ORANGE PUBLIC SCHOOLS			
CONTENT AREA: Science/Biology	**GRADE: H.S.**	**UNIT #: 2**	**UNIT NAME: Matter and Energy in Organisms and Ecosystems**

SCOPE AND SEQUENCE

OVERVIEW				
Lesson	Topic	PE's and DCI's	Chapter	Suggested Pacing (Blocks)
1	Photosynthesis	HS-LS1-5	4.1, 4.2, 4.3	3
2	Biological Macromolecules	HS-LS1-6	2.3, 2.4, 2.5	4
3	Cellular Respiration	HS-LS1-7	4.4, 4.6	2
4	Cycles of Matter	HS-LS2-5	13.5	1
5	Energy Transfer in Ecosystems	HS-LS2-3	13.3	1/2
6	Organization for Matter and Energy Flow in Organisms	HS-LS2-4	2.4, 13.1, 13.2, 13.4, 13.6	3

CALENDAR- NOVEMBER 2015

M	T	W	R	F
2A	**3**	**4**	**5**	**6**
9B	**10**	**11**	**12**	**13**
16A	**17**	**18**	**19**	**20**
23B	**24**	**25**	**26**	**27**
30A				

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CALENDAR- DECEMBER 2015

M	T	W	R	F
	1	2	3	4
7B	8	9	10	11
14A	15	16	17	18
21B	22	23	24	25

CALENDAR- JANUARY 2016

M	T	W	R	F
4A	5	6	7	8
11B	12	13	14	15
18	19A	20	21	22
25	26	27	28	

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How do organisms obtain and use energy they need to live and grow?

How do matter and energy move through ecosystems?

Students construct explanations for the role of energy in the cycling of matter in organisms and ecosystems. They apply mathematical concepts to develop evidence to support explanations of the interactions of photosynthesis and cellular respiration and develop models to communicate these explanations. They relate the nature of science to how explanations may change in light of new evidence and the implications for our understanding of the tentative nature of science. Students understand organisms' interactions with each other and their physical environment, how organisms obtain resources, change the environment, and how these changes affect both organisms and ecosystems. In addition, students utilize the crosscutting concepts of matter and energy and systems and system models to make sense of ecosystem dynamics. (p. 2, Life Science Topics Storyline).

# Blocks	STUDENT LEARNING OBJECTIVES	CORRESPONDING Pes and DCIs	CURRICULAR & SUPPLEMENTAL RESOURCES	ASSESSMENT
4	**Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.** *[Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.]* [Assessment Boundary: Assessment does not include specific biochemical steps.]	**HS-LS1-5**	Biology text: Chapter 13.3-13.6 Chapter 14 Activity 1: Explanation Development Exploring Energy Transformation in Plants. https://www.glbrc.org/education/classroom-materials/exploring-energy-transformations-plants-0 Testing for Sugars http://www.seplessons.org/node/362	Activity 1: Explanation Development Design a self-watering grow system. Design and construct a Plant Light Box. Teacher/students will design a rubric to assess the quality of the designs. Common Assessment 1.

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# Blocks	STUDENT LEARNING OBJECTIVES	CORRESPONDING Pes and DCIs	CURRICULAR & SUPPLEMENTAL RESOURCES	ASSESSMENT
3	**Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.** *[Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.]* [Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.*]*	**HS-LS1-6**	Biology Text Chapter 2.3 Activity 2: Biological Macromolecules: Biological Macromolecules Lab.doc - apbioredesign *http://apbioredesign.wikispaces.com/file/view/Biological+Macromolecules+Lab.doc* Activity 3: Carbon-based molecules: *http://www.scribd.com/doc/73769330/Chemistry-of-Life-Lesson-Plan-Carbon-Based-Molecules* Activity 4: Enzyme Lab http://www.biologycorner.com/worksheets/enzyme_lab.html	Activity 2: Biological Macromolecules Alternatively students may present on how a chosen macromolecule contains the components and properties Activity 3: Carbon-based molecules: Activity 4: Enzyme Lab
2	**Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.** *[Clarification Statement: Emphasis is on the conceptual*	**HS-LS1-7**	Biology Text Chapter 4 Activity 5: Determining the calorie content of foods. http://www.algebralab.org/activities/activity.aspx?file=science_caloriecontent.xml	Activity 5: Determining the calorie content of foods. • Check for food allergies. • Nuts should be avoided.

	understanding of the inputs and outputs of the process of cellular respiration.] [Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.*]*		OR alternatively http://www.nuffieldfoundation.org/practical-biology/how-much-energy-there-food	
1	**Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.** *[Clarification Statement: Examples of models could include simulations and mathematical models.]* [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.*]*	**HS-LS2-5**	Biology Text Chapter Create a graphic to show how your lunch may be traced to the Sun. Include the processes of photosynthesis and respiration in the graphic.	Teacher-created rubric for the graphic.
	Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. *[Clarification Statement: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments.]* [Assessment Boundary: Assessment does not	**HS-LS2-3**		

	include the specific chemical processes of either aerobic or anaerobic respiration.*]*			
6	**Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.** *[Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy is conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem.]* [Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.*]*	**HS-LS2-4**		
7	Use visual representations to illustrate how interactions among living systems and with their environment result in the movement of matter and energy.	LS1.C		

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The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models (pp. 56-59, NRC, 2012)

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-5),(HS-LS1-7)
- Develop a model based on evidence to illustrate the relationships between systems or components of a system. (HS-LS2-5)

Using Mathematics and Computational Thinking(pp. 64-67, NRC, 2012)

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena or design solutions to support

Disciplinary Core Ideas

LS1.C: Organization for Matter and Energy Flow in Organisms (pp. 147-148, NRC, 2012)

- The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5)
- The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6)
- As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6),(HS-LS1-7)
- As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy

Crosscutting Concepts

Systems and System Models (pp. 91-94, NRC, 2012)

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-LS2-5)

Energy and Matter (pp. 94-96, NRC, 2012)

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-LS1-5), (HS-LS1-6)
- Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. (HS-LS1-7),(HS-LS2-4)

Energy drives the cycling of matter within and between systems. (HS-LS2-3)

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Connections to Nature of Science

Scientific Knowledge is Open to Revision in Light of New Evidence (pp. 96-101, Appendix H)

- Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (HS-LS2-3)

claims. (HS-LS2-4) **Constructing Explanations and Designing Solutions** (pp. 67-71, NRC, 2012) Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS1-6),(HS-LS2-3)	transfer to the surrounding environment. (HS-LS1-7) **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** (pp. 152-154, NRC, 2012) • Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3) • Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4) • Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and	

	geosphere through chemical, physical, geological, and biological processes. (HS-LS2-5) **PS3.D: Energy in Chemical Processes** (pp. 128-130, NRC, 2012) • The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. *(secondary to HS-LS2-5)*	

Connections to other DCIs in this grade-band:
HS.PS1.B (HS-LS1-5),(HS-LS1-6),(HS-LS1-7),(HS-LS2-3),(HS-LS2-5); **HS.PS2.B** (HS-LS1-7); **HS.PS3.B** (HS-LS1-5),(HS-LS1-7),(HS-LS2-3),(HS-LS2-4); **HS.PS3.D** (HS-LS2-3),(HS-LS2-4); **HS.ESS2.A** (HS-LS2-3); **HS.ESS2.D** (HS-LS2-5)

Articulation of DCIs across grade-bands:
MS.PS1.A (HS-LS1-6);**MS.PS1.B** (HS-LS1-5),(HS-LS1-6),(HS-LS1-7),(HS-LS2-3); **MS.PS3.D** (HS-LS1-5),(HS-LS1-6),(HS-LS1-7),(HS-LS2-3),(HS-LS2-4),(HS-LS2-5); **MS.LS1.C** (HS-LS1-5),(HS-LS1-6),(HS-LS1-7),(HS-LS2-3),(HS-LS2-4),(HS-LS2-5); **MS.LS2.B** (HS-LS1-5),(HS-LS1-7),(HS-LS2-3),(HS-LS2-4),(HS-LS2-5); **MS.ESS2.A** (HS-LS2-5); **MS.ESS2.E** (HS-LS1-6)

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Common Core State Standards Connections:

ELA/Literacy -

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS1-6),(HS-LS2-3)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-6),(HS-LS2-3)
WHST.9-12.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS1-6),(HS-LS2-3)
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-6)
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-LS1-5),(HS-LS1-7)

Mathematics -

MP.2	Reason abstractly and quantitatively. (HS-LS2-4)
MP.4	Model with mathematics. (HS-LS2-4)
HSN.Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-LS2-4)
HSN.Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. (HS-LS2-4)
HSN.Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-LS2-4)

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Table: Component Ideas arranged into courses. The table uses the information in the NGSS foundation boxes to connect the high school NGSS performance expectations to the component ideas from the *Framework*.

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