Wallingford Public Schools - HIGH SCHOOL COURSE OUTLINE

Course Title: Topics in Biology	**Course Number**: A 2643
Department: Science	**Grade(s)**: 11 & 12
Level(s): Academic	**Credit**: 1

Course Description

This course is intended for students who have a genuine interest in the field of biology and wish to explore topics not covered in biology. Topics may include: ecology, genetics, forensics, disease, nutrition, and human biology and behavior.

Required Instructional Materials	**Completion/Revision Date**
• No required textbook • Current and sufficient laboratory materials and equipment for each of the learning strands • Appropriate safety equipment – goggles, aprons, eyewash, safety shower, etc. • Information technologies – internet and library resources	Approved by Curriculum Council October 26, 2004 Adopted by Board of Education November 15, 2004

Mission Statement of the Curriculum Management Team

The mission statement of the Science Curriculum Management Team is to promote scientific literacy emphasizing the process, content, and interdisciplinary nature of science.

Enduring Understandings for the Course

- Inquiry is the integration of process skills, the application of scientific content and critical thinking to solve problems.
- Science is the method of observation and investigation used to understand our world.
- Matter can be described, organized, and classified for understanding.
- The environment is a complex assemblage of interacting and evolving chemical, physical, and biological processes.
- Food energy creates forces that can do work.
- The basic building blocks of foods become the basic building blocks of cells.
- Scientific ideas evolve as new information is uncovered.
- The current state of the environment is maintained by the dynamic exchange of the processes that dictate its nature. Changes in any of the interacting processes will impact the current state (for better or worse).
- The analysis of evidence involves the application of all disciplines of science.
- Popular media does not always accurately portray science.
- There are multiple causes, vectors, and treatment of diseases.
- Technological advances improve the quality of life and raise bioethical issues.
- The theory of evolution has changed as new information is uncovered.

• Human activities impact and alter cell environments
• The nervous system senses, processes, and responds to the environment.
• Cells are a complex assemblage of interacting and changing chemical, physical and biological processes.
• Humans continue to have a positive and negative influence on wildlife as a result of interacting with the environment.

NOTE: This course is designed to be tailored to student interest. This course outline has a collection of units that may vary in length depending on student interests. Teachers will cover a minimum of 4 learning strands in a year. Other learning strands may be suggested by the teacher and or students. Permission to teach learning strands not addressed in this curriculum may be made in writing by the teacher to the Science Department Head and Chairperson of the Science Curriculum Management Team for prior approval.

LEARNING STRAND

1.0 Scientific Reasoning and Communication Skills

NOTE: This learning strand should be taught through the integration of the other learning strands. This learning strand is not meant to be taught in isolation as a separate unit.

ENDURING UNDERSTANDING(S)

- Inquiry is the integration of process skills, the application of scientific content and critical thinking to solve problems.
- Science is the method of observation and investigation used to understand our world.

LEARNING OBJECTIVES The student will:

1.1 Generate scientific questions to be investigated.
1.2 Apply appropriate instruments needed to collect data precisely.
1.3 Analyze experimental design and data so as to question validity, identify variables, and improve experimental design.
1.4 Develop conclusions based on critical data analysis identifying further investigations and/or questions based on the results.
1.5 Organize data in tables and graphs.
1.6 Utilize graphs in order to determine patterns and make predictions.
1.7 Apply computer-based tools to present and research information.
1.8 Gather information using a variety of print and non-print sources.
1.9 Support scientific arguments using a variety of print and non-print sources.
1.10 Present scientific information orally.
1.11 Present scientific information in an expository format so that it adheres to standard forms of grammar and mechanics.

INSTRUCTIONAL SUPPORT MATERIALS

- Sufficient laboratory instrumentation

SUGGESTED INSTRUCTIONAL STRATEGIES

- Performance tasks
- Open-ended labs
- Inquiry
- Modeling
- Hands-on, minds-on lab activities
- Computer created spreadsheets and graphs
- See other learning strands for integration

SUGGESTED ASSESSMENT METHODS

- Lab reports
- Open-ended questions
- Teacher observations
- Essays and/or compositions
- Excel spreadsheets and graphs
- Research based projects
- Computer created spreadsheets and graphs
- See other learning strands for integration

LEARNING STRAND

2.0 Ecology – Stream Ecosystem

ENDURING UNDERSTANDING(S)

- Matter can be described, organized, and classified for understanding.
- The environment is a complex assemblage of interacting and evolving chemical, physical, and biological processes.
- The current state of the environment is maintained by the dynamic exchange of processes that dictate its nature. Changes in any of the interacting processes will impact the current state.

LEARNING OBJECTIVES – The student will:

2.1 Understand the value of topographic maps needed to delineate a watershed.
2.2 Analyze land use maps to determine potential pollution sources and types.
2.3 Demonstrate various methods to find longitude and latitude.
2.4 Identify the sources of water, carbon, and nitrogen, to stream life.
2.5 Explain the impact different levels of carbon, nitrogen, oxygen and water level have on stream life and its relationship to the carbon, nitrogen and water cycle. (nitrogen in LIS, hypoxia)
2.6 Analyze physical and chemical data using resources and relate this to the health of the stream.
2.7 Analyze long/short term population data to determine the effects of environmental impacts. (fecal coliform, macro-invertebrate)
2.8 Measure water quality and biological communities using DEP standards. (ex. quality control and assurance, inquiry and scientific method)

INSTRUCTIONAL SUPPORT MATERIALS

- *Project Search Manual*- CT DEP
- Macro-invertebrate field guides
- USGS Maps (Topographical, Drainage Basin, discharge leachate, water quality, land use)
- Water quality testing equipment
- Fecal Coliform Testing equipment
- Dissecting Microscope
- Internet access
- Spreadsheet/graphing software
- Macroinvertebrate collection nets
- Community speakers(sewage treatment plant)
- Environmental Monitoring Laboratories (DEP)

SUGGESTED INSTRUCTIONAL STRATEGIES

- Inquiry based investigations
- Hands-on labs
- Student directed learning
- Summarize/Critique scientific articles
- Online research
- Computer based graphing and presentations
- Modeling of lab techniques
- Field trip to a stream
- *Luck Isn't Enough: Fight for Clean Waters* - NEMO educational video tape
- *Troubled Waters* – Video on CT Aquifer Protection
- Current Long Island Sound reports and data

SUGGESTED ASSESSMENT METHODS

- Group and/or individual presentations
- Laboratory techniques

	• Student video /oral/ written presentations • Research reports (LIS health, pesticides, invasive species, etc.) • Tests/ quizzes • Newspaper article/ pamphlet on stream sampling results • Data analysis/presentations

LEARNING STRAND

3.0 Nutrition

ENDURING UNDERSTANDING(S)

- The basic building blocks of foods become the basic building blocks of cells.
- Scientific ideas evolve as new information is uncovered.
- Matter can be described, organized, and classified for understanding.
- Food energy creates forces that can do work.

LEARNING OBJECTIVES – The student will:

3.1 Classify foods in terms of the macromolecules of life. (proteins, carbohydrate, lipids, etc.)
3.2 Differentiate the basic building blocks of each macromolecule and how these relate to building polymers.
3.3 Compare and contrast current models of various types of diet plans. (Atkins, South Beach, Ornish, etc.)
3.4 Analyze a model diet and determine how this relates to various dietary standards.
3.5 Determine the relationship between dietary energy intake to energy expenditure. (compare runner to sedentary worker)
3.6 Identify major nutritional issues as they relate to various diseases.
3.7 Evaluate the role of vitamins and minerals in nutritional health.
3.8 Explain how the digestive system functions in nutrient absorption.

INSTRUCTIONAL SUPPORT MATERIALS

- Food labels
- Recommended daily allowance charts

SUGGESTED INSTRUCTIONAL STRATEGIES

- Directed reading
- Student research
- Mathematical calculations (calories, percent fat, etc)
- Modeling
- Calorie lab
- Lab using chemical tests to identify macromolecules content in food
- Class discussions
- Online research
- Read and summarize current articles on nutrition/diet
- Videos on nutrition/diet with follow up questions

SUGGESTED ASSESSMENT METHODS

- Tests and quizzes
- Dietary analysis report
- Poster/ Oral presentation
- Lab reports
- Summary/Critique of articles

LEARNING STRAND

4.0 Marine Biology

ENDURING UNDERSTANDING(S)

- The environment is a complex assemblage of interacting and evolving chemical, physical, and biological processes
- The current state of the environment is maintained by the dynamic exchange of the processes that dictate its nature. Changes in any of the interacting processes will impact the current state.

LEARNING OBJECTIVES – The student will:

4.1 Evaluate the interactions of tides, the marine environment, and organisms.
4.2 Illustrate and label marine topography.
4.3 Compare and contrast various marine habitats around the world.
4.4 Discuss natural and man-made issues effecting marine environments.
4.5 Summarize marine habitat/wildlife issues and possible solutions.
4.6 Discuss the importance of marine environments to humans and in maintaining an ecological balance.
4.7 Recognize major North American marine organisms. (i.e. plankton, algae, invertebrates and vertebrates).
4.8 Relate animal and plant adaptations to their habitat.
4.9 Explain the importance of chemical and physical parameters on the survival of marine organisms. (i.e. dissolved gases and solids, temperature, topography, etc.)

INSTRUCTIONAL SUPPORT MATERIALS

- Field guides on marine organisms
- Samples or pictures of marine organisms
- *The Blue Planet Se*ries - BBC Video
- *The Living Planet-The Open Ocean* -Time Life Video

SUGGESTED INSTRUCTIONAL STRATEGIES

- Group discussions
- Directed reading
- Research on marine organisms and habitats
- Diagram labeling of marine organisms and habitats
- Labs using different marine species
- Debate on marine problems / issues
- Discussion on current marine issues using recent sources
- Field trip to marine environment
- Videos on the marine environment
- Community speakers on endangered habitats/local issues

SUGGESTED ASSESSMENT METHODS

- Research project and 3-D presentation on a marine habitat
- Design a model aquarium (like Mystic) based on web quest research.
- Quizzes and tests
- Lab reports
- Lab practical
- Essay on controversial marine issue

LEARNING STRAND

5.0 Forensics

ENDURING UNDERSTANDING(S)

- Scientific ideas evolve as new information is uncovered.
- The analysis of evidence involves the application of all disciplines of science.
- Popular media does not always accurately portray science.

LEARNING OBJECTIVES – The student will:

5.1 Summarize the history of forensic science.
5.2 Explain the sources of forensic evidence including chemical, biological, and physical. (i.e. fertilizer, drugs, blood, saliva, DNA, damage, footprints, etc.)
5.3 Explain techniques used to collect crime scene evidence. (i.e. fingerprints, blood samples, handwriting, hair samples, DNA, footprints, etc.)
5.4 Analyze numerous forms of evidence from different crime scenes. (fingerprints, blood types etc.)
5.5 Apply collected observations/evidence to offer plausible explanations to a crime scene.
5.6 Discuss the problems encountered when solving forensic crimes.
5.7 Evaluate the accuracy of popular crime shows and media reports based on forensic science.
5.8 Discuss careers opportunities and education requirements related to broad area of forensic science.

INSTRUCTIONAL SUPPORT MATERIALS

- Lab materials for assorted forensic labs
- Magazine and Internet articles on current forensic technology

SUGGESTED INSTRUCTIONAL STRATEGIES

- Forensic labs (fingerprinting, blood typing, handwriting comparison, hair samples, DNA, soil comparison etc.)
- Forensic videos with discussion
- Forensic case studies
- Modeling of lab techniques
- Problem solving
- Reading assignments
- Demonstrations
- Inquiry lab activities

SUGGESTED ASSESSMENT METHODS

- Forensic labs and write ups
- Quizzes and tests
- Research project/presentation on forensic case study
- Essay on the accuracy of forensic shows
- Homework
- Scenarios

LEARNING STRAND

6.0 Infectious Diseases

ENDURING UNDERSTANDING(S)

- Scientific ideas evolve as new information is uncovered
- There are multiple causes, vectors, and treatment of diseases.
- Technological advances improve the quality of life and raise bioethical issues.

LEARNING OBJECTIVES – The student will:

6.1 Categorize human diseases by cause, transmission, and symptom.
6.2 Explain transmission methods and prevention of disease.
6.3 Utilize current information from organizations that research and discover human diseases to compare and contrast epidemics, diseases, and current health issues in different countries.
6.4 Summarize how the human body reacts to and prevents diseases.
6.5 Evaluate the relationship of diseases and bioterrorism.
6.6 Explain the symptoms, cause, prevention, and treatment of several common diseases.
6.7 Defend doctors who do not prescribe antibiotics for the common cold.
6.8 Evaluate the risk factors associated with local outbreaks found in Connecticut. (West Nile, Lime Disease, Meningitis, E. Coli, etc.)

INSTRUCTIONAL SUPPORT MATERIALS

- Internet sites: CDC, WHO, American Museum of Natural History Epidemic Website, etc.
- *Parasites Eating Us Alive* - Discovery Channel Video

SUGGESTED INSTRUCTIONAL STRATEGIES

- Directed reading using current articles and internet sources
- Evaluating videos on diseases
- Research on disease symptoms, cause, prevention and treatment
- Class discussion/debates on disease issues (i.e. antibiotic resistance, side effects of vaccines, DDT, etc.)
- Research on health and diseases of other countries
- Web quest on biological weapons
- Labs on vectors of infectious diseases
- Jig-saw activities to share information
- Graphic organizers

SUGGESTED ASSESSMENT METHODS

- Design a booklet to present research information on health services and issues of different countries
- Tests and quizzes
- Labs reports on vectors of infectious diseases
- Graphic organizers
- Homework
- Student presentations

LEARNING STRAND

7.0 Evolution

ENDURING UNDERSTANDING(S)

- The theory of evolution has changed as new information is uncovered.

LEARNING OBJECTIVES – The student will:

7.1 Describe the theory of evolution and the history of its development.
7.2 Explain the evidence that scientists have supporting evolution.
7.3 Illustrate the geologic time scale and its relationship to evolution.
7.4 Explain the process of natural selection.
7.5 Describe examples of natural selection. (antibiotic resistant bacteria, pesticide resistant insects, etc.)
7.6 Describe how and why humans have changed through time.
7.7 Analyze the issues behind the controversy of teaching evolution.

INSTRUCTIONAL SUPPORT MATERIALS

- Assorted human skulls

SUGGESTED INSTRUCTIONAL STRATEGIES

- Videos on human evolution and natural selection
- Read and discuss/respond to articles (evolution controversy, history, current issues, etc.)
- Labs (human fossils, natural selection, adaptations, homologous structures lab - arm bones)
- Discussion and analysis of videos
- Class discussions
- Debates (evolution viewpoints, antibiotic use, pesticide use, etc.)

SUGGESTED ASSESSMENT METHODS

- Research the evolution of an organism
- Presentation of research to class
- Tests and quizzes
- Position statement essay

LEARNING STRAND

8.0 Genetics and Diseases

ENDURING UNDERSTANDING(S)

- Technological advances improve the quality of life and raise bioethical issues.
- Scientific ideas evolve as new information is uncovered.
- The environment is a complex assemblage of interacting and evolving chemical, physical, and biological processes.

LEARNING OBJECTIVES – The student will:

8.1 Identify the role that DNA, chromosomes, genes and RNA have in protein synthesis and cell function.
8.2 Explain how different types of mutations relate to changes in protein structure and function in disease.
8.3 Compare and contrast different inheritance patterns and frequencies of various genetic disorders.
8.4 Relate the effect of various genetic disorders to quality of life. (symptoms, phenotype, etc.)
8.5 Describe the location of the genetic defect on the human genome.
8.6 Construct a pedigree to show long term inheritance patterns.
8.7 Explain processes used to detect genetic disorders before birth.
8.8 Explain the available treatments and/or preventions of genetic disorders.
8.9 Debate economic and bioethical implications of having or preventing genetic disorders.

INSTRUCTIONAL SUPPORT MATERIALS

- Video - *Secret of Life*

SUGGESTED INSTRUCTIONAL STRATEGIES

- Model protein synthesis: manipulatives/ play
- Student directed learning
- Model writing strategies
- Case studies
- Model research skills
- Model internet search strategies
- Class discussion / debate
- Web based instruction

SUGGESTED ASSESSMENT METHODS

- Group presentations
- Research paper
- Test/quizzes
- Lab reports
- Essays

LEARNING STRAND

9.0 Psychopharmacology (Effects of Drugs on the Nervous System)

ENDURING UNDERSTANDING(S)

- Human activities impact and alter cell environments
- The nervous system senses, processes, and responds to the environment.
- Cells are a complex assemblage of interacting and changing chemical, physical and biological processes.

LEARNING OBJECTIVES – The student will:

9.1 Relate the structure of the neuron to the function of nerve transmission.
9.2 Explain the role neurotransmitters play in nerve transmission and behavior.
9.3 Compare and contrast inhibitory and excitatory neural pathways.
9.4 Describe the mechanism of the neuromuscular junction.
9.5 Determine the interaction various drugs have on nerve transmission.
9.6 Relate the consequence of drugs to the effects on the body and behavior. (addiction)

INSTRUCTIONAL SUPPORT MATERIALS

- Brain and Addiction- NIH curriculum research

SUGGESTED INSTRUCTIONAL STRATEGIES

- Model nerve transmission
- Lab- Effect of drugs on Daphnia
- Debate the use of drugs in treatment, of addiction: prevention and help, and/or issues facing youth
- Class discussion
- Student based learning
- Web based research
- Research strategies

SUGGESTED ASSESSMENT METHODS

- Research paper
- Lab report
- Test/Quizzes
- Oral and written presentation

LEARNING STRAND

10.0 Global Environmental Issues

ENDURING UNDERSTANDING(S)

- The current state of any environment is maintained by the dynamic exchange of the processes that dictate its nature. Changes in any of the interacting processes (human impact, pollution, etc) will impact the current state (for better or worse).
- Scientific ideas evolve as new information is uncovered.
- The environment is a complex assemblage of interacting and evolving chemical, physical, and biological processes.

LEARNING OBJECTIVES – The student will:

10.1 Identify the common environmental issues and their effects on populations. (air pollution, acid rain, endangered species, etc.)

10.2 Evaluate the cause(s) and possible solutions to these issues.

10.3 Evaluate different position statements from various environmental organizations on current environmental issues.

10.4 Compare and contrast government funded organizations (DEP, EPA, etc.) and non-profit community organizations (WWF, Sierra Club, etc.) with regards to their mission statement and effectiveness.

10.5 Evaluate what individuals can do to protect the environment.

INSTRUCTIONAL SUPPORT MATERIALS

- Popular environmental issue videos such as Erin Brokovich, Civil Action and Medicine Man
- Magazines or pamphlets produced by a variety of organizations (CT Wildlife, DEP, EPA, WWF, Sierra Club, etc.)

SUGGESTED INSTRUCTIONAL STRATEGIES

- Class discussion (air pollution – limitations and actions)
- Research and debate current local/global issues
- Research and presentations (Power Point presentations)
- Read and summarize current magazine articles
- Class discussion on what the individual can do to improve environmental issues
- Graphic organizers to organize information
- Community outreach/service projects
- Power point presentations
- Labs (air pollution, acid rain, etc.)

SUGGESTED ASSESSMENT METHODS

- Tests and quizzes
- Research and presentations
- Position statement essay

LEARNING STRAND

11.0 Connecticut Wildlife

ENDURING UNDERSTANDING(S)

- Humans continue to have a positive and negative influence on wildlife as a result of interacting with the environment.
- The environment is a complex assemblage of interacting and evolving chemical, physical, and biological processes.
- The current state of any environment is maintained by the dynamic exchange of the processes that dictate its nature. Changes in any of the interacting processes will impact the current state.

LEARNING OBJECTIVES – The student will:

11.1 Identify common Connecticut wildlife including insects, amphibians, birds, reptiles and mammals.

11.2 Analyze the benefits and problems that wildlife poses for human society.

11.3 Discuss pest species and invasive species in Connecticut.

11.4 Evaluate the effect that the human population has had on the wildlife in Connecticut.

11.5 Evaluate the position statement and actions taken by different wildlife organizations on current and historical issues.

INSTRUCTIONAL SUPPORT MATERIALS

- Connecticut field guides
- Pictures of organisms
- Assorted wildlife magazines (CT Wildlife, National Wildlife, Audubon, etc.)

SUGGESTED INSTRUCTIONAL STRATEGIES

- Group work to identify organisms
- Hike around the school (identify birds, insects, etc.)
- Read and summarize articles on current issues
- Internet research on CT DEP

SUGGESTED ASSESSMENT METHODS

- Test and quizzes (identifying organisms)
- Create field guides on organisms (research based – focusing on different states)
- Photo collage of Wallingford's habitats and wildlife