Elizabethtown Area School District

Biochemistry/Biotechnology

Course Number:	359	Length of Course:	1 semester – 18 weeks
Grade Level:	11-12 Elective	Total Clock Hours:	120 hours
Length of Period:	80 minutes	Date Written:	June 11, 2007
Periods/Week :	5 periods/week	Written By:	Chris Eurich
Credits (if app.):	1.0	Weighting:	1.1
Prerequisite:	Biology and Chemistry		

Course Description:
This lab-centered course examines the chemistry of the life processes. Three major units are studied during the semester. Unit one examines basic organic chemistry, the chemistry of carbon compounds, which form the background for all biologically important compounds. In unit two the focus is on the biological molecules: carbohydrates, lipids, proteins and nucleic acids. The final unit is biotechnology: techniques used to extract, manipulate and analyze DNA will be learned and performed in the laboratory.

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I. Overall Course/Grade Level Standards

Students will KNOW and be able TO DO the following as a result of taking this course.

A. Distinguish between organic and inorganic compounds, list examples of each, and state their importance in our everyday lives.

B. Describe the physical and chemical properties of organic compounds.

C. Explain the fundamental rules of the IUPAC system of nomenclature for organic compounds and apply those rules to the naming of any given hydrocarbon.

D. Diagram both expanded and condensed structural formulas for organic compounds.

E. Assemble three-dimensional models of various molecules using molecular model kits.

F. Write equations that illustrate the major chemical reactions of organic compounds.

G. Describe the importance of each of the major biological molecules to the proper functioning of an individual.

H. Differentiate between the various monomers and polymers for each of the major classes of biological molecules.

I. Write equations showing how the polymers of carbohydrates, lipids, proteins and nucleic acids are produced from their respective monomers.

J. Define biotechnology and review the history of its development.

K. Discuss the bioethical decisions which must be addressed when using biotechnology in our society.

L. Demonstrate safe and proper lab techniques.

M. Follow procedural directions to perform lab activities used to identify and analyze organic compounds.

N. Perform biotechnology techniques used to isolate, study and analyze DNA samples.

O. Use the internet for research, drill & practice and molecular analysis on topics relating to biochemistry and biotechnology.

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II. Content

Major Areas of Study

Unit	Estimated Time	Materials
1. Organic Chemistry- Saturated Hydrocarbons	2 weeks	Textbook, Prepared Overheads, Molecular Model Kits, Melting Point Apparatus, Computer/Internet Access
2. Organic Chemistry- Unsaturated Hydrocarbons	2 weeks	Textbook, Prepared Overheads, Molecular Model Kits, Computer/Internet Access
3. Organic Chemistry- Functional Groups Part I: Alcohols, Ethers, Thiols & Amines	1.5 weeks	Textbook, Prepared Overheads, Molecular Model Kits, Organic Glassware Kits, Computer/Internet Access
4. Organic Chemistry- Functional Groups Part II: Aldehydes, Ketones, Carboxylic Acids, Esters & Amides	1.5 weeks	Textbook, Prepared Overheads, Molecular Model Kits, Organic Glassware Kits, Computer/Internet Access
5. Biological Chemistry- Carbohydrates	2 weeks	Textbook, Prepared Overheads, Molecular Model Kits, Computer/Internet Access
6. Biological Chemistry- Lipids	1 week	Textbook, Prepared Overheads, Molecular Model Kits, Computer/Internet Access
7. Biological Chemistry- Proteins & Enzymes	2 weeks	Textbook, Prepared Overheads, Molecular Model Kits, Enzymology Lab Materials, Computer/Internet Access
8. Biological Chemistry- Nucleic Acids	1.5 weeks	Textbook, Prepared Overheads, Molecular Model Kits, DNA Extraction Kits, Computer/Internet Access
9. Biotechnology	4.5 weeks	Textbook, Prepared Overheads, Molecular Model Kits, Digital Pipettes, Electrophoresis Equipment, Incubator, Hot Water Bath, White Light Box, Fotodyne Camera, Lab Kits: Restriction Analysis, Green Gene Colony Tranformation, Human Alu Insertion, Web Cutter, PCR Simulation, Computer/Internet Access

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Name of Course: Biochemistry/Biotechnology
Name of Unit : Organic Chemistry-Saturated Hydrocarbons

Essential Question: How do organic compounds differ from inorganic compounds?

Unit Objectives/Key Questions	Priority	Aligned to Course Standard	Aligned to PA Standard
A. Distinguish organic from inorganic compounds and list some of the ways in which hydrocarbons that occur in nature (coal, oil and natural gas) are involved in our everyday lives.	E	A	3.4.12.A
B. Examine the structure of the carbon atom and explain how it is capable of forming 4 bonds due to sp3 hybridization.	I	B, D	3.4.12.A
C. Use both common and IUPAC systems to name and draw structures (expanded/condensed) for various alkanes and cycloalkanes.	E	C, D	3.4.12.A
D. Differentiate among positional isomers, geometric isomers, and chiral compounds.	E	B, D	3.4.12.A
E. Explain the difference between configuration and conformation.	I	B, D	3.4.12.A
F. Describe the physical and chemical properties of alkanes and write equations illustrating their reactions.	E	B, F	3.4.12.A
G. Experimentally determine the melting point of an organic compound.	I	L, M	3.4.12.A 3.7.10.A, B
H. Build 3-D models of various alkanes and cycloalkanes.	E	E	3.4.12.A 3.7.10.B

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Name of Course: Biochemistry/Biotechnology
Name of Unit : Organic Chemistry-Unsaturated Hydrocarbons

Essential Question: What are the structures and properties of unsaturated hydrocarbons?

Unit Objectives/Key Questions		Priority	Aligned to Course Standard	Aligned to PA Standard
A.	Recognize the carbon-carbon double bond as the functional group of alkenes, and distinguish alkenes from other hydrocarbons.	E	B	3.4.12.A
B.	Use common and IUPAC rules to name and draw formulas (expanded/condensed) for unsaturated hydrocarbons.	E	C, D	3.4.12.A
C.	Describe the physical and chemical properties of unsaturated hydrocarbons and write equations for addition, polymerization, substitution and oxidation reactions.	E	B, F	3.4.12.A
D.	Distinguish between cis/trans geometric isomers of unsaturated hydrocarbons.	I	B, D	3.4.12.A
E.	Describe the structure and stability of aromatic hydrocarbons.	E	B, D	3.4.12.A
F.	Build 3-D models of various unsaturated hydrocarbons.	E	E	3.4.12.A
G.	Prepare a food web illustrating the principle of biological magnification of pesticides.	C	A, B	3.4.12.A 3.7.10.A

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Name of Course: Biochemistry/Biotechnology
Name of Unit : Organic Chemistry-Functional Groups Part I

Essential Question: What are the structures and properties of alcohols, ethers, thiols and amines?

Unit Objectives/Key Questions		Priority	Aligned to Course Standard	Aligned to PA Standard
A.	Distinguish between alcohols, phenols, ethers, thiols and amines, cite examples of each and state how each is used in industry, medicine and our everyday lives.	E	A	3.4.12.A
B.	Use common and IUPAC rules to name and draw formulas (expanded/condensed) for alcohols, phenols, ethers, thiols and amines.	E	C	3.4.12.A
C.	Describe the physical and chemical properties associated with the functional groups of alcohols, phenols, ethers, thiols and amines and write equations for their reactions.	I	B, F	3.4.12.A
D.	Differentiate between primary, secondary and tertiary classification of alcohols and amines.	I	B, D	3.4.12.A
E.	Understand the history of the use of ether as an anesthetic and the role it played in the development of modern medicine.	C	A	3.4.12.A 3.3.12.B
F.	Build 3-D models of selected alcohols, phenols, ethers, thiols and amines using molecular model kits.	E	E	3.4.12.A
G.	Separate and purify a mixture of liquids by performing a distillation using ground glassware kits.	I	L, M	3.4.12.A

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Name of Course: Biochemistry/Biotechnology
Name of Unit : Organic Chemistry-Functional Groups Part II

Essential Question: What are the structures and properties of aldehydes, ketones, carboxylic acids, esters and amides?

Unit Objectives/Key Questions		Priority	Aligned to Course Standard	Aligned to PA Standard
A.	Distinguish between aldehydes, ketones, carboxylic acids, esters and amides, cite examples of each and state how each is used in industry, medicine and our everyday lives..	E	A	3.4.12.A
B.	Use common and IUPAC rules to name and draw formulas (expanded/condensed) for aldehydes, ketones, carboxylic acids, esters and amides.	E	C	3.4.12.A
C.	Describe the physical and chemical properties associated with the functional groups of aldehydes, ketones, carboxylic acids, esters and amides and write equations for their reactions.	I	B, F	3.4.12.A
D.	Build 3-D models of selected aldehydes, ketones, carboxylic acids, esters and amides using molecular model kits.	E	E	3.4.12.A
E.	Understand the biological importance of amides in the formation of proteins from amino acids by drawing equations to illustrate this reaction.	I	A, F	3.4.12.A 3.3.12.B
F.	Prepare lab solutions of varying concentration (Molar, %) after calculating the necessary volumes/masses of solute/solvent.	C	L, M	3.4.12.A
G.	Perform chemical tests (Benedict's and Tollen's) to identify the presence of the carbonyl group present in aldehydes and ketones.	I	L, M	3.4.12.A
H.	Prepare esters using various carboxylic acids and alcohols, note their characteristic odors and write equations illustrating these reactions.	I	L, M	3.4.12.A
I.	Write an equation that illustrates why carboxylic acids are classified as "acids" and compare the strength of organic acids vs. inorganic acids by calculating their pH values.	E	B, F	3.4.12.A

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Name of Course: Biochemistry/Biotechnology
Name of Unit : Biological Chemistry-Carbohydrates

Essential Question: What are the structures and properties of carbohydrates and why are they important to life?

Unit Objectives/Key Questions	Priority	Aligned to Course Standard	Aligned to PA Standard
A. Describe the biological role of carbohydrates as a primary energy source for organisms.	E	G	3.3.12.B
B. Distinguish between monosaccharides, disaccharides and polysaccharides citing examples and sources of each.	E	H	3.3.12.B
C. Write an equation for the process of photosynthesis illustrating how plants can transform light energy into chemical bond energy.	I	F	2.2.12.B
D. Diagram equations illustrating carbohydrate synthesis and hydrolysis.	I	I	3.3.12.B
E. Diagram the formation of cyclic sugars (α, β) and the glycosidic bond.	C	B, I	3.4.12.A
F. Distinguish between the two major classes of stereoisomers: diastereomers and enantiomeres and explain the biological importance of each.	E	B	3.4.12.A 3.3.12.A
G. Build 3-D models of various carbohydrates.	E	E	3.7.10.A
H. Perform chemical tests used in the identification of various carbohydrates.	E	J, K	3.7.10.A

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Name of Course: Biochemistry/Biotechnology
Name of Unit : Biological Chemistry-Lipids

Essential Question: What are the structures and properties of lipids and why are they important to life?

Unit Objectives/Key Questions	Priority	Aligned to Course Standard	Aligned to PA Standard
A. Describe the biological role of lipids and their importance to the human body.	E	G	3.3.12.B
B. Distinguish between simple and complex lipids and cite examples of each.	E	H	3.3.12.B
C. Diagram equations illustrating the synthesis of a triacylglyceride molecule from glycerol and three fatty acid molecules.	E	I	3.3.12.B
D. Differentiate between saturated and unsaturated fats and oils.	E	B	3.4.12.A
E. Recognize the "steroid nucleus" stucture common to all steroids and state the major classes along with examples and functions.	E	B	3.3.12.A, B 3.4.12.A
F. Build 3-D models of various lipids.	E	E	3.7.10.A
G. Chemically test for the presence of lipids.	I	J, K	3.7.10.A
H. Describe the structure and properties of polar lipids and explain their aggregation into bilayer membranes.	I	B, G	3.3.12.A 3.3.12.B
I. Diagram a model of the fluid mosaic membrane and describe the types of transport that occur across it.	E	B, G	3.3.12.A 3.3.12.B
J. Examine the health consequences of a diet too high in saturated fat and cholesterol.	I	G	3.3.12.B

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Name of Course: Biochemistry/Biotechnology
Name of Unit : Biological Chemistry-Proteins & Enzymes

Essential Question: What are the structures and properties of proteins and why are they important to life?

Unit Objectives/Key Questions	Priority	Aligned to Course Standard	Aligned to PA Standard
A. Describe the biological roles of proteins in the body and cite examples of each.	E	G	3.3.12.B
B. Draw a structural formula for an α-amino acid and identify the various functional groups common to all.	E	B, D	3.3.12.B
C. Classify amino acids as polar, nonpolar, acidic or basic.	I	B	3.3.12.B
D. Diagram the formation of the peptide bond between two amino acids.	E	I	3.4.12.A 3.3.12.B
E. Distinguish between 1^o, 2^o, 3^o, and 4^o structures of proteins and explain the forces responsible for each.	I	B	3.3.12.A 3.4.12.A
F. Build 3-D models of various amino acids and peptides.	E	E	3.4.12.A 3.7.10.A
E. Define an enzyme and recognize its substrate and function from its name.	E	C, G	3.3.12.B
F. Describe the binding of a substrate to an enzyme and explain why enzymes illustrate specificity.	E	C, G	3.3.12.A, B
G. List factors that influence enzyme activity.	I	B	3.4.12.A
H. Perform an experiment on the factors influencing enzyme reaction rates.	E	J, K	3.4.12.A 3.7.10.A

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Name of Course: Biochemistry/Biotechnology
Name of Unit : Biological Chemistry-Nucleic Acids

Essential Question: What are the structures and properties of nucleic acids and why are they important to life?

Unit Objectives/Key Questions		Priority	Aligned to Course Standard	Aligned to PA Standard
A.	Describe the biological roles of nucleic acids in the body.	E	G	3.3.12.B
B.	Recognize the structure of nucleotides and identify the common nitrogenous bases and sugars found in each.	E	B, D	3.3.12.B
C.	Describe the structure of DNA and explain how it is capable of replicating.	I	B, D	3.3.12.A, B
D.	Identify the three types of RNA and state the function(s) of each type.	E	G	3.3.12.B 3.4.12.A
E.	Explain how the genetic code stores information in triplet base sequences.	E	G	3.3.12.B 3.3.12.C
F.	Describe how proteins are synthesized through the processes of transcription and translation.	E	I	3.3.12.A, B 3.3.12.C
G.	Define the term mutation, explain how mutations can affect the body and compile a list of known mutagenic agents.	E	B	3.3.12.B
H.	Research various genetic diseases citing their causes, characteristics and treatments.	I	A, G	3.3.12.B
H.	Build 3-D models of various nucleotides and demonstrate how they can join together illustrating the base-pairing rule.	E	E	3.7.10.A

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Name of Course: Biochemistry/Biotechnology
Name of Unit : Biotechnology

Essential Question: What is biotechnology?

Unit Objectives/Key Questions	Priority	Aligned to Course Standard	Aligned to PA Standard
A. Describe the scientific experiments that led to the development of modern biotechnology.	E	J	3.2.12.A, B
B. Develop the lab skills required to use a digital micropipette to transfer microvolumes of liquid samples.	E	L, M, N	3.7.10.A, B
C. Demonstrate the "sterile technique" used in transferring bacterial cultures in lab.	E	L, M, N	3.7.10.A, B
D. Explain the theory behind electrophoresis and list the steps involved in setting up and running the apparatus.	E	L, M, N	3.7.10.A, B
E. Perform various biotechnology labs including: DNA Isolation, DNA Restriction Analysis, Transformatin, Gene Insertion and DNA Identification.	E	L, M, N	3.7.10.A, B
F. Examine the field of bioinformatics and use a public online database to analyze and identify a sequence of DNA bases.	I	O	3.3.12.B 3.7.10.A, B
G. Explain the importance of the Human Genome Project and the ethical decisions, which have to be decided, based upon the information which is now available from this research.	E	K, O	3.2.12.A, B 3.3.12.B 3.7.10.A, B
H. Examine bioethics and the impact of biotechnology on society.	I	K	3.2.12.A, B

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III. Course Assessments

Check types of assessments to be used in the teaching of the course.
(Provide examples of each type.)

__X_ Objective Tests/Quizzes
____ Constructed Responses
____ Essays
__X_ Reports
__X_ Projects
____ Portfolios
__X_ Presentations
__X_ Performance tasks
__X_ Lab Activities
____ Response Journals
____ Logs
__X_ Computer Simulations
____ Research Papers
__X_ Class Participation
__X_ Notetaking
__X_ Daily Assignments
____ Writing Samples
____ _____

Provide copies of common assessments that will be utilized for all students taking this course. Overall course/grade level standards will be measured by a common course assessment. Unit objectives will be measured on an ongoing basis as needed by the classroom teacher to assess learning and plan for instruction. List common assessements below and recommended date/time frame for administration (at least quarterly).

	Name of Assessment	When given?
1.	Unit Tests	At the conclusion of each major unit
2.	Final Exam	At the conclusion of the semester
3.	Lab Reports	At the conclusion of a lab
4.	Biological Magnification Project	At the conclusion of unit 2

IV. Expected levels of achievement

Current grading scale:

As defined in the current grading policy outlined in the student handbook.

A+	98-100
A	95-97
A-	92-94
B+	89-91
B	86-88
B-	83-85
C+	80-82
C	77-79
C-	74-76
D+	71-73
D	68-70
D-	65-67
F	0-64

PA Proficiency Levels
Advanced Proficient
Basic Below Basic

Attach rubrics, checklists, or other documentation noting how levels of proficiency will be determined for common assessments. The following scoring documents have been developed for this course:

1. Rubric for Biological Magnification Project (attached)

Biochemistry/Biotechnology
Mr. Eurich
25 Points

Name _____
Date _____
Sect _____

Lab: Food Webs and Biological Magnification of Pesticides

Directions:

A study was performed on pesticide levels (measured in parts-per-million or ppm) in feeding relationships. Examine the following list of organisms from a Long Island estuary and the nearby shore. Arrange the cut-out organisms on your construction paper (folded in half "hamburger-bun style") so that the top consumers of the food chain are along the top margin, the bottom members (producers) are along the bottom margin, and the intermediate consumers are in the middle. Place the marsh plants and organic debris on the outside and the cladophora and plankton toward the center. After you have placed them according to this information check to be sure that the organisms that they feed on are relatively close by and then tack them down with adhesive. Avoid placing organisms along the folded midline of the construction paper. Draw lines with arrows ***from the producers to the consumers and so on until you reach the top members of the food chain.*** You may cross over lines and go around organisms but try to reduce this as much as possible. Finally, place the following title "**Pesticide Levels in a Salt Marsh Food Web Illustrating Biological Magnification**" above your food web. Complete the analysis calculations on the second page and paste this sheet (with the grading rubric) on the back side of the construction paper. Finally, answer the summary questions and paste this sheet on the front side of the construction paper to complete the project. Be sure to include your name, date and section in the space provided.

Organism	**Feeds On**
Bay Shrimp	Organic Debris
Billfish	Bay Shrimp, Silversides
Blowfish	Clams, Mud Snail, Cladophora
Clam	Plankton
Cormorant	Eel, Fluke
Cricket	Marsh Plants
Diptera	Marsh Plants
Eel	Organic Debris, Cladophora
Fluke	Cladophora
Fundulus	Plankton
Green Heron	Billfish, Minnow, Fundulus
Gulls	Clams
Kingfisher	Minnow, Fundulus
Osprey	Billfish, Eel, Blowfish
Merganser	Blowfish, Fluke, Eel
Minnow	Cladophora, Plankton
Mud Snail	Cladophora
Redwing Blackbird	Cricket
Silversides	Plankton
Tern	Billfish, Silversides

Pesticide Magnification Analysis: In the space below record five (5) different food chains consisting of at least three (3) organisms (single feeding relationship within the food web) starting with either the plankton or the cladophora. Underneath each organism record the pesticide level in ppm. For each consumer calculate the pesticide increase in the body tissue compared to the original amount in the producer and record this value above the name of the consumer followed by an "x".

1.

2.

3.

4.

5.

Grading/Scoring Rubric:

CATEGORY	4	3	2	1	Score	Weighting	Score
Presentation/ Attractiveness	The project is neat and attractive. Spelling and grammar are also correct.	The project is neat and attractive. There are few errors in spelling and grammar.	The project is acceptable. There are few errors in spelling and grammar.	The project is messy. There are several errors in spelling and grammar.		X1	
Required Elements	The project includes all required elements.	The majority of the required elements are included on the project.	Most of the required elements are included on the project.	Several required elements were missing on the project.		X1	
Food Web/ Food Chains	The food web/food chains are all properly connected to show relationships.	The majority of the food chains shows correct relationships in the food web.	Most of the food chains show correct relationships in the food web.	Few of the food chains show correct relationships in the food web.		X2	
Calculations	All of the calculations are accurately displayed on the project.	The majority of the calculations are accurately displayed on the project.	Most of the calculations are accurately displayed on the project.	Few of the calculations are accurately displayed on the project.		X1	
Questions	The answers to all questions are correct, complete and well thought out.	The answers to all but one of the questions are correct, complete and well thought out.	The answers to most of the questions are correct, complete and well thought out.	The answers to few of the questions are correct, complete and well thought out.		X1	
					Total		25

Biochemistry/Biotechnology
Mr. Eurich
25 Points

Name _____
Date _____
Sect _____

Lab: Food Webs and Biological Magnification of Pesticides

Summary Questions:

1. What is the difference between a food chain and a food web?

2. What is the difference between a producer and a consumer? Why are some consumers considered to be primary while others are said to be secondary or tertiary?

3. What is the concept of biological magnification? How does this apply to feeding relationships?

4. What characteristics of DDT allow it to accumulate in the body of organisms?