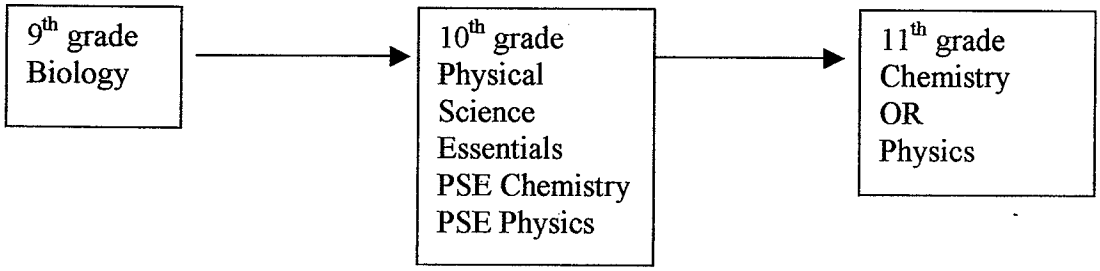
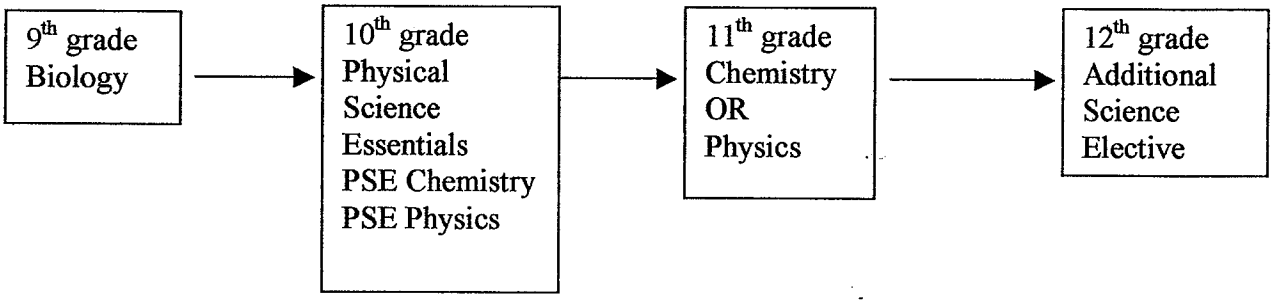
BHS Science Flow Chart, 2007

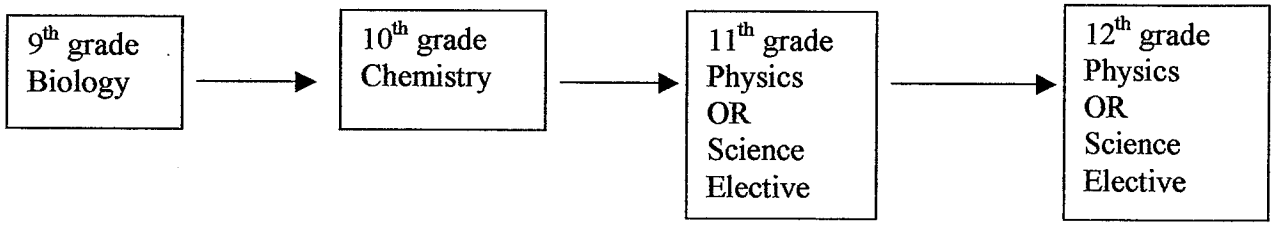
Minimum Requirement for Graduation: 3 Years



Recommended for College Bound Students: 4 Years



Recommended for College Bound Science Majors: 4 Years



Science Electives Offered:

Chemistry
Physics
Anatomy and Physiology
Botany
Geology
Astronomy
Advanced Placement Biology
Advanced Placement Chemistry
Advanced Placement Physics
Physical Science Essentials Chemistry (before Chemistry only)
Physical Science Essentials Physics (before Physics only)

Prepared by Joan Ancona, April 15, 2007

Biology, 2007

Michigan Merit Curriculum, Standards and Expectations

Curriculum Guide Description:

Biology
Course Number: 4070 – One Year Course – One Credit – Grade 9

Biology offers the study of ecology, biochemistry, cells, energetics, chromosomes, cell division, genetics, and evolution. The course will minimally present all of the essential and core expectations provided in the Michigan High School Content Expectations for Biology. After two semesters, successful students will earn one "Biology" credit toward the Michigan Merit Graduation Requirements.

Notes:

- The entire one-year course is outlined in eight units. Due to availability of supplies and student-related concerns, teachers may teach the main topics in any appropriate order. Teachers are encouraged to create their own units of study that are suitable for their individual class needs.

- The first four units of content should be covered sometime during the first semester and the last four units of content should be covered sometime during the second semester.

- The Biology course will be implemented with lesson plans intended to help all students successfully meet all of the designated state expectations. A common pool of assessment questions have been selected to measure, in part, the students' success. The questions can be used to form quizzes, unit tests and/or final exams, etc.

- The Biology course will include dedicated computer instruction via the "Virtual Fly" software package as implemented by the work of the On-Line Subcommittee (High School Reform Committee).

Prepared by Joan Ancona, April 15, 2007

Biology, 2007- continued

Michigan Merit Curriculum, Standards and Expectations

- Biology students will be mixed into heterogeneous groups consisting of all ability levels.
- The course will be scheduled as year-long.
- Biology courses that team a general education instructor with a special education instructor will continue to be offered.
- Biology will remain a course intended for the 9th grade student exclusively since we also incorporate a great deal of study/organizational skills and change-of-level coping strategies. The department will complete guidelines for an appropriate remediation policy.
- The science department will complete guidelines for an appropriate general grading policy. Grades awarded to Biology students will be proficiency based.
- As soon as possible, a new textbook, or a renewal of a newer edition of the current textbook needs to be selected and implemented because the current textbook (Miller, Kenneth R. and Levine, Joseph. Biology. Prentice Hall, 2002), has a five-year-old copyright. Science books are constantly being updated as are support materials.

Biology, 2007

Unit 1—Scientific Method and Ecology

Chapter 1	"The Science of Biology"
Chapter 3	"The Biosphere"
Chapter 4.2	"What Shapes an Ecosystem?"
Chapter 5	"Populations"
Chapter 6.3	"Biodiversity"

B1.1 Scientific Inquiry

B1.1A Generate new questions that can be investigated in the laboratory or field.
B1.1B Evaluate the uncertainties or validity of scientific conclusions using an understanding of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.
B1.1C Conduct scientific investigations using appropriate tools and techniques (e.g. selecting an instrument that measures the desired quantity- length, volume, weight, time interval, temperature- with the appropriate level of precision.)
B1.1D Identify patterns in data and relate them to theoretical models.
B1.1E Describe a reason for a given conclusion using evidence from an investigation.
B1.1f Predict what would happen if the variables, methods, or timing of an investigation were changed.
B1.1g Use empirical evidence to explain and critique the reasoning to draw a scientific conclusion or explanation.
B1.1h Design and conduct a systematic scientific investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables.
B1.1i Distinguish between scientific explanations that are regarded as current scientific consensus and the emerging questions that active researchers investigate.

B1.2 Scientific Reflection and Social Implications

B1.2A Critique whether or not specific questions can be answered through scientific investigations.
B1.2B Identify and critique arguments about personal or social issues based on scientific evidence.
B1.2C Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.
B1.2D Evaluate scientific explanations in a peer review process or discussion format.
B1.2E Evaluate the future career and occupational prospects of science fields.
B1.2f Critique solutions to problems, given criteria and scientific constraints.
B1.2g Identify scientific tradeoffs in design decisions and choose among alternative solutions.
B1.2h Describe the distinctions between scientific theories, laws, hypothesis, and observations.
B1.2i Explain the progression of ideas and explanations that leads to scientific theories that are part of the current scientific consensus or core knowledge.

B1.2j Apply science principles or scientific data to anticipate effects of technological design decisions.
B1.2k Analyze how science and society interact from a historical, political, economic, or social perspective.

B2.2g Propose how moving an organism to a new environment may influence its ability to survive and predict the possible impact of this type of transfer.

B3.3 Factors Influencing Ecosystems

B3.3A Use a food web to identify and distinguish producers, consumers, and decomposers and explain the transfer of energy through trophic levels.
B3.3b Describe environmental processes (e.g. the carbon and nitrogen cycles) and their role in processing matter crucial for sustaining life.

B3.4 Changes in Ecosystems

Although the interrelationships and interdependence or organisms may generate biological communities in ecosystems that are stable for hundreds or thousands of years, ecosystems always change when climate changes or when one or more new species appear as a result of migration or local evolution. The impact of the human species has major consequences for other species.
B3.4A Describe ecosystem stability. Understand that if a disaster such as a flood or fire occurs, the damages ecosystem is likely to recover in stages of succession that eventually result in a system similar to the original one.
B3.4B Recognize and describe that a great diversity of species increases the chance that at least some living organisms will survive in the face of cataclysmic changes in the environment.
B3.4C Examine the negative impact of human activities.

B3.4x Human Impact

Humans can have tremendous impact in the environment. Sometimes their impact is beneficial, and sometimes it is detrimental.
B3.4d Describe the greenhouse effect and list possible causes.
B3.4e Examine the negative impact of human activities.

B3.5 Populations

Populations of living things increase and decrease in size as they interact with other populations and with the environment. The rate of change is dependent upon relative birth and death rates.
B3.5A Graph changes in population growth, given a data table.
B3.5B Explain the influences that affect population growth.
B3.5C Predict the consequences of an invading organism on the survival of other organisms.

B3.5x Environmental Factors

B3.5d Describe different reproductive strategies employed by various organisms and explain their advantages and disadvantages.

B3.5e Recognize that and describe how the physical or chemical environment may influence the rate, extent, and nature of population dynamic within ecosystems.

B3.5f Graph an example of exponential growth. Then show the population leveling off at the carrying capacity of the environment.

B3.2 Ecosystems

The chemical elements that make up the molecules of living things pass through food webs and are combined and recombined in different ways. At each link in an ecosystem, some energy is stored in newly made structures, but much is dissipated into the environment as heat. Continual input of energy from sunlight keeps the process going.

B3.2A Identify how energy is stored in an ecosystem.

B3.2B Describe energy transfer through an ecosystem accounting for energy lost to the environment as heat.

B3.2C Draw the flow of energy through an ecosystem. Predict changes in the food web when one or more organisms are removed.

Unit 2—Chemistry and Biochemistry

Chapter 2	"The Chemistry of Life"

B2.5 Living Organism Composition

All living or once-living organisms are composed of carbohydrates, lipids, proteins, and nucleic acids. Carbohydrates and lipids contain carbon-hydrogen bonds that also store energy.

B2.5A Recognize and explain that macromolecules such as lipids contain high energy bonds.

B2.2 Organic Molecules

There are four major categories of molecules that make up living systems: carbohydrates, fats, proteins, and nucleic acids.

B2.2A Explain how carbon can join to other carbon atoms in chains and rings to form large and complex molecules.

B2.2B Recognize the six most common elements in organic molecules (C, H, N, O, P, S).

B2.2C Describe the composition of the four major categories of organic molecules (carbohydrates, lipids, proteins, and nucleic acids).

B2.2D Explain the general structure and primary functions of the major complex organic molecules that compose living organisms.

B2.2E Describe how dehydration and hydrolysis relate to organic molecules.

B2.2x Proteins

Protein molecules are long, usually folded chains composed mostly of amino acids and are made of C, H, O, and N.

Protein molecules assemble fats and carbohydrates; they function as enzymes, structural components, and hormones. The function of each protein molecule depends on its specific sequence of amino acids and the shape of the molecule.

B2.2f Explain the role of enzymes and other proteins in biochemical functions (e.g., the protein hemoglobin carries oxygen in some organisms, digestive enzymes, and hormones).

Unit 3—Cells and Homeostasis

Chapter 7	"Cell Structure and Function"
Chapter 19	"Bacteria and Viruses"

B2.3 Maintaining Environmental Stability

The internal environment of living things must remain relatively constant. Many systems work together to maintain stability. Stability is challenged by changing physical, chemical, and environmental conditions as well as the presence of disease agents.

B2.3A Describe how cells function in a narrow range of physical conditions, such as temperature and pH (acidity), to perform life functions.

B2.3B Describe how the maintenance of a relatively stable internal environment is required for the continuation of life.

B2.3C Explain how stability is challenged by changing physical, chemical, and environmental conditions as well as the presence of disease agents.

B2.4 Cell Specialization

In multicellular organisms, specialized cells perform specialized functions. Organs and organ systems are composed of cells and function to serve the needs of cells for food, air, and waste removal. The way in which cells function is similar in all living organisms.

B2.4g Explain that some structures in the modern eukaryotic cell developed from early prokaryotes, such as mitochondria, and in plants, chloroplasts.

B2.4h Describe the structures of viruses and bacteria.

B2.4i Recognize that while viruses lack cellular structure, they have the genetic material to invade living cells.

B2.5 Living Organism Composition

All living or once-living organisms are composed of carbohydrates, lipids, proteins, and nucleic acids. Carbohydrates and lipids contain many carbon-hydrogen bonds that also store energy.

B2.5g Compare and contrast plant and animal cells.

B2.5h Explain the role of cell membranes as a highly selective barrier (diffusion, osmosis, and active transport).

B2.5i Relate cell parts/organelles to their function.

B2.6x Internal/External Cell Regulation

Cellular processes are regulated both internally and externally by environments in which cells exist, including local environments that lead to cell differentiation during the development of multicellular organisms. During the development of complex multicellular organisms, cell differentiation is regulated through the expression of different genes.

B2.6a Explain that the regulatory and behavioral responses of an organism to external stimuli occur in order to maintain both short- and long-term equilibrium.

Unit 4—Energetics

Chapter 8	"Photosynthesis"
Chapter 9	"Cellular Respiration"

B3.1 Photosynthesis and Respiration

Organisms acquire their energy directly or indirectly from sunlight. Plants capture the Sun's energy and use it to convert carbon dioxide and water to sugar and oxygen through the process of photosynthesis. Through the process of cellular respiration, animals are able to release the energy stored in the molecules produced by plants and use it for cellular processes, producing carbon dioxide and water.

B3.1A Describe how organisms acquire energy directly or indirectly from sunlight.

B3.1B Illustrate and describe the energy conversions that occur during photosynthesis and respiration.

B3.1C Recognize the equations for photosynthesis and respiration and identify the reactants and products for both.

B3.1D Explain how living organisms gain and use mass through the processes of photosynthesis and respiration.

B3.1e Write the chemical equation for photosynthesis and cellular respiration and explain in words what they mean.

B3.1f Summarize the process of photosynthesis.

B2.1 Transformation of Matter and Energy in Cells

In multicellular organisms, cells are specialized to carry out specific functions such as transport, reproduction, or energy transformation.

B2.1A Explain how cells transform energy (ultimately obtained from the sun) from one form to another through the processes of photosynthesis and respiration. Identify the reactants and products in the general reaction of photosynthesis.

B2.1B Compare and contrast the transformation of matter and energy during photosynthesis and respiration.

B2.5x Energy Transfer

All living or once living organisms are composed of carbohydrates, lipids, proteins, and nucleic acids. Carbohydrates and lipids contain many carbon-hydrogen bonds that also store energy. However, that energy must be transferred to ATP (adenosine triphosphate) to be usable by the cell.

B2.5A Recognize and explain that macromolecules such as lipids contain high energy bonds.

B2.5B Explain how major systems and processes work together in animals and plants, including relationships between organelles, cells, tissues, organs, organ systems, and organisms. Relate these to molecular functions.

B2.5C Describe how energy is transferred and transformed from the Sun to energy-rich molecules during photosynthesis.

B2.5D Describe how individual cells break down energy-rich molecules to provide energy for cell functions.

Unit 5—DNA/RNA, Protein Synthesis and Chromosomal Mutations

Chapter 12	"DNA and RNA"

B4.2x DNA, RNA, and Protein Synthesis

Protein synthesis begins with the information in a sequence of DNA bases being copied onto messenger RNA. This molecule moves from the nucleus to the ribosome in the cytoplasm where it is "read." Transfer RNA brings amino acids to the ribosome, where they are connected in the correct sequence to form a specific protein.

B4.2C Describe the structure and function of DNA.

B4.2f Demonstrate how the genetic information in DNA molecules provides instructions for assembling protein molecules and that this is virtually the same mechanism for all life forms.

B4.2g Describe the processes of replication, transcription, and translation and how they relate to each other in molecular biology.

B4.2h Recognize that genetic engineering techniques provide great potential and responsibilities.

Unit 6—Cell Division

Chapter 10	"Cell Growth and Division"
Chapter 11.4	"Meiosis"

B2.1x Cell Differentiation

Following fertilization, cell division produces a small cluster of cells that then differentiate by appearance and function to form the basic tissues of an embryo.
B2.1C Explain cell division, growth, and development as a consequence of an increase in cell number, cell size, and/or cell products.
B2.1d Describe how, through cell division, cells can become specialized for specific function.
B2.1e Predict what would happen if the cells from one part of a developing embryo were transplanted to another part of the embryo.

B4.3 Cell Division — Mitosis and Meiosis

Sorting and recombination of genes in sexual reproduction results in a great variety of possible gene combinations from the offspring of any two parents.
B4.3A Compare and contrast the processes of cell division (mitosis and meiosis), particularly as those processes relate to production of new cells and to passing on genetic information between generations.
B4.3B Explain why only mutations occurring in gametes (sex cells) can be passed on to offspring.
B4.3C Explain how it might be possible to identify genetic defects from just a karyotype of a few cells.
B4.3d Explain that the sorting and recombination of genes in sexual reproduction result in a great variety of possible gene combinations from the offspring of two parents.
B4.3e Recognize that genetic variation can occur from such processes as crossing over, jumping genes, and deletion and duplication of genes.
B4.3f Predict how mutations may be transferred to progeny.
B4.3g Explain that cellular differentiation results from gene expression and/or environmental influence (e.g., metamorphosis, nutrition).

Unit 7—Mendelian & Molecular Genetics

Chapter 11	" Introduction to Genetics"
Chapter 13	"Genetic Engineering"

B4.1 Genetics and Inherited Traits

Hereditary information is contained in genes, located in the chromosomes of each cell. Cells contain many thousands of different genes. One or many genes can determine an inherited trait of an individual, and a single gene can influence more than one trait. Before a cell divides, this genetic information must be copied and apportioned evenly into the daughter cells.

B4.1A Draw and label a homologous chromosome pair with heterozygous alleles highlighting a particular gene location.

B4.1B Explain that the information passed from parents to offspring is transmitted by means of genes that are coded in DNA molecules. These genes contain the information for the production of proteins.

B4.1c Differentiate between dominant, recessive, codominant, polygenic, and sex-linked traits.

B4.1d Explain the genetic basis for Mendel's laws of segregation and independent assortment.

B4.1e Determine the genotype and phenotype of monohybrid crosses using a Punnett Square.

B4.2 DNA

The genetic information encoded in DNA molecules provides instructions for assembling protein molecules. Genes are segments of DNA molecules. Inserting, deleting, or substituting DNA segments can alter genes. An altered gene may be passed on to every cell that develops from it. The resulting features may help, harm, or have little or no effect on the offspring's success in its environment.

B4.2A Show that when mutations occur in sex cells, they can be passed on to offspring (inherited mutations), but if they occur in other cells, they can be passed on to descendant cells only (noninherited mutations).

B4.2B Recognize that every species has its own characteristic DNA sequence.

B4.2D Predict the consequences that changes in the DNA composition of particular genes may have on an organism (e.g., sickle cell anemia, other).

B4.2E Propose possible effects (on the genes) of exposing an organism to radiation and toxic chemicals.

B4.4x Genetic Variation

Genetic variation is essential to biodiversity and the stability of a population. Genetic variation is ensured by the formation of gametes and their combination to form a zygote. Opportunities for genetic variation also occur during cell division when chromosomes exchange genetic material causing permanent changes in the DNA sequences of the chromosomes. Random mutations in DNA structure caused by the environment are another source of genetic variation.

B4.4a Describe how inserting, deleting, or substituting DNA segments can alter a gene. Recognize that an altered gene may be passed on to every cell that develops from it and that the resulting features may help, harm, or have little or no effect on the offspring's success in its environment.

B4.4b Explain that gene mutation in a cell can result in uncontrolled cell division called cancer. Also know that exposure of cells to certain chemicals and radiation increases mutations and thus increases the chance of cancer.

B4.4c Explain how mutations in the DNA sequence of a gene may be silent or result in phenotypic change in an organism and in its offspring.

Unit 8—Evolution, Health/Human Systems, Comparative Structure & Function

Chapter 15	"Darwin's Theory of Evolution"
Chapter 16	"Evolution of Populations"
Chapter 17	"The History of Life"
Chapter 35.1	"Human Body Systems"
Chapter 40.1	"Infectious Disease"
Chapter 40.4	"Cancer"

B5.1 Theory of Evolution

The theory of evolution provides a scientific explanation for the history of life on Earth as depicted in the fossil record and in the similarities evident within the diversity of existing organisms.

B5.1A Summarize the major concepts of natural selection (differential survival and reproduction of chance inherited variants, depending on environmental conditions).

B5.1B Describe how natural selection provides a mechanism for evolution.

B5.1c Summarize the relationships between present-day organisms and those that inhabited the Earth in the past (e.g., use fossil record, embryonic stages, homologous structures, chemical basis).

B5.1d Explain how a new species or variety originates through the evolutionary process of natural selection.

B5.1e Explain how natural selection leads to organisms that are well suited for the environment (differential survival and reproduction of chance inherited variants, depending upon environmental conditions).

B5.1f Explain, using examples, how the fossil record, comparative anatomy, and other evidence supports the theory of evolution.

B5.1g Illustrate how genetic variation is preserved or eliminated from a population through natural selection (evolution) resulting in biodiversity.

B5.2x Molecular Evidence

Molecular evidence substantiates the anatomical evidence for evolution and provides additional detail about the sequence in which various lines of descents branched.

B5.2a Describe species as reproductively distinct groups of organisms that can be classified based on morphological, behavioral, and molecular similarities.

B5.2b Explain that the degree of kinship between organisms or species can be estimated from the similarity of their DNA and protein sequences.

B5.2c Trace the relationship between environmental changes and changes in the gene pool, such as genetic drift and isolation of subpopulations.

B5.3 Natural Selection

Evolution is the consequence of natural selection, the interactions of (1) the potential for a population to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection from environmental pressure of those organisms better able to survive and leave offspring.

B5.3A Explain how natural selection acts on individuals, but it is populations that evolve. Relate genetic mutations and genetic variety produced by sexual reproduction to diversity within a given population.

B5.3B Describe the role of geographic isolation in speciation.

B4.3C Give examples of ways in which genetic variation and environmental factors are causes of evolution and the diversity of organisms.

B5.3d Explain how evolution through natural selection can result in changes in biodiversity.

B5.3e Explain how changes at the gene level are the foundation for changes in populations and eventually the formation of new species.

B5.3f Demonstrate and explain how biotechnology can improve a population and species.

B2.3x Homeostasis

The internal environment of living things must remain relatively constant. Many systems work together to maintain homeostasis. When homeostasis is lost, death occurs.

B2.3d Identify the general functions of the major systems of the human body (digestion, respiration, reproduction, circulation, excretion, protection from disease, and movement, control, and coordination) and describe ways that these systems interact with each other.

B2.3e Describe how human body systems maintain relatively constant internal conditions (temperature, acidity, and blood sugar).

B2.3f Explain how human organ systems help maintain human health.

B2.3g Compare the structure and function of a human body system or subsystem to a nonliving system (e.g., human joints to hinges, enzyme and substrate to interlocking puzzle pieces).

B2.4 Cell Specialization

In multicellular organisms, specialized cells perform specialized functions. Organs and organ systems are composed of cells and function to serve the needs of cells for food, air, and waste removal. The way in which cells function is similar in all living organisms.

B2.4A Explain that living things can be classified based on structural, embryological, and molecular (relatedness of DNA sequence) evidence.

B2.4B Describe how various organisms have developed different specializations to accomplish a particular function and yet the end result is the same (e.g., excreting nitrogenous wastes in animals, obtaining oxygen for respiration).

B2.4C Explain how different organisms accomplish the same result using different structural specializations (gills vs. lungs vs. membranes).

B2.4d Analyze the relationships among organisms based on their shared physical, biochemical, genetic, and cellular characteristics and functional processes.

B2.5 Living Organism Composition

All living or once-living organisms are composed of carbohydrates, lipids, proteins, and nucleic acids. Carbohydrates and lipids contain many carbon-hydrogen bonds that also store energy.

B2.5B Explain how major systems and processes work together in animals and plants, including relationships between organelles, cells, tissues, organs, organ systems, and organisms. Relate these to molecular functions.