Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
2000 Volume VI: The Chemistry of Photosynthesis

Gardens in an Urban Environment

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Photosynthesis is at the center of the building and continuation of life in the planet. The process of photosynthesis is essential for the growth of most plants on land and in the oceans of the world. The growth of plants is key to the maintenance of life on the planet. Humans depend on plants and animals for survival. Photosynthesis is directly connected to the growth of gardens. This curriculum unit is designed for students of the fifth grade elementary level in an urban or suburban environment. This could also apply for any other environment where plants could grow. One of the objectives of this unit is to have students describe and explain the process of photosynthesis. Students will also be able to connect photosynthesis to other fields of science and the disciplines in the curricula of the fifth grade. Students will also plan, design, set up, maintain and evaluate several types of urban gardens in the school environment.

Writing, reading, mathematics and social studies are directly connected to the exploration of photosynthesis in this unit. A garden is an effective motivator for students to learn how to love science and how to present their findings in writing and in oral presentations. Measurements and proportions involved in the growth of plants also apply to the planning and construction of gardens in the school grounds and in the community. The context of this unit is the ecological reality of our time. There is a pressing need for better management of our environment, food and resources used in a modern economy. Students will be able to conduct research and experiments related to the environment and to learn the value of a balanced ecology. The classroom will be the center of operations, expanding from there into the school gardens and finally into the local community garden. The experience gained in the classroom and the school is applied in the community garden.

Human beings at the present time of history are at the center of the production and control of the environment more than any other being alive in the world. We depend both on flora and fauna to survive and to continue our species on earth. As we advance and encroach into the areas of the world that have been under-explored and practically untouched by western technology, the need for conservation becomes of utmost importance. To be sure, there are many ecological areas in the world today that are under attack by the penetration and indiscriminate destruction by humans. For instance, rain forests of the tropical areas of the world, some of the wooded areas of the northern latitudes, and marshes all around the world are under direct jeopardy of disappearance. Students in an urban setting could approach the problem of the destruction of these endangered ecological enclaves by studying about the importance of conservation. It is necessary to understand the role of these endangered ecological systems in the maintenance of a healthy earth. In this sense, photosynthesis could bring us into a discussion of issues of a multidisciplinary nature.

For this curriculum unit, the study of plant growth and the role of photosynthesis are further tied to development of gardens in the school and the community. Urban and suburban gardens are healthy and beautiful to look at and admire. The rain forests and the natural environments of the world are, by and large, the producers of soil and oxygen needed for the growth of plants and the perpetuation of animal life on the planet. Farmers in the world produce the necessary foods for people. Students should understand the basic principles involved in photosynthesis and its relationship to the natural environments and the production of foods and oxygen.

New Haven lends a myriad of opportunities to pursue this kind of project in the classroom, the school environment and the community. Since many people in the world live in cities, it is necessary to develop a sense of the balance involved in the cycles of life. Further, it is important for students and the community to make an effort to have a closer contact with the forces of nature by growing plants in school and the community. This is an opportunity for people to work together for a common cause. This exercise would increase the interest of students to study science and to become aware of problems in urban environments and the world itself. In schools, teachers should encourage students to develop sensitivity for gardens and life in neighborhoods. This kind of outlook is particularly important since in the neighborhood of the schools in the New Haven area there is always an empty lot, or a patch of land, that could be turned into a useful garden.

The Use of the Scientific Process (Hachten, 1996)

Necessarily, students have to learn the scientific foundations and the background of this complex process and understand the implications for earth and every living organism on it. One of the ways to learn and to build a scientific construct is to actually use hands-on activities and experiments following the inquiry method. Students should be able to address questions about photosynthesis. These questions will be explored and discussed in class to the point that more questions are generated bringing to light a more refined question. One of the objectives is the use of the scientific process where students will conduct experiments following the steps to test predictions and hypotheses. They will put to use these aspects of science in experiments and planting and growing gardens.

Background

The use of the scientific process is used in a science fair project or just about in any exercise that requires some sort of question or inquiry. When we read we make predictions or we anticipate an event or an outcome. One of the richest, challenging and most productive activities in the curriculum of a school is a science fair. The backbone of this pursuit is the realization that students learn better when they have the opportunity to explore, experiment and handle things on their own, with the guidance of a teacher, a mentor, a parent, or whoever has the time and ability to make a contribution. Photosynthesis and related themes are some of the possible exercises where students could apply the scientific process.

Science fair projects are of great value to the student's education and preparation for the future because these projects incorporate the skills and disciplines necessary to survive in our society today and in the future. A science project could be chosen from any of the fields of scientific investigation. We could have projects from physical science, earth science or biological science. There are several types of science projects. A science fair could have projects that involve the collection of objects. In this case we would be talking about the ability of a student to set up taxonomies, classifications, categories, and simply order. A student could also

have a demonstration about some scientific fact. Some of the most favorite projects for students of all ages are inventions. Students get a kick out of any of these scientific projects when they have the ability to show imagination, originality and in many instances beauty. By far, the most challenging scientific project is the one that is built on the scientific method. We formulate a question. We propose a problem of scientific interest. We target a purpose for this pursuit. Then we must make a prediction. Our hypothesis is that we think that this and that is going to happen. This type of science project requires of the student the skills and know-how to handle a diversity of concepts and the will and ability to put it all together in a coherent way. A research paper is expected of the student as well as a presentation to judges and visitors of the school or elsewhere.

The spirit of competition is vibrant in the environment. It becomes valuable when we realize that the work of the student or students, in the case of a team, is the product of a series of efforts that involves many people. The support of the school--via the teacher, the home--via the parents, or the community-- via a mentor, is always a necessary fact for a job well done. Generally, planning a science fair in school starts in September and the fair itself would take place in March. The components of the scientific process to include in an experiment for a science fair are the following:

Title

-Is the title very clear?
-Do you ask a single question?
-What is the purpose for asking this?
-Does it make sense?

Purpose

-What do you want to find out?
-Why are you doing this experiment?

Hypothesis

-What do you think is going to happen?
-Make a clear prediction.

Materials

-Did you list all the objects you used?
-Is it easy for people to get these things?

Procedure

-What are the steps that you took to do this experiment?
-Did you write them in order?
-Would other students be able to follow your steps?

Data

-Did you choose a scale?
-What measuring system do you use?
-Are you using a table?
-Are your observations correct?
-Is the language clear?

Graphs

-Do you have a dependent and an independent variable?
-Did you choose the correct graph for the data?
-Is the graph labeled?

Illustrations

-Show drawings or pictures that illustrate the problem better.
-Does it add to the display?

Limitations

-What were some problems that you found in the process?
-Is your experiment limited to a certain type of phenomenon?

Results

-What did you find out with your experiment?
-What does the data tell you about the experiment?
-Does it make sense?

Conclusions

-Is your hypothesis correct?
-What happened to your predictions?

Applications

-How are you going to use your new information in the real world?
-Is your discovery applicable to industry? Medicine? Art?

Research paper

-Background information: Is the information you used relevant to your experiment?
-Did you quote?
-Did you re-write information in your own words? Did you use paraphrases?
-Is a bibliography included?
-How about illustrations, graphs, tables and other related materials?
-Does it have unity? Did you stick to the subject?
-Is it clear and coherent?
-Do you use the scientific language to explain, argue and demonstrate your point?

Oral Presentation

-Did you go over all the weak spots of your project?
-Do you understand the language of science and its implications?
-Did you use inductive and deductive reasoning?
-Can you argue about related material?
-Are you ready to speak clearly and with confidence in from of an audience?
-Can you stick to the subject?
-Can you give supportive evidence of what you are talking about?
-Is that evidence in your project?

Audience of Science fair

Our audience is the school population, the community and other people who are invited to judge and to visit our fair. Many times, our audience is the press: local newspapers and television.

Purpose of Science Fair

The purpose of a science fair is to increase the knowledge and interest in science of students in an urban setting. We are interested in instilling in our students the methodology necessary for an experiment using the scientific method. We want to have the active participation of students who traditionally have been left behind due to various factors. Another goal is to bring together efforts of the community and the school. We want to work together with industry, universities and people in leadership positions to share information and to bring new resources to our school. Community gardens are a great stimulation for people to work together for a common cause. We also want to train our staff with a series of mini-workshops, publications, visits to the classrooms, sharing information formally and informally. Another purpose is to bring up the scores of the Connecticut Mastery Test (CMT). All this is not possible without the participation of parents. In all, students, parents, teachers, administrators, and the community put together all the resources for the undertaking of science fair to give our students the best educational opportunity they can get and for a better future for all. Science fairs are not easy to put together. They take a lot of work. They take a lot of time and effort. They take a lot of resources both human and material. Make sure that you have patience and that you don't give up. Also, and most important of all, make sure that you have lots of fun!

Procedure of Science Fair (Mini-Tasks)

Throughout all the process of preparing a science fair, a council of science and mathematics, or some equivalent body should be installed in school in order to make sure that all the elements of the fair are set in

place and successful. Students in the fifth grade could participate with individual projects, or in groups of two. Students from kindergarten to fourth grade could have more than two students in a group. Kindergarten and first grade ought to have class projects. All of them, except fifth grade, should have a paper with background information together with their display board. Fifth grade is expected to have a research paper with a bibliography. All students have to be ready to answer questions and to give a presentation of their projects. In the case of the class projects, students with verbal ability should represent the class. Assessment lists are given to students throughout the process of development of the project. This material could be used to build an assessment portfolio. Finally, you must think how to use this experience to make your next science fair better?

Photosynthesis

The world is turning little by little into an urban environment. People are concentrating more in large cities and depleting the natural resources of the earth (Walker, 1993: 249-252). This single reality should encourage the creation of urban gardens in cities across the world. Plants in the city do so much good for all of us equally. Could we think of a New York City without Central Park? It is also necessary to conserve the natural environments that are left over from the onslaught of a greedy invasion by human beings in the last five hundred years. Students at all levels of education have to learn the context of this problem. There is an urgency to create urban gardens and to instill in students and the community respect for nature so as to safeguard natural resources for future generations. Through the various components of gardening students at all levels can become aware of ways to change the current trend of waste disposal, pollution, the use of nuclear power and the consequences for the future. It is also imperative to address the scientific knowledge of the process of photosynthesis. Life, as we know it on our planet, is at the center of our discussion.

Experiment # 1: The Essential Elements of Photosynthesis

In the classroom, the information of the seminar, “The Chemistry of Photosynthesis,” is essential because it brings new light and the latest developments in the field.

This subject matter falls into the curricular material of the New Haven Public School System. Photosynthesis is at the meeting point of just about everything that has to do with life in our planet. Let’s take for example the process of photosynthesis itself in order to understand the growth of plants. Light is essential for the process, so is water, air (carbon dioxide) and soil. Photosynthesis is a process that involves many steps. In an experiment in the class, we could challenge the students by making them come out with the necessary elements for the process of photosynthesis (Project Wet, 1996: 76-78). In an empty box, we place a cup of soil measured in milligrams, and a cup of water measured in milliliters. Covering the box we could ask the students to come out with the elements of life necessary in plant growth. There are four elements of life. Apparently, the box contains two of them. Which are the elements missing? If we cover the box we eliminate one of the ingredients. Which is this ingredient? Students could challenge each other trying to come out with the essential elements. One of them will realize that light is one of the elements necessary for a plant to grow. By covering the box we cover the source of light. Then, which is the fourth element necessary in the process of life? Again, without telling them directly, in an instructional conversation, they will sooner or later realize that the element not accounted for is carbon dioxide present in air.

This exercise is also written while the discussion is on. Sometimes it is easier for students to write when they

have a strong partner. Whichever might be the case, the opportunity for writing is enhanced by the step-by-step procedure of the experiment. This serves as an anchor for their attention and concentration. The hands-on experience is vital in the development of strategies for expression. Generally, it is expected that students in the fifth grade level should develop strategies for expository writing. As such, it is central to consider a main idea and details, keeping in mind the organization, the fluency and expression. In our case, the writing for the experiment has elements applicable in expository writing. The main idea is the elements of life for plant growth. If students do not know this information they might write in the form of a prediction or even a hypothesis. Testing and recording information with rich details would be one of the ways to organize their writing exercises. Students in this way could compare notes, results, drawings and solutions. This lends itself for an application of the scientific process (See above, *The Use of the Scientific Process*).

By this time students are already very excited to have come out with the answers. The classroom is full of sounds and conversations; the next step is the analysis of the photosynthesis process itself. How does this happen? Plants fabricated sugar in the process of photosynthesis using these four elements. But how does this miracle take place? The key lies in the composition of air, in water and in the energy of the sun. The elements are present in the air. The carbon dioxide, the oxygen and the water are elements indispensable for the production of sugar. This process could be best illustrated once the soil and the water are put to use together with air and light. All we need is a seed in the soil and some good care. Once the plant starts growing we could visualize the process of the production of sugar in the leaves of the growing plant. A brief background of the history of the discovery of the process of photosynthesis would be appropriate at this point (Conant, 1957). The history itself is fascinating since it is not too long ago that we did not have much information about the elements and the procedure involved in photosynthesis. In fact, it is in the beginning of the XIX century that De Suassure came up with a fairly clear picture of the dynamics of photosynthetic materials (Conant, 1957: 420). “Gas” became part of the common parlance of the scientific community in the beginning of the XVII century by the experiments of the Belgian physician Baptista van Helmont (Conant, 1957: 327-328). Students would be able to put the process in perspective and be able to visualize it much clearly. The fact of having discovered the various substances involved in photosynthesis through various stages of experimentation no doubt gives the students a sense of comfort with their own ideas and constructs of science. The discovery of the functions of oxygen, water and carbon dioxide in the production of sugar is one step into the understanding of the complex steps of photosynthesis. At the same time, the exposure of this discovery lends the opportunity in the classroom to make a transition from the general to the more specific. That is to say that now the students are ready to discuss the process including more detailed accounts of its components.

Experiment #2: Growing Popcorn in the Classroom

In order to illustrate the production of sugar by plants we could use six small pots with uniform soil (one produced in the classroom from recycled material is best). We are going to plant nine seeds in equal pots and soil. We separate them in sets of three. Each set is going to get different amounts of water. Formulate a hypothesis: The seeds with more water are going to grow larger than the others (we follow the steps for the scientific process). Students record information, graph, give results and come to conclusions after rigorous analysis. The plants with larger leaves and flowers are the ones with more food--sugar.

In this way students are more ready to visualize the process of photosynthesis as a formula where what goes in has to come out on the other side balanced.

$CO_2 + H_2O$ + ENERGY FROM THE SUN AND CHLOROPASTS ’! SUGAR + O_2

In other words, the photosynthetic apparatus in the chloroplast makes the following chemical reaction occur:

6CO2 + 6H2O + LIGHT ENERGY '! C6H12O6 + 6O2 (Flowering Plants. 1991: 27).

Later on, as the understanding and enthusiasm of the student has increased, we could get into the more complex relations of photosynthesis and respiration and some of the details of oxidation and reduction. (Walker, 1993: 13, 16-17). At this stage of the game in the fifth grade classroom it would suffice to talk about the nature of the balance of both sides of the formula. We started with 6 carbons, 18 atoms of oxygen, and 12 of hydrogen and we end up with the same amount on the other side, which really corresponds to the sugar molecule, C6H12O6, and the oxygen bond. O2. The use of manipulatives to present the formation of molecules to the class can also contribute to the understanding of the process of sugar production by plants. This will also explain the law of conservation of matter.

Experiment # 3: Playing with candy

We use for this experiment gummy drops, toothpicks and the formula for photosynthesis. We make the molecules needed for photosynthesis and then, after formulating a prediction, we test it by re-using the same candy to make sugar and oxygen molecules.

The exploration of themes related to photosynthesis ranging from pigmentation to the evolution of the Earth's atmosphere is important for the class. I find this very fascinating and necessary, particularly when these ideas are going to be presented with a hands-on approach. Students in the elementary level need to be guided through a particular lesson with a tangible process, step by step, to a point where they could actually begin to build a construct for further learning and exploration on their own. The experiments conducted in the seminar can be adapted for the classroom situation where we could align the guidelines of the standards and the curriculum to accomplish our objectives. Experiments such as the production of carbon dioxide and oxygen to make students visualize the differences and similarities of the elements involved in the production of sugar. These experiments would also help to understand the concepts of oxidation, combustion, and reduction as a good start. The production of CO2 can easily be accomplished with baking soda, or from dry ice, whereas oxygen could be isolated by the direst process of photosynthesis in the growth of elodia canadensis (Anacharis) trapping the gas in a cylinder (Stodola, 1987: 97, 99). The differentiation of the two materials can best be illustrated by putting a fire out, or by keeping it going with carbon dioxide and oxygen respectively.

Gardens Inside and Outside

At present my class is engaged in an on-going project with gardens inside and outside the school grounds. They have chosen several questions for science fair relating to plant growth. All of these projects have to do with gardens in an urban environment. We have an empty lot next to the school with boxes full of soil where we have been planting vegetables and flowers for the last five years. To do this students will have to use the scientific method by asking questions and laying out hypothesis that will have to be tested. Would a plant grow faster with top water or with water from the supermarket? Beginning with simple questions is a good way to encourage students to have fun and continue working in their scientific inquiry into more complex questions. Because of all this, writing the curriculum unit will help to focus on the scientific aspects of the growth of plants. A deeper understanding of photosynthesis will bring new vistas in the classroom for students to explore and experiment. This would also bring more opportunities for students to themes in social studies

and mathematics. Writing and reading are essential elements of the curriculum. In this sense science becomes a vehicle for the practice of expository writing.

In the last few weeks my classroom, in conjunction with two other classrooms, has been working on the exploration of photosynthesis in the classroom. We have a light and a platform where we grow different kinds of plants. We have vegetables and tropical plants. Students have been working on potting several shoots and growths of plants into pots to take them home to build their own gardens and to increase the plant population in the school grounds. Some students have grown avocado trees. They took them home and they tell me that they are very healthy. Many spider plants have grown shoots that students planted and gave away to other students. This process of giving and growing gives students the ability to understand the steps and force of nature in an urban environment. The growth of plants indoors is a bit different than the growth of plants outdoors. During these experiments with plants, it is important for students to visit the several gardens and community green houses in the area (see, **Field Trips**). Also the Peabody Museum has an array of displays related to the history and the ecology of the area from which students could benefit.

Soil (Backyard Composting, 1995)

All the soil needed for planting the shoots of the various plants in the building is prepared by the work of the students. They have been working on composting since the beginning of the school year. We have several boxes outside the school where we put all the organic materials from lunch. This is a fine soil in high esteem by students. We also have larger containers in out garden across the street from the school. This is the lot at our Sylvan Avenue garden. This garden has been working for about six years. We have plenty of composting soil there. Students go there with plastic bags and bring the fresh soil into two of the boxes outside the school. From this site we take the soil and use it for plants inside the building. There is a cycle in this adventure. This is a cycle of life of plants in an urban environment. It is important to note that a school has to create a healthy relationship with the community in order for the gardens flourish and the boxes to be safe. We have a special relationship with the New Haven Land Trust. This organization provides us with tools, fresh soil, seeds, plants and human power to keep our photosynthetic enterprise in good shape. In this way what we learn in the community and in the classroom come together in our gardens.

Our next project is to plant orchids indoors in a little garden inside the school. This used to be our butterfly garden a couple of years ago. Today this is going to be our beautiful orchid patch. The butterfly garden of the school is now at Orchard Street. There, we have a collection of specialized plants that attract butterflies of different species. The plants were about a foot tall three years ago; now they are about ten feet tall. There are many species of butterflies coming after the nectar. We are planning to expand around the school. May be, eventually, we might call it the Butterfly School.

In all we are very busy and happy to see that spring is here. Even when a little bit of snow might have damaged the tips of the young shoots and growths, the future is full of surprises for all of us, specially for kids of the inner city where butterflies and ladybugs come only when we put with our hands a little bit of knowledge and love in the soil.

Assessment

One of the procedures that take place in the classroom whenever a new lesson is presented to the student is an assessment list of the task the student is expected to do. In this unit I have included lists in English and Spanish for those students who have just arrived from another country. This is a way to involve the student in the process of producing a product by means of experimentation and discussion. The student is active in producing a program of study together with the teacher. The list is ideally generated in class with the participation of the student. Before the concept of photosynthesis is introduced to the class, students brainstorm about the concept and the implications of it. We make connections and set a pathway for action. We generate the questions in the list as elements to guide the study of any particular subject. Further, students are able to reflect on the work that they are expected to do and after they have done it they evaluate themselves. The teacher evaluates them and in this way a dialogue and cycle is established. The following lessons are an example of this methodology (Hibbard, 1996).

Lesson one: Photosynthesis

LISTA DE EVALUACION DE LA FOTOSINTESIS

Puntaje de la Evaluación

Posibles Puntaje Obtenido

Elementos Puntos Propio Maestro

1. Nosotros prestamos atención

a las instrucciones con mucho cuidado. _____ _____ _____

2. Hay una explicación clara de lo que intenta

demostrar el modelo. _____ _____ _____

3. Nuestro grupo pudo llegar a un acuerdo

sobre qué y cómo hacer el trabajo. _____ _____ _____

4. Preparamos los materiales con cuidado. _____ _____ _____

5. Pudimos hacer buenas observaciones

durante nuestro trabajo. _____ _____ _____

6. La persona encargada de tomar notas

tomó la información generada en las

conversaciones del grupo. _____ _____ _____

7. Usamos medidas a escala y estimamos

cuando necesario.. _____ _____ _____

8. Usamos colores, títulos, y líneas claras

para expresar lo que es la photosynthesis. _____ _____ _____

9. El trabajo es nítido y bien presentado. _____ _____ _____

10.Escribimos la formula de la fotosíntesis. _____ _____ _____

PUNTAJE TOTAL 100% _____ _____ _____

PERFORMANCE TASK ASSESSMENT LIST FOR PHOTOSYNTHESIS			Assessment Points
	Points	Earned Assessment	
Elements	Possible Self Teacher		
1. We listened to the directions and instructions very carefully.	_____ _____ _____		
2. There is a clear explanation of the meaning of photosynthesis.	_____ _____ _____		
3. Our group was able to come to an agreement about how and what to do.	_____ _____ _____		
4. We prepared our materials carefully. .	_____ _____ _____		
5. We were able to make good observations throughout our task.	_____ _____ _____		
6. Our recorder was able to keep track of the information generated in our group.	_____ _____ _____		
7. We used excellent estimations and measure the elements carefully.	_____ _____ _____		
8.We used colors, titles and made clear lines.	_____ _____ _____		
9.The work is neat and well presented.	_____ _____ _____		
10. The formula of photosynthesis is correct.	_____ _____ _____		
TOTAL POINTS 100%			

Background

Photosynthesis is a process that involves plants, air, soil and sunlight. Plants produce sugar and oxygen and take from nature CO2 and H2O. They need chlorophyll in order for all this to happen.

Your Task

Your task is to balance the elements involved in the process of photosynthesis

Materials

Plants, sunlight, soil and water.

Audience

Students and teachers in the classroom.

Purpose

To find out about the connections between photosynthesis and life in the planet.

Procedure

Have some plants on the sun and some in the dark. Compare and contrast day after day the results. Make a chart and a graph to express findings. Make a hypothesis and test it.

Applications

Once you have your findings, how can we apply this information in real life?

Lesson two: Photosynthesis and Seaweed

LISTA DE EVALUACION DE LA FOTOSINTESIS Y LAS ALGAS DEL MAR

Puntaje de la Evaluación

Posibles Puntaje Obtenido

Elementos Puntos Propio Maestro

1. Nosotros prestamos atención

a las instrucciones con mucho cuidado. _____ _____ _____

2. Hay una explicación clara de lo que intenta

demostrar el experimento. _____ _____ _____

3. Nuestro grupo pudo llegar a un acuerdo

sobre qué y cómo hacer el trabajo. _____ _____ _____

4. Preparamos los materiales con cuidado. _____ _____ _____

5. Pudimos hacer buenas observaciones

durante nuestro experimento. _____ _____ _____

6. La persona encargada de tomar notas

tomó la información generada en las

conversaciones del grupo. _____ _____ _____

7. Usamos medidas a escala y estimamos

cuando necesario.. _____ _____ _____

8. Usamos colores, títulos, y líneas claras

para expresar la relación de la photosynthesis

y las algas del mar. _____ _____ _____

9. El trabajo es nítido y bien presentado. _____ _____ _____

10.Escribimos los resultados claramnete. _____ _____ _____

PUNTAJE TOTAL 100% _____ _____ _____

PERFORMANCE TASK ASSESSMENT LIST FOR PHOTOSYNTHESIS AND SEAWEED

Elements	Assessment Points Possible	Points Earned Self	Assessment Teacher
1. We listened to the directions and instructions very carefully.	_____	_____	_____
2. There is a clear explanation of the meaning of the experiment.	_____	_____	_____
3. Our group was able to come to an agreement about how and what to do.	_____	_____	_____
4. We prepared our materials carefully. .	_____	_____	_____

5. We were able to make good observations

throughout our task. _____ _____ _____

6. Our recorder was able to keep track of the

information generated in our group. _____ _____ _____

7. We used excellent estimations and measure

the elements carefully. _____ _____ _____

8.We used colors, titles and made clear

lines. _____ _____ _____

9.The work is neat0 and well presented. _____ _____ _____

10. The results are written clearly. _____ _____ _____

TOTAL POINTS 100% _____ _____

Background

Photosynthesis is a process that involves plants, air, soil and sunlight. Plants produce sugar and oxygen and take from nature CO2 and H2O. They need chlorophyll in order for all this to happen. Because of this, cycles of life are possible on earth. How does this happen? Can you think of one cycle of life? In the shoreline, how is seaweed related to this cycle (a trip to the seashore anywhere in the area is a good way to illustrate the work in the classroom; Lighthouse Park is excellent for this activity)?

Your Task

Your task is to find a cycle of life in the shoreline. Think about the relationship, if any, between your cycle of life and seaweed. Use an organizer or a web. Write a paragraph about your findings. Make drawings.

Materials

Seaweed
Magnifying glass
Microscopes

Audience

Students and teachers in the classroom.

Purpose

To find out about the structure and composition of seaweed and how it fits in the cycles of life in the seashore.

Procedure

Make a team of three or four students. Take two different samples of seaweed. Analyze it under the microscope and magnifying glass. Make observations using your senses. Compare and contrast. Make drawings of the seaweed under the microscope, under the magnifying glass and without a magnifying aid.

Applications

Once you have your findings, how can we apply this information in real life?

Glossary

C6H12O6: This is the chemical composition of sugar.
Chlorophyll: One of the molecules necessary in the process of photosynthesis; it has one magnesium and four nitrogen atoms.

CO2: Carbon Dioxide.

Conservation: The action which has the tendency to maintain the original state of matter.

Diversity: That is not homogeneous.

Energy: That which is needed for work.

Flora: Vegetable life.

H2O: Water.

High energy compound: A substance that gives out high energy when molecules are broken into atoms.

Low energy compound: A molecule that gives little energy when broken into atoms.

MgN4: Chlorophyll.

Photosynthesis: The process by which plants make sugar and give out oxygen using CO2 and H2O; Chlorophyll and solar energy are necessary.

Process: An action that takes place step by step.

O2: Oxygen molecule.

Oxidation: That gains oxygen.

Reduction: That gains electrons.

Scientific Process: The steps and procedures involved in proving a hypothesis through experimentation, data recording and analysis.

Urban Garden: A garden in a city.

Water splitting: The process by which water is broken into its original atoms; an example is photosynthesis.

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Field Trips

Connecticut Audubon Coastal Center at Milford Point

The Whitney Water Center

The Peabody Museum

Norwalk Marine Center

Bishop Farms in Guilford

Several other farms and gardens in the area

1There are some life forms that are produce without the direct energy of the sun. These life forms are able to generate energy from the thermal reactions at the depths of the ocean floor (Information from seminar).

2In our seminar, we explored some of the one hundred plus steps involved in the production of sugar by plants. This is not a simple process, but for the classroom purposes, we use the simple formulation.