BIG BEAVER FALLS AREA SCHOOL DISTRICT
Once a Tiger, Always a Tiger

UNIT 3: WE ALL NEED ENERGY

Teacher Name: Rebecca Cottington
Grade/Course: Biology
Dates of Unit: ~7

Stage 1 – Desired Results
Unit Topic and Length
We All Need Energy ~7 weeks
Curriculum Indicators/Standards
B-LS.7: Describes how homeostatic mechanisms help an organism survive (i.e. osmoregulation, thermoregulation, oxygen regulation) B-LS.10: Identifies the function of the four major macromolecules (i.e. carbohydrates, proteins, lipids, nucleic acids) B-LS.11:Explains how photosynthesis and cellular respiration are complementary processes for cycling carbon dioxide and oxygen as well as transforming energy in ecosystems. B-LS.12: Explains the initial reactants, final products, and general purposes of photosynthesis by identifying that cells trap energy from sunlight using chlorophyll and then use the energy, carbon dioxide, and water to produce energy-rich organic molecules (glucose) and oxygen. B-LS.13: Explains the initial reactants, final products, and general purposes of cellular respiration by identifying that cells break down organic molecules using oxygen, which produces energy (ATP), carbon dioxide, and water B-LS.14: Differentiates between how autotrophs and heterotrophs obtain energy. B-LS.15: Explains that chemical energy is transported within the cell in the form of ATP and explains the role of ATP in cell metabolism B-LS.16: Explains why many biological macromolecules such as ATP contain high energy bonds. B-LS.17: Describes how enzymes catalyze chemical reactions within the cell. B-LS.18: Explains why enzymes are important in cellular metabolism B-LS.19: Identifies how factors such as pH and temperature affect the efficiency or functionality of enzymes. B-LS.20: Explains the role of enzymes in cell chemistry B-LS.27: Describes the relationship between the organelles in a cell and the function of that cell. B-LS.58: Explains how enzymes control the rate of metabolic reaction by acting as a catalyst B-LS.59: Recognizes that most cells function best within a narrow range of pH and temperature, and explains the consequences of extreme changes in pH and temperature on the structure and function of proteins B-LS.60: Analyzes the effects of environmental conditions, such as reactant and product concentrations, temperature, pH, and the presence of an enzyme on the efficiency of a chemical reaction. B-EC.10: Identifies and analyzes human activities (e.g. deforestation, fossil burning, pollution) that interrupt biogeochemical cycles (i.e. water cycle, carbon cycle, oxygen cycle, nitrogen cycle) B-EC.11: Researches the impact of these behaviors on organisms in various ecosystems. B-EC.12: Arranges components of a food web according to energy flow. B-EC.13: Compares the quantity of energy in the steps of an energy pyramid B-EC.14: Defines trophic levels as the feeding position in a food chain or food web. B-EC.15: Describes how energy is passed up a food chain or web from lower to higher trophic levels and explains how the loss of energy (90%) affects the number of trophic levels in a food chain or web.

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B-EC.16: Describes how the processes of photosynthesis and cellular respiration are involved in the flow of energy through an ecosystem
B-EC.19: Lists abiotic factors (e.g., temperature, water, nutrients, sunlight, pH, topography) in a watershed.
B-EC.20: Lists biotic factors (e.g., plants, animals, organic matter) that affect an aquatic ecosystem
B- SI.3 Formulates hypotheses based on cause-and-effect relationships.
B- SI.4 Justifies hypotheses based on both preliminary observations and scientific literature.
B- SI.5 Identifies the independent variable (IV) and the values of the IV that will be used in the experiment.
B- SI.6 Selects dependent variables that allow collection of quantitative data.
B- SI.7 Uses appropriate technology for data collection, including probeware interfaced to a graphing calculator and/or computer, microscope, video microscope, or digital camera with image processing software.
B- SI.8 Identifies variables that must be held constant.
B- SI.9 Establishes controls as appropriate.
B- SI.10 Writes clear, replicable procedures.
B- SI.11 Records quantitative data in clear labeled tables with units.
B- SI.12 Includes labeled diagrams in the data record.
B- SI.13 Critically examines and discusses the validity of results reported in scientific literature and databases.
B- SI.17 Plots data graphically, showing independent and dependent variables.
B- SI.18 Describes linear mathematical functions from the data where appropriate, using a graphing calculator and/or computer spreadsheet.
B- SI.19 Discusses accuracy, confidence, and sources of experimental error based on number of trials and variance in the data.
B- SI.20 Recognizes and discusses contradictory or unusual data.
B- SI.21 Uses evidence, applies logic, and constructs an argument for conclusions based on reported data.
B- SI.22 Determines the extent to which data supports/does not support a hypothesis, and proposes further hypotheses and directions for continued research.

<u>Reading Standards</u>

B.R.1: Locates and explains explicitly stated information in the text or portion of the text using own words and includes supporting key details from the text as evidence.
B.R.2: Locates and explains what is not directly stated in the text by drawing inferences based on implied information, using text structure, text features, and graphic aids, as evidence.
B.R.3: Analyzes several portions of a text to determine and explain explicit information in the text and make inferences using relevant evidence from the text to make connections, draw conclusions and generalize what is read.
B.R. 17: Identifies evidence the author uses to support his/her viewpoint or purpose and conflicting evidence or viewpoints presented in a given text
B.R.18: Compares and contrasts the author's evidence and/or viewpoints to the conflicting evidence and/or viewpoints in one or more texts.
B.R.21: Interprets information presented visually, orally, or quantitatively and explains how each presentation contributes to an understanding of a topci.
B.R.22: Integrates information taken from various media, formats, or texts to demonstrate understanding of a topic or issue.

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B.R. 29: Analyzes information gained from experiments and compares and contrasts with a written text on the same subject

Writing Standards

B.W.1: Presents a manageable thesis in response to text (both on-demand and process writing) while maintaining a consistent focus that establishes clear relationships among the thesis, reasons, and text-based evidence.
B.W.2: Composes an engaging introduction (e.g. vivid, detailed description, historical/cultural background, contrasting situation) to establish a controlling idea in response to text.
B.W.4: Provides significant and convincing reasons and relevant support for the claim, including facts, details, and explanations from texts, non-print media, and/or research.
B.W.5: Evaluates and explains the accuracy and credibility of sources for argument writing used and the relevance of the evidence used to support the claim.
B.W. 6: Constructs an evidence-based argument that identifies, explains, and supports a claim to be more effective than the counterclaim.
B.W.8: Builds support for claims and counterclaims with logical reasoning and relevant evidence, distinguishing between relevant and irrelevant evidence.
B.W.9: Composes an effective conclusion (statement or section) that is more than a repetition of the introduction and both follows from and supports the text-based response.
B.W.10: Uses transitional words, phrases, and clauses within major sections of the writing to signal emphasis or show logical relationships among ideas and between reasons and evidence (e.g. in fact, consequently, as a result, on the other hand, etc.)
B.W.11: Uses effective sequences between and within paragraphs by using transitions to emphasize points in an argument or to show logical connections (e.g. inasmuch as, possibly, therefore etc)
B.W.13: Selects precise language that conveys a particular tone for a response to text that creates appropriate imagery (e.g. explicit nouns, vivid verbs, natural modifiers) and uses specialized vocabulary particular to the subject/topic to provide ease of understanding.
B.W. 14: Selects and uses techniques (e.g. direct audience appeal, rhetorical questions, repetition, etc.) and precise language to emphasize and explain the argument and address the reader's concerns.
B.W.15: Varies sentence patterns for meaning, reader interest, and style and maintains consistency in style and tone when writing.
B.W. 16: Establishes a topic that has been narrowed to create a specific purpose for writing that establishes a controlling idea, theme, or thesis about the topic.
B.W. 17: Composes an engaging introduction (e.g. vivid, detailed description, historical/cultural background, contrasting situation) to organize ideas, concepts, and information in order to make important connections and distinctions.
B.W.18: Explains topic with relevant and sufficient facts, definitions, details, quotations, or other appropriate information and examples (e.g. figures, graphs, tables)
B.W.19: Synthesizes research or a variety of information to support ideas using text-based evidence.
B.W.20: Identifies and determines when to include text features (graphics, charts, tables, multimedia), appropriate formatting, and graphics to aid in comprehension.
B.W.21: Identifies and selects an appropriate text structure (definitions, classifications, comparison/contrast, cause/effect) that is most effective to further the development of a topic.

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B.W.22: Uses transitional words, phrases, and clauses within major sections of the writing to signal emphasis or show logical relationships among ideas and concepts (e.g. in fact, consequently, as a result, on the other hand, etc.)
B.W. 23: Uses effective sequences between and within paragraphs by using transitions to emphasize points in an argument or to show logical connections (e.g. inasmuch as possible, therefore, etc)
B.W.24: Composes an effective conclusion (statement or section) that is more than a repetition of the introduction and both follows from and supports the ideas and concepts.
B.W. 26: Maintains a consistent and formal style in informative/explanatory writing, free from slang, abbreviations, and "text" talk
B.W.27: Selects precise language that conveys a particular tone for a response to text that creates appropriate imagery (e.g. explicit nouns, vivid verbs, natural modifiers) and uses specialized vocabulary particular to the subject/topic to provide ease of understanding.
B.W. 28: Varies sentence patterns for meaning, reader interest, and style, and maintains consistency in style and tone when writing.
B.W.29: Analyzes the reason for writing to decide on task, purpose, and audience.
B.W.30: Determines the appropriate idea development strategies.
B.W.31: Determines the appropriate organization.
B.W.32: Produces writing with clear and coherent idea development.
B.W.33: Produces writing with clear and coherent organization.
B.W.34: Produces writing with appropriate style.
B.W. 35: Generates ideas prior to organizing them and adjusts prewriting strategies accordingly (e.g. brainstorms a list, selects relevant ideas/details to include in a piece of writing), with guidance and support from peers.
B.W.36: Gathers information from a range of sources, formulates questions, and uses an organizer/thinking map to analyze/or synthesize to plan writing, with guidance and support from peers.
B.W. 37: Determines suitable idea development strategies, organization, and style that is appropriate to the task, purpose, and audience.
B.W.38: Develops and strengthens writing by creating a plan, revising, editing, rewriting, and trying new approaches using guidance and support from peers and adults.
B.W. 39: Rereads own writing several times for meaning both orally and silently checking for accuracy and detail, and with a different focus for each reading (e.g. first reading-adding specific details for elaboration; second reading-deleting sentences or phrases to achieve paragraph unity; third reading-reorganizing ideas for meaning.)
B.W.40: Records feedback using identified procedure and makes decisions about writing based on feedback (e.g revision before final draft)
B.W. 41: Uses multiple sources for proofreading and editing (e.g. writing guide, rubric, peer, adult, computer, thesaurus)
B.W. 42: Selects and uses appropriate word processing tools and for communicating and collaborating with others.
B.W.43: Uses keyboarding skills to type three or more pages in a single setting.
B.W. 44: Uses Internet sources as a resource for information, to conduct research.
B.W.45: Publishes making purposeful decisions about format, graphics, illustrations, and other features (e.g. captioned photos, maps) based on audience.
B.W. 46: Publishes using a variety of technology (e.g. word processor, spreadsheet, multimedia, slideshow, publication software) and publishing options (e.g. graphic, document)
B.W.47: Applies appropriate research and inquiry methods to conduct a research project.
B.W.48: Applies multiple resources to conduct short research projects.

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B.W. 49: Determines sources to answer a research question.
B.W. 50: Narrow or refocus the inquiry by selecting information from multiple sources which will support or justify the answer.
B.W. 51: Conducts steps for research to answer a question.
B.W.52: Conducts a short research project to answer a question with appropriate information derived from research in a variety of sources.
B.W. 57: Gathers relevant information from print and digital sources.
B.W. 58: Paraphrases the data and conclusions of others.
B.W. 62: Writes an essay by introducing the topic, providing a grade-appropriate organizational structure, concluding with a statement or section, choosing words and phrases for effect, and using grade-appropriate conventions of standard English grammar, usage, capitalization, punctuation and spelling.
B.W. 63: Demonstrates commitment to topic (e.g. sustains writing, elaborates, shows knowledge of topic)
B.W. 64: Manages time and process when writing for a given purpose to produce a writing product within a set period of time.
B.W. 65: Uses established criteria and rubric to reflect on quality and effort in writing.

Meaning

Enduring Understandings/Big Ideas
Students will understand that . . .

- Energy is required for life.
- Through a variety of mechanisms organisms seek to maintain homeostasis.
- Matter and energy cycle through both living and nonliving systems

Essential Questions
Students will continue to consider. . .

- Why is energy needed?
  - How is energy used to maintain homeostasis?
  - How is energy used in chemical reactions? (Catabolism or Anabolism)
- How is energy obtained?
  - Why are photosynthesis and chemosynthesis essential?
- How is energy used?
  - Why are cellular respiration and fermentation essential?
  - How does energy flow through an ecosystem?
  - How do forms of matter cycle through an ecosystem?

Acquisition

Know (Content and Literacy) ***Students will Know…***

- What energy is.
- How energy is utilized to maintain homeostasis in a variety of ways (i.e. thermoregulation, osmoregulation, glucose regulation, and oxygen regulation).
- What role energy plays in catabolic and anabolic reactions.

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- How energy is transformed in the processes of photosynthesis, cellular respiration, chemosynthesis, and fermentation.
- How energy and matter are transferred within an ecosystem.

Do (Discipline and Literacy Skills) ***Students will be Skilled at…***

- Explaining the role of photosynthesis and cellular respiration within an ecosystem.
- Explaining the relationship between photosynthesis and cellular respiration.
- Identifying homeostatic mechanisms used to regulate hydration levels, glucose levels, and temperature.

Vocabulary

energy catabolism anabolism reactants products activation energy enzyme	photosynthesis respiration chemosynthesis fermentation chloroplast mitochondria cytoplasm	producer consumer primary consumer herbivore secondary consumer carnivore omnivore tertiary consumer

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Stage 2 – Assessment Evidence	
Evaluative Criteria (Rubrics or Scoring Tool)	**Assessment Evidence**
1. Observations to identify current level of understanding and misconceptions. 2. Observations to identify current level of understanding and misconceptions. 3. Observations to identify current level of understanding and misconceptions.	**Initial/Pre-Assessment:** 1. Energy Warm-up Discussion: Brain Dump-Energy (Think-Pair-Share) a. Prompts: What is it? What is it used for? Where does it come from? 2. PS/CR Warm-up Discussion: Give students a diagram or graphic to guide their discussion of photosynthesis and cellular respiration. a. Prompts: Where do they happen? Who does it? What does it need? etc. 3. Matter and Energy in an Ecosystem Diagrams: Students use manipulatives to design a diagram to depict the cycling of matter (C, O, and H_2O) and energy in an ecosystem.
1. Rubric a. Content b. Data representation and analysis c. Standardized writing standards 2. Rubric a. Content b. Standardized writing standards	**Performance Tasks:** 1. Catalase Lab: a. **Goal:** Your task is to investigate the enzyme catalase to determine where it is found and under what conditions it works best. b. **Role:** You are a lab technician. c. **Audience:**COVESTRO who will be attempting to produce and sell this enzyme. d. **Situation:** COVESTRO has hired you to determine where catalase is found and under what conditions it works best in. They would like to produce and sell catalase as a supplement to protect humans and possibly their pets from the damaging effects of hydrogen peroxide. e. **Product, Performance, and Purpose:** You will develop a summary of your research findings to present to COVESTRO. f. **Standards and Criteria for Success:** Accurately summarizes their specific research findings. Identifies possible errors that may have affected their results and ways to avoid these errors in future research. 2. Energy flow in a Biome: **a. Goal:** Develop a food web that represents the energy flow through an assigned biome (terrestrial or aquatic) **b. Role:** Ecologist researching a particular biome or aquatic system **c. Audience:** Textbook company **d. Situation:** A textbook company has hired you to create a visual to add into their new Biology textbook. This visual will help

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	demonstrate how energy flows through a particular biome or aquatic system. This visual will accompany an article describing the biome and how human activities have affected it. **e. Product, Performance, and Purpose:** You will develop a food web that represents the flow of energy through a biome or aquatic system to present in a gallery walk for feedback. **f. Standards and Criteria for Success:** Accurately represents the trophic level of each organism (producer, primary, secondary, or tertiary consumer, herbivores, carnivores, omnivores, detritivores, and decomposers) Accurately identifies the chemical process(es) that each organism uses to transform energy (photosynthesis, chemosynthesis, cellular respiration, fermentation)
1. Rubric a. Focus on content b. Feedback for writing 2. Rubric a. Focus on content b. Feedback for writing 3. Answer key	**Other Constructed Response Tasks:** 1. Modeling How an Enzyme Works: Students choose whether their enzyme will do dehydration synthesis or hydrolysis. They will then design a simple model of how the enzyme will work, graph how the chemical reaction will be affected by the enzyme, and write an explanation of their model and graph. 2. Photosynthesis and Cellular Respiration in Beaver Falls: Students will explain why photosynthesis and cellular respiration are important in BF and what is happening in each process. 3. Unit Exam (Summative Assessment): Mix of multiple choice and constructed response.
1. Rubric a. Focus on Content	**Other Evidence:** 1. Cycles of Matter in Beaver Falls (C, O_2, and N): Students will work in small groups (2-3) to develop one diagram for each cycle. To accompany each diagram a small description of how human activities can impact these cycles will be written using internet sources.
All: Are students grasping the concepts? Are they presenting any misconceptions?	**Formative Tasks/Evidence:** 1. Warm-ups 2. Class Discussions 3. Observations

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Stage 3 – Learning Plan		
Unit Texts and Resources		
• Holt Biology: 2.4/2.5, 4.1, 4.2/4.3, 4.4/4.5, 13.3/13.4/13.6		
Lessons and Activities	**Progress Monitoring**	**Scaffolding/Supports**
Pre-Assessment: Energy Warm-up Discussion: Brain Dump-Energy (Think-Pair-Share) -Prompts: What is it? What is it used for? Where does it come from? **Notes:** Energy Overview (Energy from macromolecules transferred to ATP, Function and structure of ATP) **Notes**: Enzymes (Reactants, products, activation energy, endothermic, exothermic, characteristics and function of enzymes, the effect of environmental conditions on enzymes, lock-and-key model vs. induced fit model) Modeling How Enzymes Work: Students choose whether their enzyme will do dehydration synthesis or hydrolysis. They will then design a simple model of how the enzyme will work, graph how the chemical reaction will be affected by the enzyme, and write an explanation of their model and graph.	Pre-assessment: Identify current level of understanding and misconceptions. Modeling How Enzymes Work: This assessment will be utilized to determine which students need more explanation of enzymes before beginning the lab investigation.	Pre-Assessment: Think-Pair-Share Accomodations: Prompts written out, as needed. **Notes:** All: Free notes in class. Screencast/copy of notes available for post-class review. Accomodation: Guided notes, or notes transcripts provided as needed. **Notes:** All: Free notes in class. Screencast/copy of notes available for post-class review. Accomodation: Guided notes, or notes transcripts provided as needed. Modeling How Enzymes Work: All: This can be completed independently or as a pair. No more than two students per group. Accomodations: Additional chunking and prompts, or one-on-one assistance, as needed.

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Catalase Lab Students will investigate the sources and optimal conditions for the enzyme catalase. They will form a research-based hypothesis, design an experiment, execute the procedure, collect and analyze data, and draw conclusions from their data. Students will then summarize their work in a formal lab report. Peer Review of Catalase Lab Students will look at a collection of data from across all sections of Biology/Lab Biology and analyze the results identifying contradictory data and drawing inferences from the larger data set.	Catalase Lab: This assignment will be utilized to assess students' ability to complete the scientific research process, communicate their results formally, and their understanding of how environmental conditions affect the function of an enzyme.	Catalase Lab: All: Guided research framework to organize the scientific research process and their writing process. Accomodations: IEP/504 students can be assessed through the guided research framework and a written conclusions section, as needed. Peer Review of Catalase Lab All: Peer review process can be completed in groups of 3-4. Accomodations: Peer review process can be teacher-led in a small group.
Pre-Assessment: PS/CR Discussion -Give students a diagram or graphic to guide their discussion of photosynthesis and cellular respiration. -Prompts: Where do they happen? Who does it? What does it need? etc. **Activity**: Seeing PS and CR in action: Elodea in indicator solution (Bromothymol blue or chlorophenol red) -Students will make a prediction, observe, and reflect on the experience. **Notes**: PS and CR notes (Connections between the two processes, location where each occur, Stage 1 and 2 of each including modeling, glycolysis)		Pre-Assessment: All: Students can work in groups of 2-3. Accomodations: Prompts written out, as needed. **Activity:** Seeing PS and CR in action All: Teacher-led demo. **Notes:** All: Free notes in class. Screencast/copy of notes available for post-class review. Accomodation: Guided notes, or notes transcripts provided as needed.

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PS and CR in Beaver Falls: -Students will explain why photosynthesis and cellular respiration are important in BF and what is happening in each process. **Activity:** Fermentation Demo -Prompt: What happens when there's no O_2? -Simulate this with yeast and sugar. Use a balloon to capture the gas that is released. -Students will form a prediction, observe what happens, and then reflect on the experience. **Notes:** Fermentation (Alcoholic vs lactic acid fermentation, fermentation in our daily life)	PS and CR in Beaver Falls: This assessment will allow me to see who needs more support with PS and CR before the Energy Flow in a Biome assignment and provide students with feedback on their writing.	PS and CR in Beaver Falls: Accomodations: Shortened length and writing guides provided, as needed for IEP/504 students. **Activity:** Fermentation Demo All: Teacher-led demo **Notes:** All: Free notes in class. Screencast/copy of notes available for post-class review. Accomodation: Guided notes, or notes transcripts provided as needed.
Pre-Assessment: Matter + Energy in an Ecosystem -Students use manipulatives to design a diagram to depict the cycling of matter (C, O, and H_2O) and energy in an ecosystem. **Notes:** Matter + Energy Cycles (Cycles of matter-C, O_2, N, food chain/web, levels of organization, relationships within an ecosystem-predation, competition, parasitism, mutualism, commensalism, energy pyramids) **Cycles of Matter in BF**	**Cycles of Matter in BF** This	Pre-Assessment: All: Students may work in groups of 2-3. **Notes:** All: Free notes in class. Screencast/copy of notes available for post-class review. Accomodation: Guided notes, or notes transcripts provided as needed. **Cycles of Matter in BF:**

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-Students will work in small groups (2-3) to develop one diagram for each cycle. To accompany each diagram a small description of how human activities can impact these cycles will be written using internet sources. Energy Flow in a Biome Students will design a diagram and write an article about a specific biome or aquatic system. The diagram will include a food web, labels for each organism and their relationships and trophic level on the food web. The article will explain the diagram and describe how this particular biome or aquatic system can be impacted by human activities.	assignment will be used to determine who needs more support on the cycles of matter before the summative evaluation. Energy Flow in a Biome: This assignment will be utilized to assess students' current understanding of how energy flows through a biome and their ability to communicate this information formally.	All: Small groups of 2-3. Essential terminology to include in the diagram. Accomodations: For IEP/504 students, one diagram can be developed and the other two can be gained from other groups to utilize as a resource. Energy Flow in a Biome: All: Planning sheets for the diagram and the article. Accomodations: Students can be assigned fewer organisms to include in their diagram, as needed. IEP/504 students can work with a partner, as needed.
One-Pager: Students will organize the information from the unit into a one-page study tool that emphasize the major topics, visuals, vocabulary etc. Summative Exam: Unit 3 exam.	Summative Exam: Summative evaluation to identify long term remediation needs.	One-Pager: If needed, separate study materials will be provided for IEP/504 students. They will work with their support teacher separately to study for the exam. Summative Exam: Chunking and modifications made as needed per IEP requirements.