Unit of Study

Contributed by Jennifer Ward & Amy Hall, Marion Co. HS

Unit Title: **Cellular Energy**

Length of Unit: **Two Weeks**

Organizer: **How do plant & animal cells make and use energy?**

Essential Questions:

How are plant pigments used to trap solar energy?
How do plants change solar energy into chemical energy?
How do plant & animal cells use chemical energy?
Compare and contrast photosynthesis and cellular respiration.
How important is oxygen in cellular respiration?

Standards:

- ## Academic Expectations –

  2.2 Students identify, analyze, and use patterns such as cycles and trends to understand past and present events and predict possible future events.

  2.3 Students identify and analyze systems and the ways their components work together or affect each other.

- ## Program of Studies-

  S-HS-LS-2 Students will investigate cell regulation, differentiation, and how the process of photosynthesis provides a vital connection between the Sun and energy needs of living systems.

  S-HS-LS-8 Students will analyze energy flow through ecosystems.

  S-HS-LS-11 Students will recognize that living systems require continuous input of energy.

  S-HS-LS-12 Students will investigate photosynthesis, cellular respiration, and the energy relationships among them.

➢ ➢ Core Content-

SC-H-3.1.5 Plant cells contain chloroplasts, the site of photosynthesis. Plants and many microorganisms (e.g., Euglena) use solar energy to combine molecules of carbon dioxide and water into complex, energy-rich organic compounds and release oxygen to the environment. This process of photosynthesis provides a vital link between the Sun and energy needs of living systems.

SC-H-3.5.2 Energy flows through ecosystems in one direction from photosynthetic organisms to herbivores to carnivores and decomposers.

SC-H-3.6.1 Living systems require a continuous input of energy to maintain their chemical and physical organization since the universal tendency is toward more disorganized states. The energy for life primarily derives from the Sun. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing molecules. These molecules can be used to assemble larger molecules (e.g., DNA, proteins, sugars, fats). In addition, the energy stored in the bonds between the atoms can be used as sources of energy for life processes.

➢ ➢ National Standards-

NSS12_3.16 Energy flows through ecosystems in one direction from photosynthetic organisms to herbivores to carnivores and decomposers.

NSS12_3.21 The energy for life primarily derives from the Sun. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing molecules. These molecules can be used to assemble larger molecules (e.g., DNA, proteins, sugars, fats). In addition, the energy stored in the bonds between the atoms can be used as sources of energy for life processes.

NSS12_3.5 Plant cells contain chloroplasts, the site of photosynthesis. Plants and many microorganisms (e.g., Euglena) use solar energy to combine molecules of carbon dioxide and water into complex, energy-rich organic compounds and release oxygen to the environment. This process of photosynthesis provides a vital link between the Sun and energy needs of living systems.

Culminating Performance

Read the attached article "*Power Plants*". As an astronaut living on a space station on the moon, how can you help to create an atmosphere that would support life?

Write an open response that would indicate the changes necessary to help create an atmosphere that contains oxygen. Are there any flaws to this theory? Would this task be possible?

Culminating Performance Rubric:

4. **The student shows the relationship between the need for plants to undergo photosynthesis in order to generate oxygen. They also SEE the flaws associated with this thinking because of the lack of CO_2 and H_2O and the lack of sufficient gravity in order to maintain an atmosphere. The student uses correct grammar throughout with logical scientific thinking skills.**

3. **The student shows the relationship between the need for plants to undergo photosynthesis in order to generate oxygen. They understand that simply planting green plants may not work but their ties to gravity & atmosphere are not evident. They may have a few grammatical errors but it does not take away from the reading.**

2. **The student shows the relationship between the need for plants to undergo photosynthesis in order to generate oxygen but they are not able to SEE that the lack of atmosphere and insufficient gravity will limit life on the moon. The student may have several grammatical errors.**

1. **The student has a lack of understanding concerning photosynthesis and oxygen production. They made an attempt to answer the question but their lack of understanding limits their ability to answer the question. They may have grammatical errors but those are not as relevant as the main focus of the paper.**

0. **Blank paper**

Name: Jennifer Ward & Amy Hall Date: 10/23/2004 Lesson Length: 2
School: Marion County High School Age/Level: 10th # of Students: omit
Content/Subject: Biology Unit Title: Cellular Energy

ESSENTIAL QUESTION:

How are plant pigments used to trap solar energy?

OBJECTIVES:

The students will learn that pigments are responsible for trapping certain wavelengths of light from the sun.
The students will be able to analyze plant pigments and identify the different types.
The students will be able to create and interpret graphs to show relationships between the different pigments energy absorption.

<u>CONNECTIONS</u>:

- **Academic Expectations-**

  2.3 Students identify and analyze systems and the ways their components work together or affect each other.

- **Program of Studies –**

  S-HS-LS-2 Students will investigate cell regulation, differentiation, and how the process of photosynthesis provides a vital connection between the Sun and energy needs of living systems.

  S-HS-LS-12 Students will investigate photosynthesis, cellular respiration, and the energy relationships among them.

- **Core Content –**

  SC-H-3.1.5 Plant cells contain chloroplasts, the site of photosynthesis. Plants and many microorganisms (e.g., Euglena) use solar energy to combine molecules of carbon dioxide and water into complex, energy-rich organic compounds and release oxygen to the environment. This process of photosynthesis provides a vital link between the Sun and energy needs of living systems.

  SC-H-3.6.1 Living systems require a continuous input of energy to maintain their chemical and physical organization since the universal tendency is toward more disorganized states. The energy for life primarily derives from the Sun. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing molecules. These molecules can be used to assemble larger molecules (e.g., DNA, proteins, sugars, fats). In addition, the energy stored in the bonds between the atoms can be used as sources of energy for life processes.

- **National Standards –**

  NSS12_3.21 The energy for life primarily derives from the Sun. Plants capture energy by absorbing light and using it to form strong

(covalent) chemical bonds between the atoms of carbon-containing molecules. These molecules can be used to assemble larger molecules (e.g., DNA, proteins, sugars, fats). In addition, the energy stored in the bonds between the atoms can be used as sources of energy for life processes.

CONTEXT:

Students have completed a unit on cell parts and regulation. This lesson is the introduction for photosynthesis and the pigments necessary. This lesson serves as a bridge to cellular respiration and energy transfer within the cell.

RESOURCES/MATERIALS:

Dynamics of Life, Biology Textbook
Ward's Natural Science Chromatography of Spinach Lab
Prentice-Hall Absorption of Chlorophyll Skill Activity
Absorption of Light Lab
Computer and Media Projector

PROCEDURES:

Beginning Review:
Students will review the difference in plant and animal cells. A focus will be placed upon the plant cell and chloroplast, the organelle responsible for photosynthesis.

Anticipatory Set:
The students will investigate various types of plants and should conclude that the primary color associated with plants is green. The students will be asked: Why are plants green?

Concept Development:

The students will receive information via media projector and computer PowerPoint presentation. Emphasis will be placed on the pigments responsible for photosynthesis.

Guided Practice:
The students will complete a chlorophyll skill activity. The teacher will prompt the students to discuss primary verses secondary pigments as well as absorption wavelengths.

Independent Practice:
The students will complete the Chromatography of Spinach Lab. As a group they will follow lab procedure and complete an analysis at the conclusion of the lab.

Ending Review:

The teacher will prompt a classroom discussion of the Chromatography of Spinach Lab. This will be followed by a homework assignment on the absorption of light of chlorophyll *a* and chlorophyll *b*.

STUDENT ASSESSMENT:

Formative Assessment:
The teacher will assess the students during an oral class discussion.
The teacher will assess student's comprehension during the lab session.

The students will be assessed on the results of the lab and their analysis.
The students will be assessed on class participation.

Summative Assessment:
The students will be assessed by accurate completion of the homework assignment.
The students will be assessed at the conclusion of the unit with a comprehension exam.

ADAPTATIONS:

Gifted and Talented:
Identified G/T students will be given leadership roles in the lab session. Also a topic related website list will be given to G/T students to accelerate their understanding.

ESL:
ESL students will have access to bilingual software.

IEP:
All IEP accommodations will be made according to the student's individual IEP. Some possible accommodations would include modified notes, grading scale, test taking procedures, etc.

Name: Jennifer Ward & Amy Hall **Date: 10/23/2004** **Lesson Length: 2**
School: Marion County High School **Age/Level: 10th** **# of Students: omit**
Content/Subject: Biology **Unit Title: Cellular Energy**

ESSENTIAL QUESTION:

How do plants change solar energy into chemical energy?

OBJECTIVES:

The students will learn how plants convert solar energy into chemical energy through the process of photosynthesis.
The students will learn the steps involved in photosynthesis.
The students will be able to distinguish between the light and dark stages of photosynthesis and the products of each.
The students will be able to translate the chemical equation for photosynthesis.

<u>CONNECTIONS</u>:

- **Academic Expectations-**

  2.2 Students identify, analyze, and use patterns such as cycles and trends to understand past and present events and predict possible future events.

  2.3 Students identify and analyze systems and the ways their components work together or affect each other.

- **Program of Studies –**

  S-HS-LS-2 Students will investigate cell regulation, differentiation, and how the process of photosynthesis provides a vital connection between the Sun and energy needs of living systems.

  S-HS-LS-8 Students will analyze energy flow through ecosystems.

  S-HS-LS-11 Students will recognize that living systems require continuous input of energy.

  S-HS-LS-12 Students will investigate photosynthesis, cellular respiration, and the energy relationships among them.

- **Core Content –**

  SC-H-3.1.5 Plant cells contain chloroplasts, the site of photosynthesis. Plants and many microorganisms (e.g., Euglena) use solar energy to combine molecules of carbon dioxide and water into complex, energy-rich organic compounds and release oxygen to the environment. This process of photosynthesis provides a vital link between the Sun and energy needs of living systems.

  SC-H-3.6.1 Living systems require a continuous input of energy to maintain their chemical and physical organization since the universal tendency is toward more disorganized states. The energy for life primarily derives from the Sun. Plants capture energy by absorbing

light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing molecules. These molecules can be used to assemble larger molecules (e.g., DNA, proteins, sugars, fats). In addition, the energy stored in the bonds between the atoms can be used as sources of energy for life processes.

- **National Standards –**

  NSS12_3.21 The energy for life primarily derives from the Sun. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing molecules. These molecules can be used to assemble larger molecules (e.g., DNA, proteins, sugars, fats). In addition, the energy stored in the bonds between the atoms can be used as sources of energy for life processes.

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CONTEXT:

Students have completed an introductory lesson on photosynthesis and the pigments necessary. This lesson will develop their knowledge of the cycles involved in photosynthesis.

RESOURCES/MATERIALS:

Dynamics of Life, Biology Textbook
Video on photosynthesis
Computer and Media Projector

PROCEDURES:

Beginning Review:
Students will review the chloroplast and pigments involved in photosynthesis. There will be a discussion to review the main and accessory pigments.

Anticipatory Set:
The students will be asked to identify when photosynthesis occurs. The teacher will lead students to consider light as a necessary component for photosynthesis.

Concept Development:

The students will receive information via media projector and computer PowerPoint presentation. Emphasis will be placed on the steps involved in photosynthesis, by breaking the process into two parts (light and dark reactions).

Guided Practice:
The students will construct a flow chart to show the reactions that occur during photosynthesis. Students will investigate the chemical equation for photosynthesis and translate into common language.

Independent Practice:
The students view a video that illustrates and compares the light and dark reactions that occur in photosynthesis.

Ending Review:
The students will compose a paragraph to critique the video and summarize the information.

STUDENT ASSESSMENT:

Formative Assessment:
The teacher will assess the students during an oral class discussion.
The students will be assessed on class participation.

Summative Assessment:
The students will be assessed by the accuracy of the summary.
The students will be assessed at the conclusion of the unit with a comprehension exam.

ADAPTATIONS:

Gifted and Talented:
Identified G/T students will be given leadership roles in the lab session. G/T students will have the opportunity to complete a lab on transpiration. These students will be able to investigate how differing conditions can affect the rate of photosynthesis. This lab will be multi-disciplinary via the mathematics and writing activities involved. Also a topic related website list will be given to G/T students to accelerate their understanding.

ESL:
ESL students will have access to bilingual software.

IEP:
All IEP accommodations will be made according to the student's individual IEP. Some possible accommodations would include modified notes, grading scale, test taking procedures, etc.

Name: Jennifer Ward & Amy Hall **Date: 10/23/2004** **Lesson Length: 2**
School: Marion County High School **Age/Level: 10th** **# of Students: omit**
Content/Subject: Biology **Unit Title: Cellular Energy**

ESSENTIAL QUESTION:

How do plant and animal cells use chemical energy aerobically?

OBJECTIVES:

The students will learn how plant and animal cells use chemical energy (glucose) aerobically to provide ATP (usable) energy for the cell.
The students will learn the steps involved in cellular respiration: Glycolysis, Kreb's Cycle, and Electron Transport Chain.
The students will be able to calculate the energy transformation of one glucose molecule into ATP's.
The students will be able to translate the chemical equation for cellular respiration.

CONNECTIONS:

- **Academic Expectations-**

  2.2 Students identify, analyze, and use patterns such as cycles and trends to understand past and present events and predict possible future events.

  2.3 Students identify and analyze systems and the ways their components work together or affect each other.

- **Program of Studies –**

  S-HS-LS-8 Students will analyze energy flow through ecosystems.

  S-HS-LS-11 Students will recognize that living systems require continuous input of energy.

  S-HS-LS-12 Students will investigate photosynthesis, cellular respiration, and the energy relationships among them.

- **Core Content –**

  SC-H-3.5.2 Energy flows through ecosystems in one direction from photosynthetic organisms to herbivores to carnivores and decomposers.

SC-H-3.6.1 Living systems require a continuous input of energy to maintain their chemical and physical organization since the universal tendency is toward more disorganized states. The energy for life primarily derives from the Sun. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing molecules. These molecules can be used to assemble larger molecules (e.g., DNA, proteins, sugars, fats). In addition, the energy stored in the bonds between the atoms can be used as sources of energy for life processes.

- **National Standards –**

  NSS12_3.16 Energy flows through ecosystems in one direction from photosynthetic organisms to herbivores to carnivores and decomposers.

  NSS12_3.21 The energy for life primarily derives from the Sun. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing molecules. These molecules can be used to assemble larger molecules (e.g., DNA, proteins, sugars, fats). In addition, the energy stored in the bonds between the atoms can be used as sources of energy for life processes.

CONTEXT:

Students have been introduced to the topics of photosynthesis and how solar energy is trapped and changed into chemical energy (glucose). In this lesson the students will trace the path of glucose through the cell as it is transformed into a form of energy usable by all life forms (ATP).

RESOURCES/MATERIALS:

Dynamics of Life, Biology Textbook
Video on cellular respiration
Modified notes
Computer and Media Projector

PROCEDURES:

Beginning Review:
The students will review how solar energy is converted into chemical energy.

Anticipatory Set:
Teacher will set up a scenario in which students are traveling to a foreign country and need to exchange their dollars for Euros. This will form an analogous relationship between the glucose and ATP conversion that occurs in the cell.

Concept Development:

The students will receive information via media projector and computer PowerPoint presentation. Emphasis will be placed on the steps involved in cellular respiration, by breaking the process into three parts (Glycolysis, Kreb's Cycle, and Electron Transport Chain).

Guided Practice:
The students will construct a flow chart to show the reactions that occur during each step of cellular respiration. Students will investigate the chemical equation for cellular respiration and translate into common language. The students will focus on the necessary component involved –Oxygen.

Independent Practice:
The students view a video that illustrates reactions that occur in cellular respiration.

Ending Review:
The students will compose a paragraph to critique the video and summarize the information.

STUDENT ASSESSMENT:

Formative Assessment:
The teacher will assess the students during an oral class discussion.
The students will be assessed on class participation.

Summative Assessment:
The students will be assessed by accurate completion of the homework assignment.
The students will be assessed at the conclusion of the unit with a comprehension exam.

ADAPTATIONS:

Gifted and Talented:
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School: Marion County High School Age/Level: 10th # of Students: omit
Content/Subject: Biology Unit Title: Cellular Energy

ESSENTIAL QUESTION:

Compare and contrast photosynthesis and cellular respiration.

OBJECTIVES:

The students will be able to compare the cellular processes of photosynthesis to cellular respiration and form a relationship between the two. Students should notice the reversibility of the reactions.

CONNECTIONS:

- **Academic Expectations-**

  2.2 Students identify, analyze, and use patterns such as cycles and trends to understand past and present events and predict possible future events.

  2.3 Students identify and analyze systems and the ways their components work together or affect each other.

- **Program of Studies –**

  S-HS-LS-2 Students will investigate cell regulation, differentiation, and how the process of photosynthesis provides a vital connection between the Sun and energy needs of living systems.

  S-HS-LS-8 Students will analyze energy flow through ecosystems.

  S-HS-LS-11 Students will recognize that living systems require continuous input of energy.

  S-HS-LS-12 Students will investigate photosynthesis, cellular respiration, and the energy relationships among them.

- **Core Content –**

  SC-H-3.1.5 Plant cells contain chloroplasts, the site of photosynthesis. Plants and many microorganisms (e.g., Euglena) use solar energy to combine molecules of carbon dioxide and water into complex, energy-rich organic compounds and release oxygen to the environment. This process of photosynthesis provides a vital link between the Sun and energy needs of living systems.

  SC-H-3.5.2 Energy flows through ecosystems in one direction from photosynthetic organisms to herbivores to carnivores and decomposers.

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CONTEXT:

Students have been introduced to the topics of photosynthesis and cellular respiration. Students will build connections the two processes.

RESOURCES/MATERIALS:

Dynamics of Life, Biology Textbook
Prentice-Hall Photosynthesis and Respiration Crossword Puzzle
Macmillan Publishing Photosynthesis and Respiration Lab
Modified notes
Computer and Media Projector

PROCEDURES:

Beginning Review:
The students will review the chemical equations for photosynthesis and cellular respiration.

Anticipatory Set:
The teacher will prompt the students to evaluate the equations written in the review. The students should formulate a relationship between the two equations.

Concept Development:

The students will obtain flow charts created during previous lessons and begin to compare and contrast photosynthesis and cellular respiration. Reactants and products will be noted and connections made between the two processes. Students should also investigate the time required for the processes to occur.

Guided Practice:
The class will have discussions during the concept development in which the teacher prompts.

Independent Practice:
The students will complete the Photosynthesis and Respiration lab in which the rate of each process is investigated.

Ending Review:
The students will complete a crossword puzzle that compares and contrasts photosynthesis and cellular respiration.

STUDENT ASSESSMENT:

Formative Assessment:
The teacher will assess the students during an oral class discussion.
The teacher will assess student's comprehension during the lab session.

The students will be assessed on the results of the lab and their analysis.
The students will be assessed on class participation.

Summative Assessment:
The students will be assessed by the accuracy of the summary.
The students will be assessed at the conclusion of the unit with a comprehension exam.

ADAPTATIONS:

Gifted and Talented:
Identified G/T students will be given leadership roles in the lab session. Also a topic related website list will be given to G/T students to accelerate their understanding.

ESL:
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School: Marion County High School Age/Level: 10th # of Students: omit
Content/Subject: Biology Unit Title: Cellular Energy

ESSENTIAL QUESTION:

How do cells use energy anaerobically?

OBJECTIVES:

The students will learn that cells can continue to use energy anaerobically.
The students will learn how muscle cells undergo lactic acid fermentation when placed in an anaerobic situation for short periods of time.
The students will learn how some organisms like yeasts can undergo alcoholic fermentation in order to obtain energy in an anaerobic situation.
The students will see how aerobic cellular respiration is much more energy efficient compared to the anaerobic processes.

CONNECTIONS:

- **Academic Expectations-**

  2.1 Students understand scientific ways of thinking and working and use those methods to solve real-life problems.

  2.2 Students identify, analyze, and use patterns such as cycles and trends to understand past and present events and predict possible future events.

  2.1 Students identify and analyze systems and the ways their components work together or affect each other.

- **Program of Studies –**

  S-HS-LS-2 Students will investigate cell regulation, differentiation, and how the process of photosynthesis provides a vital connection between the Sun and energy needs of living systems.

  S-HS-LS-12 Students will investigate photosynthesis, cellular respiration, and the energy relationships among them.

- **Core Content –**

  SC-H-3.1.5 Plant cells contain chloroplasts, the site of photosynthesis. Plants and many microorganisms (e.g., Euglena) use solar energy to combine molecules of carbon dioxide and water into complex, energy-rich organic compounds and release oxygen to the environment. This process of photosynthesis provides a vital link between the Sun and energy needs of living systems.

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- **National Standards –**

  NSS12_3.21 The energy for life primarily derives from the Sun. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing molecules. These molecules can be used to assemble larger molecules

(e.g., DNA, proteins, sugars, fats). In addition, the energy stored in the bonds between the atoms can be used as sources of energy for life processes.

CONTEXT:

Previously in this unit, students have learned about the processes of photosynthesis and cellular respiration. They have learned the cycles involved in each and the energy used or stored. They have learned where in the cell the processes have occurred and the organelles involved. This lesson will serve as a final activity to connect all the material together.

RESOURCES/MATERIALS:

Dynamics of Life, Biology Textbook
Computer and Media Projector
Fermentation Lab by Flinn
Mindjoggers Video, Prentice-Hall

PROCEDURES:

Beginning Review:
Review of the processes of cellular respiration and photosynthesis via the equations so they can visualize the formulas and that they are reversible. The class will check the homework crossword puzzle and review this for accuracy.
Anticipatory Set:
The following questions will be asked to the class, prompting a discussion:

What happens when oxygen is not available to the cells?

Do the cells die?

What about those organisms that do not require oxygen?

How do they make energy from food?

What are some organisms that you know are anaerobic? (bacteria, yeasts)

Concept Development:

The students will receive information via media projector and computer PowerPoint presentation. Students will receive information on Lactic Acid Fermentation and how the cells use this process when oxygen is depleted for short periods of time. They will build a connection on how this process affects the body. The topic will then move onto the topic of alcoholic fermentation and how yeasts use this process to get energy when oxygen is not available. The students will learn how this alcoholic fermentation is used to make bread rise and to make alcoholic drinks.

Guided Practice:
The teacher will lead the students in a discussion concerning lactic acid fermentation while a runner experiences a shortage of oxygen. Students can make connection to real-world applications with athletes and proper nutrition. Also there will be a discussion on how yeast is used in the production of alcoholic drinks and bread making. A possible higher order connection can be made to the microbiology involved in fermentation.

Independent Practice:
The students will conduct an experiment in which they create an anaerobic environment for yeasts to make alcohol. Indicators will be used to show the presence of alcohol and carbon dioxide production.

Ending Review:
The final results of this lab will take a few days to actually visualize. We will discuss the results that we expect to see. The class will conduct a review of this unit with a MINDJOGGERS activity. This is a question/answer session that quizzes the students at different levels of Bloom's taxonomy.

STUDENT ASSESSMENT:

Formative Assessment:
The teacher will assess the students during an oral class discussion.
The teacher will assess student's comprehension during the lab session.

The students will be assessed on the results of the lab and their analysis.
The students will be assessed on class participation.

Summative Assessment:
The students will be assessed by accurate completion of the homework assignment.
The students will be assessed at the conclusion of the unit with a comprehension exam.

ADAPTATIONS:

Gifted and Talented:
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ESL:
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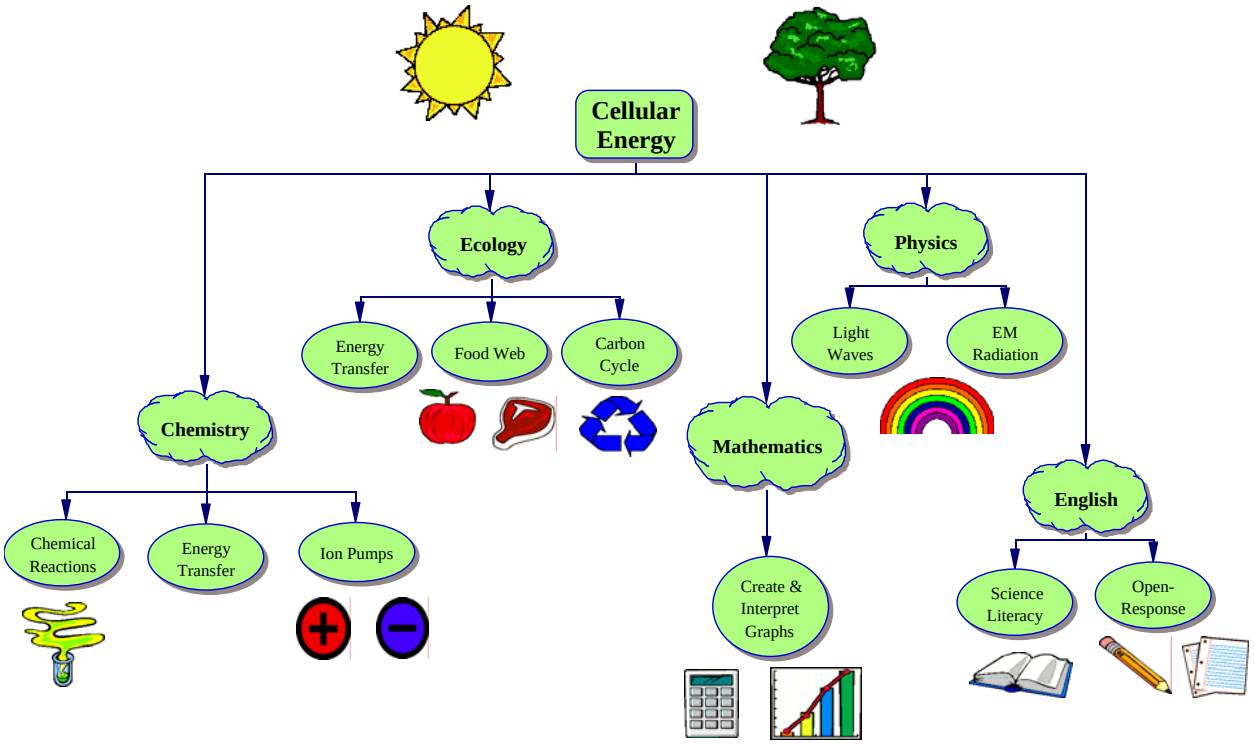
Appendix I


Cellular Energy
Ecology
Energy Transfer
Food Web
Carbon Cycle
Physics
Light Waves
EM Radiation
Chemistry
Chemical Reactions
Energy Transfer
Ion Pumps
Mathematics
Create & Interpret Graphs
English
Science Literacy
Open-Response