energy and solve problems using the law.
- Be able to calculate heat transfer.
- State the first and second law of thermodynamics and solve problems using the laws. Define a heat engine, refrigerator, and heat pump.
- Recognize that light is an electromagnetic wave, and know its wavelength range.
- Describe reflection, refraction and diffraction of a wave.
- State Coulombs law and use the law to solve problems.
- Solve problems involving current, potential difference, and power, by applying Ohm's Law.
- Explain how a changing magnetic field produces a current.
- List the factors that determine the magnitude of the force on a moving charge in a magnetic field.
- Define the photoelectric effect.
- Define the Compton Effect.
- Describe the quantum model of the atom.

INSTRUCTIONAL MODEL

This course uses a variety of instructional techniques. These include, but are not limited to, lecture, discussion, problem solving sessions, group work on problems, lab work in groups of two-four students, and demonstrations.

ASSESSMENT

Grades are based on tests, quizzes, homework and lab reports. Tests are both "free response" questions and multiple choice questions. Routinely, quizzes consist of "free response" questions only. Students must show all work and problem solving steps in the "free response" questions. The laboratory is an integral part of the problem solving method.

RESOURCES/REFERENCES

Text: *Physics*, Cutnell & Johnson, 6th Edition (2004), Wiley & Sons, Inc
Laboratory Manuals: *Physics Lab Manual*
Physics with Computers, Vernier Software and Technology, 2003
Demonstration material
Electronic Data Collection by Vernier Software and Technology
Hand calculator Ti-85

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

COURSE 563: PHYSICS
LEVEL 3

DESCRIPTIVE OVERVIEW

This course is designed to introduce eleventh and twelfth grade students to classical physics. An understanding of how and why things move, what energy is and how energy transforms will be developed in an effort to move students toward an appreciation of the physics they encounter on a daily basis. In particular, students will study kinematics, Newton's laws, conservation of momentum and energy, wave behavior, including sound and light, and electricity and magnetism. Physics concepts are presented through lecture, discussion, demonstration, and lab activities. There is an emphasis on developing problem-solving strategies and reasoning skills.

GOALS AND OBJECTIVES

The general goals of this course are as follows:

- to encourage an appreciation of the physical world.
- to develop problem-solving strategies and reasoning skills.
- to make students more independent thinkers through open ended labs and application questions.
- to provide the college-bound student intending to pursue additional study of science with a sound background in classical physics

INSTRUCTIONAL MODEL

This course uses a variety of instructional techniques. These include, but are not limited to lecture, discussion, problem-solving sessions, group presentations of solutions, lab work in groups of two to four students, demonstrations and use of computer simulations. Students are asked to apply what they learn to a variety of new situations and given ample time in class to practice with guidance from the teacher.

ASSESSMENT

Homework assignments are graded on the quality of the students' effort. Specifically, organization, use of relevant problem-solving strategies and completeness is considered. Quizzes will be given of the same level of difficulty and covering the same material as recent homework and in-class assignments. The purpose of a quiz is to ensure students are keeping up with the work and to determine if more coverage of a topic is necessary. Grading of labs and activities is focused largely on how well students demonstrate their understanding of the concepts and the "why" behind what they did and observed. Tests will take a full class period and may cover all the material from the current topic of study. Tests will usually include a combination of question types – multiple choice, short answer questions, calculation problems, graph interpretation, etc. Tests are specifically designed to assess how well students understand the concepts and their ability to put the concepts to use correctly. Tests draw on the work done in class and on homework, and almost always require students to think through slightly new situations.

TEXT

Physics: Principles and Problems (2009) Glencoe Div., Macmillan/McGraw Hill

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

COURSES 572, 573, 574: ELECTRONICS I
LEVELS 2, 3, AND 4

DESCRIPTIVE OVERVIEW

Electronics I is designed to provide experiences that will lead to a basic knowledge of electricity-electronics in the modern world. Through the use of experimentation, the beginning student is introduced to learning experiences which should help develop a sound practical understanding of basic electrical and electronic concepts. A detailed study and practice in the use of test instruments for examining the characteristics of direct and alternating current circuits, semi-conductors and robotics. These concepts provide sufficient background for students to gain an intelligent understanding of electricity and electronics.

GOALS AND OBJECTIVES

Learning standards for electronics fall under the following subtopics in the Massachusetts Frameworks in Science and Technology: *Electromagnetism;* and *Electromagnetic Radiation; Energy and Power Technologies—Electrical Systems;* and *Communication Technologies.*
The general objectives are the following:

- To provide background material for students who plan to make electricity-electronics their career.
- To provide an opportunity for students to gain a basic understanding of electricity-electronics, this will be of benefit in the present and future.
- To provide students an opportunity to perform in a laboratory oriented atmosphere.
- To provide students with an opportunity to expand their present knowledge of electricity-electronics so as to properly and safely make basic repairs and construct electrical instruments and devices.

INSTRUCTIONAL MODEL

In this course the students are presented principles and use laboratory work to reinforce concepts. Students learn from listening and taking notes in lecture and by reading and doing problems from the text. Hands-on/laboratory work gives students a chance to verify the validity of what is being presented. The evidence from lab work is supplemented by teacher demonstrations, films, and other audio-visual materials.

ASSESSMENT

Assessment is done through student labs, homework, quizzes, tests, group and individual projects.

TEXT - (Various texts are used for different units.)
Basic Electronics, McWhorten and Evans, 2000, Master Publishing, Inc.

Lab Manuals:

Gerrish. Practical Electricity & Electronics: Fundamentals for A.F. Communication. Volumes 1, 2, 3 and 4, Buck Engineering Co., Inc., Farmingdale, New Jersey 1982
Gerrish/Dugger. Transistor Electronics (1st ed.) The Goodheart-Willcox Co., Inc. 1979 (Primary Text)
Gerrish. Fundamentals for Instrumentation, Buck Engineering Co., Inc., Farmingdale, New Jersey 1982
Libes. Digital Electronics Concepts and Applications (1st ed.) 1983 Buck Engineering Co., Inc., Farmingdale, New Jersey
Libes. Advanced Digital Logic Concepts (1st ed.) 1983 Buck Engineering Co., Inc., Farmingdale, New Jersey
Libes. Microprocessor Concepts and Application 1983 Buck Engineering Co., Inc., Farmingdale, New Jersey
Gates. Introduction to Electronics (3rd ed.) Delmar Publishing 1997
Basic Electronic Experiments (Mode/PK101) Elenco Electronics, Inc. USA 1999

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

COURSES 576, 577: ELECTRONICS II
LEVELS 2 AND 3

DESCRIPTIVE OVERVIEW

This course is designed for those students who have successfully completed the Electricity-Electronics I program and who wish to continue their study in electronics. The Electricity-Electronics I course provides the student with sufficient background material so that a detailed study of tubes, transistors, semiconductors, and digital electronics is possible. Topics of study in this course include a review of Ohm's law, RCL Circuits, Resonance, Rectifier Circuits, Tubes, Semiconductors, Amplifiers, Integrated Circuits, Oscillators, and Digital Electronics

GOALS AND OBJECTIVES

The course is designed to meet the needs of students who plan to specialize in the area of electronics.

A. To provide background material for students who plan to make electronics their career.
B. To provide an opportunity for students to evaluate the electronics field and help them decide if this is what they desire for a career.
C. To provide students with an opportunity to perform in a highly sophisticated laboratory atmosphere.
D. To provide students with an opportunity to diagnose and correct sophisticated circuit characteristics.
E. To provide students with the opportunity to plan, construct, and evaluate electronic instruments.

Students will develop their ability to solve problems in technology/engineering using mathematical and scientific concepts. Students are able to relate concepts and principles they have learned in science with knowledge gained in the study of technology/engineering. For example, a well-rounded understanding of energy and power equips students to tackle such issues as the ongoing problems associated with energy supply and energy conservation.

INSTRUCTIONAL MODEL

As in the first year program, the student uses experimentations in the form of learning experiences to provide an understanding of the principles and concepts involved in tubes, transistors, semiconductors, and digital electronics. The Lab-Volt Student Experience Systems Model 1211 is used for a detailed study of transistors and semiconductor circuits. In this course the students are presented principles and use laboratory work to reinforce concepts. Students learn from listening and taking notes in lecture and by reading and doing problems from the text. Hands-on/laboratory work gives students a chance to verify the validity of what is being presented. The evidence from lab work is supplemented by teacher demonstrations, films, and other audio-visual materials.

ASSESSMENT

Assessment is done through student labs, homework, quizzes, tests, group and individual projects.

TEXT/REFERENCES

Basic Electronics, McWhorten and Evans, 2000, Master Publishing, Inc.

Lab Manuals and References:

Gerrish. Practical Electricity & Electronics: Fundamentals for A.F. Communication. Volumes 1, 2, 3 and 4, Buck Engineering Co., Inc., Farmingdale, New Jersey 1982
Libes. Digital Electronics Concepts and Applications (1st ed.) 1983 Buck Engineering Co., Inc., Farmingdale, New Jersey
Libes. Advanced Digital Logic Concepts (1st ed.) 1983 Buck Engineering Co., Inc., Farmingdale, New Jersey
Libes. Microprocessor Concepts and Application 1983 Buck Engineering Co., Inc., Farmingdale, New Jersey
Gates. Introduction to Electronics (3rd ed.) Delmar Publishing 1997

Basic Electronic Experiments (Mode/PK101) Elenco Electronics, Inc. USA 1999

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

COURSE 582: ANATOMY & PHYSIOLOGY
LEVEL 2

DESCRIPTIVE OVERVIEW

This is a year-long course open to Grade 12 students that have completed a course in biology that wish to pursue their study of human body systems with the primary objective of providing students a more in depth study of the human body than was able to be done in Biology I. Extensive in depth study is done on the structure and functioning of all human systems, including histology, clinical applications and lab activities that include some dissection of related animal organs. On-line resources, case studies, and clinical applications are used extensively. Current health topics and advances in medical technology are examined. The material is presented at the honors level and assumes prior knowledge of concepts presented in biology, chemistry and some physics.

GOALS AND OBJECTIVES

The objectives for this course are

A. to provide students with a basic understanding of the structure and functions of the human body
B. to provide future science and non-science college majors a strong background in human biology
C. to provide for future professional careers requiring a strong anatomy and physiology background
D. to examine advances in technology as it applies to human biology and medicine

INSTRUCTIONAL MODEL

This lab based course is divided into 6 units and follows a systematic approach to a study of the human body. The units of levels of organization, support and movement, integration and coordination, transport, absorption and excretion, and the human life cycle are explored through interactive PowerPoint lessons combined with lab investigations throughout the course. Some digital data collection systems are used, as are interactive websites suggested in the text and related internet resources.

ASSESSMENT

Assessment is done through student labs, quizzes, tests, group and individual projects.

TEXT

Marieb, Elaine, The Essentials of Human Anatomy and Physiology**.** Prentice Hall, New Jersey, 2006.

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

COURSE 586, 587: ENVIRONMENTAL SCIENCE
LEVELS 2 AND 3

DESCRIPTIVE OVERVIEW

Environmental science is a full year course offered at the upper standard and honors level for students in the eleventh and twelfth grades. This course offers students an introduction to basic physical, ecological, and environmental concepts underlying the relationship between human society and the natural environment. This course evaluates the problems and options available in dealing with the areas of natural resources, pollution, environmental degradation, and population growth. As a means to examine the student's environment, many labs are done outside the classroom, in the surrounding natural environment. As well, trips to local organic farms, as well as the Deer Island Wastewater Treatment Facility provide students with hands-on experiential learning opportunities. Term projects allow students to deeply examine an environmental issue of their choice, and work to educate others and themselves by presenting the information they've learned to other classmates and potentially the greater Hingham High School community. By the end of the course, students will have critically analyzed many problems associated with current environmental issues, and be able to effectively communicate their ideas for potential solutions. This course encourages students to be productive, responsible members of a democratic and ever-changing global society.

GOALS AND OBJECTIVES

The **general** goals of this course are as follows:

1. Enhance students' understanding of environmental science concepts and issues and inquiry skills for investigating the environment.
2. Enhance students' curricular, pedagogical, and assessment knowledge and skills.
3. Prepare students to implement what they've learned in their role as a member of the local and global community.

INSTRUCTIONAL MODEL

Teacher uses a combination of collaborative learning techniques, lecture, discussion and independent study strategies. Student-designed experiments and projects, as well as field-based and classroom laboratory studies are done on a consistent basis.

ASSESSMENT

Varied assessment is used to evaluate student learning. Teacher uses tests, quizzes, homework, term projects, presentations, class discussions and class participation to evaluate a student's learning and assign grades. In addition to these methods, honors level students are required to write an additional research paper each term.
Departmental midyear and final exams are given to all students. Each counts as 10% of the overall grade.

TEXT

Raven, P., Berg, L., Hassenzahl, D. (2008) Environment, 6th Edition. John Wiley and Sons, Inc., Jefferson City.

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

COURSE 597, 598: OCEANOGRAPHY
LEVELS 3 AND 4

DESCRIPTIVE OVERVIEW

Oceanography (Levels 3, 4) is a heterogeneously grouped science elective that provides students with an introduction to the fundamental components of studying the global oceans. There is a great variety of topics, projects, labs, and activities suited to various interests and ability levels. Students are exposed to biological, chemical, physical, and geological principles and processes concerning the ocean environment. The course emphasizes the interactions among the different components of the ocean. Human-related activities that result in marine exploitation and insults to various marine ecosystems are also evaluated. The intent is to foster a better comprehension of economic and sociological problems concerning the ocean environment. Synthesis of such issues will assist students in evaluating future questions evolving from how we regard our oceans. Although there is no formal prerequisite for this course, all students have completed physical science and biology. Some students may also be concurrently enrolled in chemistry or physics.

GOALS AND OBJECTIVES

The **general** goals of this course are as follows:

1. To interrelate biology, chemistry, physics, and geology using the global ocean as a theme.
2. To develop awareness and a sense of stewardship of the local and global oceans.
3. To enable students to consider how new technology utilizes ocean resources but may endanger those resources and create international conflict on usage rights.
4. To provide ongoing opportunities for students to interact with marine issues and topics through class labs and activities, readings and projects, advanced visuals and technology, and the use of actual materials and samples from the global oceans.
5. To draw inferences about marine issues in a logical manner as a result of class and laboratory experiences.
6. To enhance observation and information gathering skills in a laboratory environment.
7. To increase proficiency in organizing and comparing information obtained in classroom and laboratory activities.
8. To enhance the communication of information through the production of graphs, data tables, maps, models, presentations, and structured discussion.

INSTRUCTIONAL MODEL

In a heterogeneously grouped classroom, varied instructional techniques are needed to meet the needs of all learners. The variety of choices of activities and projects which vary in complexity allows for the individual learning styles of students. Some examples include: whole class discussions, single or multiple-period lab activities and in-class or extended term projects that require research. There are numerous activities that require students to transfer skills across academic disciplines and apply knowledge to new situations. Certain topics or lab activities require students to use technologies incorporated into research (Internet) or simulation studies in a lab environment (hands-on). Selected class activities and assigned group projects provide cooperative learning which serve as both an instructional and assessment tool. Interested students can also participate in co-curricular activities and directed-study experiences.

ASSESSMENT

Varied assessment is used to evaluate student learning. Students construct a portfolio of work for each unit that includes notes, homework, lab reports, individual and group activities, and term projects. Quizzes and tests are also used to ensure that portfolio work has been synthesized by the learner. In addition to course-specific rubrics for projects and some laboratory assignments, rubrics are also designed to address the school-wide student expectations for learning according to the mission statement.

TEXT

Greene, Thomas F. (2004). Marine Science. Marine Biology and Oceanography. Second Edition. AMSCO School Publications, Inc.

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

COURSE 546: ADVANCED PLACEMENT BIOLOGY
LEVEL 1

DESCRIPTIVE OVERVIEW

This course is equivalent to a freshman college course in biology and students are required to take the CEEB Examination in Advanced Placement Biology at the culmination of the course. Also, students are required to attend two extra laboratory periods per seven-day cycle to conduct labs required by the College Board curriculum. The course aims to provide students with a conceptual framework, factual knowledge, and analytical skills necessary to deal critically with the rapidly changing science of biology. The laboratory component allows students the opportunity to become proficient with the scientific method as an approach to inquiry by performing experiments that demonstrate the key biological concepts. As a result, students are expected to develop attitudes and methods of study to not only succeed in the course but also prepare them for college-level work.

GOALS AND OBJECTIVES

The **general** goals or themes of this course are as follows:

1. Students will evaluate science as a process in becoming adept at the scientific method and analyzing classic experiments in biology.
2. Students will understand the concept of evolution and biological change driven by natural selection.
3. Students will understand how energy is used in living things and energy transfer in cellular respiration and photosynthesis.
4. Students will evaluate how species maintain themselves from generation to generation using the genetic code, but also mechanisms leading to change over time.
5. Students will understand the relationship of structure and function ranging from the molecular level through living systems.
6. Students will analyze the regulation of cells, organisms, and systems and the dynamic balance of positive and negative feedback mechanisms.
7. Students will understand the interdependence in nature.
8. Students will evaluate the effect of science, technology, and society.

The College Board publishes 12 laboratory exercises to perform within the AP Biology curriculum:

1. Diffusion and Osmosis
2. Enzyme Catalysis
3. Mitosis and Meiosis
4. Plant Pigments and Photosynthesis
5. Cell Respiration
6. Molecular Biology
7. Genetics of Organisms
8. Population Genetics and Evolution
9. Transpiration
10. Physiology of the Circulatory System
11. Animal Behavior
12. Dissolved Oxygen and Aquatic Primary Productivity

INSTRUCTIONAL MODEL

In keeping with a college experience, structured discussion using a variety of visuals, models, and specimens will be the primary instructional method. Occasional student-centered projects help to motivate students and enrich a given topic. Cooperative learning is used extensively in the laboratory periods.

TEXT

Campbell, Neil A., Reece, Jane B. (2005). Biology. Seventh Edition, Benjamin/Cummings Publishing Company.

ASSESSMENT

Since the purpose of the course is to prepare for the AP examination, multiple choice and essay questions modeled by ETS will be the primary forms of assessment. Homework assignments emphasize using the text as a resource while constructing usable study guides. Regular quizzes consisting of multiple choice, matching, or short answer essays will help to pace student learning. Laboratory reports emphasizing the analysis of results, writing a comprehensive conclusion, and the analysis of laboratory questions are also an important component to student assessment. In addition to course-specific rubrics for open-response questions and laboratory reports, rubrics are also designed to address the school-wide student expectations for learning according to the mission statement.

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

COURSE 555: ADVANCED PLACEMENT CHEMISTRY
LEVEL 1

DESCRIPTIVE OVERVIEW

The AP Chemistry course is designed to be the equivalent of a first year, college level chemistry course. The curriculum follows College Entrance Exam Board guidelines and includes laboratory experiments representing key areas of chemical measurement and analysis. The course fosters development of clear thinking and the ability to express ideas with clarity and logic. In depth topics include: the structure of matter, the kinetic molecular theory, chemical equilibrium, thermodynamics, and chemical kinetics. Problem solving is the principle learning method. Laboratory experiments emphasize measurements, calculations, and interpretation of results. Students are required to take the AP Chemistry exam in May. The year is divided into three parts. First is an extensive summer assignment completed just prior to the course. Students study approximately five chapters from the text and do problems from each chapter. This serves to remind them of material learned as sophomores and allows them to read material that cannot be covered during the school year due to time constraints. Second, is completion during the school year of approximately twenty chapters from the text. Students also complete about 18 lab exercises. Finally, time is devoted to review for the AP Chemistry exam. Students practice problems from past papers, study a review book, and go over multiple choice exams that have been released by the College Board.

GOALS AND OBJECTIVES

This chemistry course is designed for the academically successful student who has displayed strengths in the areas of chemistry, math, and physics. Major objectives are to prepare students to pass the AP Chemistry exam in May, provide a laboratory experience equivalent to that of first year college chemistry, and to prepare students who plan to pursue majors in science with a strong chemistry background.

INSTRUCTIONAL MODEL

Class time is devoted to laboratory work and checking student solutions of problem sets. Since much of the material involves review of concepts learned in the first year course, emphasis in each chapter is on what is new to the student. Student questions determine the depth and direction of class discussion. Students complete about eighteen labs drawn primarily from Laboratory Experiments for Advanced Placement Chemistry by Sally Vonderbrink, Ph. D. (Flinn Scientific). These labs are designed specifically for AP students. Other labs are drawn from college laboratory manuals. Modifications to the lab program are made to keep current with the lab program outlined in the College Entrance Exam Board's guide to AP Chemistry.

ASSESSMENT

In order to prepare students for the AP examination, tests and quizzes modeled by ETS are a major form of assessment. Laboratory reports emphasizing the analysis of results, writing a comprehensive conclusion, and the analysis of laboratory questions are also a significant part of the process.

TEXT/ REFERENCES

Textbook: Zumdahl, Steven S., Zumdahl, Susan A. Chemistry: 7th edition, Houghton Mifflin Company, Boston, MA, 2007

Practice problems resources include
Past AP Chemistry exam papers (released free response) from last fifteen years.
Demmin, Peter E., Multiple-Choice & Free-Response Questions in Preparation for the AP Chemistry Exam. 4th edition, D&S Marketing Systems, Inc., Brooklyn, NY 2000.
Demmin, Peter E., Solution Guide (for preparation book), 4th edition, D&S Marketing Systems, Inc., Brooklyn, NY, 2000.

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

COURSE 566: ADVANCED PLACEMENT PHYSICS
LEVEL 1

DESCRIPTIVE OVERVIEW

This course is designed to be equivalent to the first year introductory course in physics for scientists and engineers. Calculus, both differential and integral, is used throughout the course. The syllabus follows that recommended by the Advanced Placement Program of the College Board. The two topics, treated equally and presented in considerable depth, are classical mechanics and electricity and magnetism. Student problem solving with established problem solving techniques, is the predominant method of learning. In the laboratory the student investigates nature as it is, rather than its idealized form. The course culminates in the AP Physics C examination from the College Board. This course is recommended for highly motivated, advanced math and science students with demonstrated, disciplined work habits and success in these areas.

GOALS AND OBJECTIVES

This physics course is designed for the academically successful student who has displayed strengths in the areas of math and physics. Major objectives are to prepare students to pass the AP Physics exam in May, provide a laboratory experience equivalent to that of first year college physics, and to prepare students who plan to pursue majors in science with a strong physics background.

INSTRUCTIONAL MODEL

Instructional strategies include lectures, problem-solving sessions and student-preformed experiments. Student problem-solving strategies and method are the primary means of learning the material. Reading and problem sets are assigned nightly. As concepts and problem solving methods are introduced, problems are then assigned. The laboratory is an integral part of the problem solving method.

ASSESSMENT

Assessment is done in a variety of ways. Homework problems are assigned, collected periodically and graded. Quizzes are given when-ever a fundamental method of problem-solving is introduced and sample problems (for homework) have been done by the student. Lab reports are done by the students and graded. Unit/chapter tests are both multiple choice and free response questions. All quiz and test questions are from recent released AP “C” Physics examinations.

TEXT/ REFERENCES

**Text*: Physics for Scientists and Engineers; 3rd Edition, by Serway Saunders College Publishing, 1992
*Lab books: *Physics – A Laboratory Manual,* Patrick Zober, 2001
Physics with Computers, Vernier Software and Technology, 2003
*From The College Board: Advanced Placement Course Description
AP “C” Physics -released examinations with solutions
*The Mechanical Universe Series videos (21 programs)
*Demonstration materials
*Electronic Data Collection by Vernier Software and Technology
*Hand calculator - Ti-85

HINGHAM HIGH SCHOOL
CURRICULUM SUMMARY

ENVIRONMENTAL SCIENCE

DESCRIPTIVE OVERVIEW

Environmental Science (Levels 2,3) is a multiple-level science elective which provides students with the scientific principles, concepts and methodologies required to understand the inter-relationships of the natural world, to identify and analyze environmental problems both natural and human-made, to evaluate the relative risks associated with these problems, and to examine alternative solutions for resolving or preventing them. Environmental science is interdisciplinary; it embraces a wide variety of topics from different areas of study. Yet there are several unifying constructs, or themes, that cut across the many topics included in the study of environmental science. Students are challenged to address how various interactions in their daily lives affect the world around them, and examine ways to improve or increase environmental stewardship. One of the key components to the environmental science program at Hingham High School is the quarterly term project. Students work collaboratively to develop a project that meets the objectives of educating themselves and others on an environmental issue and/or performing environmental remediation in their local community. Past projects have included the building of an electricity-generating bicycle, beach clean-ups, and fundraising events for environmental programs. A term project of particular interest was done in 2009 in which students wrote and won a $20,000 grant from National Geographic, and were featured in the magazine. The funds from this grant went toward the construction of an on-campus greenhouse. Students may also extend their term projects to develop a full-year project. Students that have done this have connected their projects in environmental science to their senior project, and were able to travel to the Galapagos Islands to work on environmental sustainability at the local elementary schools. Students are encouraged to develop a term project that best suits their environmental interests.

GOALS AND OBJECTIVES

The **general** goals of this course are as follows:

1. Science is a process.
   - Science is a method of learning more about the world.
   - Science constantly changes the way we understand the world.
2. Energy conversions underlie all ecological processes.
   - Energy cannot be created; it must come from somewhere.
   - As energy flows through systems, at each step more of it becomes unusable.
3. The Earth itself is one interconnected system.
   - Natural systems change over time and space.
   - Biogeochemical systems vary in ability to recover from disturbances.
4. Humans alter natural systems.
   - Humans have had an impact on the environment for millions of years.
   - Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.
5. Environmental problems have a cultural and social context.
   - Understanding the role of cultural, social and economic factors is vital to the development of solutions.
6. Human survival depends on developing practices that will achieve sustainable systems.
   - A suitable combination of conservation and development is required.
   - Management of common resources is essential.

The **specific** goals and objectives for the course by unit are:

I. Earth Systems and Resources

A. Earth Science Concepts
(Geologic time scale; plate tectonics, earthquakes, volcanism; seasons; solar intensity and latitude)

B. The Atmosphere
(Composition; structure; weather and climate; atmospheric circulation and the Coriolis Effect; atmosphere–ocean interactions; ENSO)

C. Global Water Resources and Use
(Freshwater/saltwater; ocean circulation; agricultural, industrial, and domestic use; surface and groundwater issues; global problems; conservation)

D. Soil and Soil Dynamics
(Rock cycle; formation; composition; physical and chemical properties; main soil types; erosion and other soil problems; soil conservation)

II. The Living World

A. Ecosystem Structure
(Biological populations and communities; ecological niches; interactions among species; keystone species; species diversity and edge effects; major terrestrial and aquatic biomes)

B. Energy Flow
(Photosynthesis and cellular respiration; food webs and trophic levels; ecological pyramids)

C. Ecosystem Diversity
(Biodiversity; natural selection; evolution; ecosystem services)

D. Natural Ecosystem Change
(Climate shifts; species movement; ecological succession)

E. Natural Biogeochemical Cycles
(Carbon, nitrogen, phosphorus, sulfur, water, conservation of matter)

III. Population

A. Population Biology Concepts
(Population ecology; carrying capacity; reproductive strategies; survivorship)

B. Human Population

1. Human population dynamics
(Historical population sizes; distribution; fertility rates; growth rates and doubling times; demographic transition; age-structure diagrams)
2. Population size
(Strategies for sustainability; case studies; national policies)
3. Impacts of population growth
(Hunger; disease; economic effects; resource use; habitat destruction)

IV. Land and Water Use

A. Agriculture

1. Feeding a growing population
(Human nutritional requirements; types of agriculture; Green Revolution; genetic engineering and crop production; deforestation; irrigation; sustainable agriculture)
2. Controlling pests
(Types of pesticides; costs and benefits of pesticide use; integrated pest management; relevant laws)

B. Forestry
(Tree plantations; old growth forests; forest fires; forest management; national forests)

C. Rangelands
(Overgrazing; deforestation; desertification; rangeland management; federal rangelands)

D. Other Land Use

1. Urban land development
(Planned development; suburban sprawl; urbanization)
2. Transportation infrastructure
(Federal highway system; canals and channels; roadless areas; ecosystem impacts)
3. Public and federal lands
(Management; wilderness areas; national parks; wildlife refuges; forests; wetlands)
4. Land conservation options
(Preservation; remediation; mitigation; restoration)
5. Sustainable land-use strategies

E. Mining
(Mineral formation; extraction; global reserves; relevant laws and treaties)

F. Fishing
(Fishing techniques; overfishing; aquaculture; relevant laws and treaties)

G. Global Economics
(Globalization; World Bank; Tragedy of the Commons; relevant laws and treaties)

V. Energy Resources and Consumption

A. Energy Concepts
(Energy forms; power; units; conversions; Laws of Thermodynamics)

B. Energy Consumption
1. History
(Industrial Revolution; exponential growth; energy crisis)
2. Present global energy use
3.Future energy needs

C. Fossil Fuel Resources and Use
(Formation of coal, oil, and natural gas; extraction/purification methods; world reserves and global demand; synfuels; environmental advantages/ disadvantages of sources)

D. Nuclear Energy
(Nuclear fission process; nuclear fuel; electricity production; nuclear reactor types; environmental advantages/disadvantages; safety issues; radiation and human health; radioactive wastes; nuclear fusion)

E. Hydroelectric Power
(Dams; flood control; salmon; silting; other impacts)

F. Energy Conservation
(Energy efficiency; CAFE standards; hybrid electric vehicles; mass transit)

G. Renewable Energy
(Solar energy; solar electricity; hydrogen fuel cells; biomass; wind energy; small-scale hydroelectric; ocean waves and tidal energy; geothermal; environmental advantages/disadvantages)

VI. Pollution

A. Pollution Types
1. Air pollution
(Sources—primary and secondary; major air pollutants; measurement units; smog; acid deposition—causes and effects; heat islands and temperature inversions; indoor air pollution; remediation and reduction strategies; Clean Air Act and other relevant laws)
2. Noise pollution
(Sources; effects; control measures)
3.Water pollution
(Types; sources, causes, and effects; cultural eutrophication; groundwater pollution; maintaining water quality; water purification; sewage treatment/septic systems; Clean Water Act and other relevant laws)
4. Solid waste
(Types; disposal; reduction)

B. Impacts on the Environment and Human Health
1. Hazards to human health
(Environmental risk analysis; acute and chronic effects; dose-response relationships; air pollutants; smoking and other risks)
2. Hazardous chemicals in the environment
(Types of hazardous waste; treatment/disposal of hazardous waste; cleanup of contaminated sites; biomagnification; relevant laws)

C. Economic Impacts
(Cost-benefit analysis; externalities; marginal costs; sustainability)

VII. Global Change

A. Stratospheric Ozone
(Formation of stratospheric ozone; ultraviolet radiation; causes of ozone depletion; effects of ozone depletion; strategies for reducing ozone depletion; relevant laws and treaties)

B. Global Warming
(Greenhouse gases and the greenhouse effect; impacts and consequences of global warming; reducing climate change; relevant laws and treaties)

C. Loss of Biodiversity
1. Habitat loss; overuse; pollution; introduced species; endangered and extinct species
2. Maintenance through conservation
3. Relevant laws and treaties

INSTRUCTIONAL MODEL

LABORATORY AND FIELD INVESTIGATION:

Environmental science includes a strong laboratory and field investigation component. The goal of this component is to complement the classroom portion of the course by allowing students to learn about the environment through firsthand observation. Experiences both in the laboratory and in the field provide students with important opportunities to test concepts and principles that are introduced in the classroom, explore specific problems with a depth not easily achieved otherwise, and gain an awareness of the importance of confounding variables that exist in the "real world." In these experiences students can employ alternative learning styles to reinforce fundamental concepts and principles. Because all students have a stake in the future of their environment, such activities can motivate students to study environmental science in greater depth.

COMMUNITY INTERACTION AND ENGAGEMENT:

Environmental science integrates the community as much as possible to increase student awareness of environmental issues. Each term, students have the opportunity to work with or hear from an expert in a particular environmental field of study. Community interaction may be in the form of a guest lecture or field trip. Past community interaction experiences have included visits to a local organic farm, tours of Deer Island Wastewater Treatment Facility, as well as guest speakers from the Peace Corps, the New England Aquarium, the Alliance for Climate Education and Project Research – Great White Shark (South Africa).

CLASSROOM MODEL:

In a heterogeneously grouped classroom, varied instructional techniques are needed to meet the needs of all learners. The variety of choices of activities and projects which vary in complexity allows for the individual learning styles of students. Some examples include: whole class discussions, single or multiple period lab activities, and in-class or extended term projects that require research. There are numerous activities that require students to transfer skills across academic disciplines and apply knowledge to new situations. Certain topics or lab activities require students to use advanced technologies incorporated into research or simulation studies in a lab environment. Selected class activities and assigned group projects provide cooperative learning which serve as both an instructional and assessment tool. Interested students can also participate in co-curricular activities and directed-study experiences.

ASSESSMENT

Varied assessment is used to evaluate student learning. Student grades are comprised of homework assignments, laboratory and field assignments, quizzes and tests, as well as term projects. Students taking the course for level 2 credit are required to write an additional 7-9 page research paper each term, examining the topic they've selected for their term project in depth. *In addition to course-specific rubrics for projects and some laboratory assignments, rubrics are also designed to address the school-wide student expectations for learning according to the mission statement.*

RESOURCES AND REFERENCES

Raven, P., Berg, L. and Hassenzahl, D. (2008). Environment. 6th Ed. John Wiley and Sons, Inc., Jefferson City.

Support and Supplementary Materials:

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Molnar, W. (2005). Laboratory Investigations: AP Environmental Science. People's Education, Inc. Saddle Brook, NJ.

Skelton, L., Jacob, S, et al. (2010). Facing the Future: An interdisciplinary curriculum for grades 9-12. www.facingthefuture.org, Seattle, WA.