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Preparing for the New Haven Public School Science Fair Through Environmental Science

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by Joe Lewis

I serve as Curriculum Staff Developer at East Rock Global Magnet School where one of my many duties include serving as the Science Fair Coordinator and Representative for our entire K-8 population. My entire school participates in the school-wide science fair in accordance to the rules of the city-wide Science Fair. In an effort to prepare both the staff and students for the upcoming School Science Fair, I along with two other staff members are preparing thematically based units for our staff as a means of support to achieve this goal. You can find both Judy Dixon's unit entitled **"The Aquatic Environment"** and Jacqueline Porter's unit on **"Nutritional Influences on Illness and Disease"** within the units written for Dr. Wargo's course. My curriculum unit, **Preparing for the NHPS Science Fair Through Environmental Science** will serve as a basic guide to the rules for the New Haven city-wide Science Fair and a tool for both teachers and students to use in order to produce science fair projects that will qualify for the fair. My curriculum unit will include the following sections:

I. The Olin-Yale-Bayer-New Haven School Science Fair Qualifications

- Laboratory Notebook
- Research Paper
- Project Display Board
- Oral Presentation

II. The Scientific Method

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- Forming the Hypothesis

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Science Fair Project Mini-Board
The Worm Farm

Preparing for the NHPS Science Fair Through Environmental Science is designed to meet two basic goals that I have set for myself for the next school year. First of all, I wish to utilize the information in the first part of my paper as a workshop for our staff in order to prepare them for the Annual New Haven Science Fair. It can also be used as a guide for the students to follow when preparing their science fair project. Secondly, I will include two different experiments in the final section of the paper that my students in my CPEP (Connecticut Pre-Engineering Program) will investigate for their science fair projects. This will also serve as a guide for both the students and teachers to plan a science fair investigation for their classroom. This unit is designed for middle school students in grades 6-8. According to the New Haven Public School Standards all students in grades 6 through 8 are expected to develop abilities to do scientific inquiry where they pose a question, state an hypothesis, develop an investigation, observe and document the process, and record and determine the results.

In order for our students to meet those standards, New Haven Public Schools added the following Performance Standards and objectives for students to accomplish:

Performance Standard 1.1: Students will acquire and practice the ability to do scientific inquiry.

Students will identify questions that can be answered through scientific investigations;
Student will design and conduct scientific investigations.
Students will use appropriate tools and techniques to gather, analyze and interpret data.
Students will develop descriptions, explanations, predictions and models using evidence.

Performance Standard 1.2: Students will acquire and practice the ability to understand scientific inquiry.

Students will recognize and analyze alternative explanations and predictions about the world around them.
Students will communicate scientific procedures and explanations verbally and in writing.
Students will learn to pose different kinds of questions appropriate for the different kinds of investigation.
Students will use technology to gather data to enhance the accuracy of analysis of their investigations.
Students will use mathematics in all aspects of scientific inquiry.

The Olin-Yale-Bayer-New Haven School Science Fair Program has been in existence since 1993 with seven schools participating and it has now expanded to all 48 schools in the New Haven Public School System. The goal of the science fair and this paper is help students and teachers in Kindergarten through twelfth grade carry out investigative hands-on projects in order to promote skills in critical thinking, science process and communication. The actual science fair includes three different working groups. In the elementary division Kindergarten through grade two are only allowed to enter class projects. Grades three and four are allowed to enter class or team projects with a team consisting of a maximum of four members. Individual projects are not allowed in the elementary division. Middle School participants are allowed to enter the fair as individuals or as a team. Class projects are not allowed in this division. Students in grades five and six are allowed to work on teams consisting of no more than three members. Seventh and eighth graders are may work on teams of two members. High School students in grades nine through twelve may also enter individually or as a team of no more than three participants.

The Olin-Yale-Bayer-New Haven School Science Fair

There are four main parts to a Science Fair Project: the laboratory notebook, a research paper, a project display board and an oral presentation. Each of these criterias are scored by the science fair judges in accordance to the rules sat aside by the science fair committee years ago. The laboratory notebook and research paper is worth a total of fifteen points. The project display board is worth a total of fifty-five points. When the judges review the display board they assign up to thirty point on the scientific thought placed into the board. They can give the display board up to 15 additional points based on the thoroughness of the data placed on the board. A display board can earn up to 10 additional points for the students skill in measurement and data placed on a well organized graph. All these add up to a total of fifty-five points as stated earlier. The students oral presentation is worth up to thirty points.

Laboratory Notebook

The Laboratory Notebook serves as scientific diary where the students have to document everything that they

do during the scientific process. It is suggested that the students use a composition where all the pages are bound together. Each entry in the notebook has to be dated. The notebook should include all the information that the students plan to place on their display board including the procedures, hypothesis, any observations and even a list of the materials that the students plan use to perform the experiment. This is a journal and the need to be neat is not important as long as the notes are legible to the student or other members of the group. However, the judges at the science fair will read lab notebook. The students can also use the book to design charts, tables or graphs. Documentation can be done in script or through scientific drawings.

Research Paper

The Research Paper is the written record of the entire project from start to finish. The report should be clear and precise. When the judges read the report, it should be clear enough for them to know exactly what you did, the results, and whether or not the experimental evidence supported the hypothesis. There are eight distinct parts to the research paper: (1) Title page, (2) table of contents, (3) abstract, (4) introduction, (5) experiment and data, (6) conclusion, (7) bibliography page and (8) acknowledgements. The only information that should be placed on the title page is the title of the experiment and the student names that worked on the report. The second page of the report is the table of contents. It should contain a list of everything following the table of contents.

The abstract should be no longer than one page. It is a brief overview of the project and it should include the project title, a statement of the purpose, a hypothesis, a brief description of the procedure, and the results. The introduction should contain the purpose of the experiment, and background information stating why you chose to do this particular experiment. It also should contain a brief statement of your hypothesis based on the information gained from on your the research found on the topic. It is also a good idea to state why you chose the particular project. In the experiment and data portion of the paper the students must include the problem being investigated in the experiment, followed by a final list of materials, then the procedures used to complete the experiment. All measurements and observations made during the experiment should be included in this section. It is strongly recommended that the data be placed on a chart, table or graph. The table or graph should be properly labeled.

The conclusion summarizes what was discovered during the experiment based on the data presented in the experiment and data section. The hypothesis should be restated and the students should state rather or not the hypothesis was correct. All sources should be listed in bibliography including all written materials and people interviewed. If people were interviewed, their names should be listed in alphabetical order below the bibliography. The person’s name, title, business phone number should follow the entry. If the students received help from an additional people to complete the project, they should be named on the acknowledgements page. This page is not a list of names, but a short paragraph stating the people names and how they assisted you with your project.

Project Display Board

The third part of the science fair project is the project display board. The project display board is the final step of the project. It represents all of the research and investigating that has been done throughout the project. It will also serve as your guide during the oral presentation. Even though these boards come in an array of sizes, the Olin-Yale-Bayer-New Haven School Science Fair requires that the students exhibits should be 48 inches (122 cm) wide, 30 inches (76 cm) deep, and 108 inches (274 cm) high. A three-sided backboard, which can be purchased at any office supply store, is the most popular and best way to display your project. However, some parents make these boards with out of wooden panels and hinges.

The following heading and information should be included on the science fair project board. Statement of the Problem: the students should what they are trying to find out in the experiment. Hypothesis: the students will make an educated guess about the outcome of the experiment. Materials: all the materials used to carry out the experiment should be listed in this section. Procedures: every step used to carry out the experiment should be listed in numerical order. Observations: all the data that was collected from the experiment should be placed in this section. The students can place this information on tables, charts or graphs. They can even use pictures for spectators to view things that may have occurred during the experiment. Results: summarize the data on the tables, graphs or charts. If pictures are used, the student should explain what is occurring in each of the pictures. Conclusion: the student should restate their original hypothesis and explain rather it was correct or not. They then compare their hypothesis to the final results of the experiment. Limitations: if there were anything that you could have done to improve the experiment, or make it more accurate, it should be stated in this section. Applications: briefly state how the experiment could be useful to other people.

Oral Presentation

During the oral presentation, three judges will separately ask students questions concerning their project. The student must be able to explain the science behind the projects. They will also look for evidence that the project is original, and carried out in an original and inventive way. Once the students have demonstrated their knowledge about the project, the judges will ask them a final "what if" question to see if the students can offer a logical solution to the question in relationship to their project.

II. The Scientific Method

In order to prepare students to eventually design their own experiment, the instructor should insist on having their students write up their scientific investigations using the proper method. Since one of my goals is to heighten students' interest in science, I feel that it is necessary to include this small segment explaining the scientific method so that you can show your students how scientists work.

Title

The first step of the scientific method is to come up with a good title for the experiment. Titles are often stated in the form of a question. Just from reading the title, anyone should automatically know the problem that a child is trying to solve in their experiment. For example: "Do Earthworms Have an Affect on how Well A Plant Grows?" From the title we know that the student is trying to find out the effects of earthworms on the growth of plants.

Introduction/Research

Thinking scientifically, the student should try to find possible solutions the problem through researching information about the problem he is trying to solve. The information that he finds should aid the child in forming an hypothesis during the third stage of the scientific method, and help the child in writing the introduction.

The second stage of the scientific method should be titled the introduction. The student, in paragraph format, should briefly write some sort of introductory statement which addresses such questions as, why he chose to do the particular experiment and why is it worth spending time on. The child should also include some

background information about earthworms and the role they play underground in improving soil quality. The student may also want to include some information on bean seeds and how they grow.

Hypothesis

The third step of the scientific method requires the child making an educated guess about what he is experimenting on. The educated guess is called an hypothesis. Using the previous example, a typical hypothesis for this experiment would be: Earthworms will cause the plant to grow faster and produce larger beans.

Procedures

In the fourth step called the procedure, have the student to list the material that is needed to do the experiment as well as provide the basic details as to how the experiment will be performed. This should be a detailed description and a step by step procedure of how the student could test his problem. Anyone reading the experiment should be able to collect the materials needed to perform the investigation and duplicate the experiment by reading the procedures.

Observations/Data Analysis

The fifth step called observations. The student records any pertinent information about their findings while performing the experiment. Whenever possible the student should use charts, graphs, tables or pictures to depict information.

Conclusion

The final step of the scientific method is the conclusion. Here the student analyzes the data the he has placed in his observations and formulates a conclusion. This section is also be done in a paragraph format. The student should also state whether or not his hypothesis was correct.

Keep in mind that in order for the student to fully understand how this method is employed, the instructor must walk the child through a sample experiment explaining how each step is done. It is also important the student realizes that once the hypothesis is made it should not be changed during the experiment. Remember that it is only a guess as to the outcome of the experiment; the important thing is that the conclusion at the end is correct. The conclusion either proves or disproves the hypothesis.

During any experiment or scientific research the teacher should constantly encourage students to ask questions, reach an educated guess, and to design some type of experiment to figure out if their hypothesis is correct.

Types of Science Fair Projects

There are several different types of science fair projects, including: experiments, demonstrations, research, collections and apparatus (Fredericks & Asimov, 1990). Even though NHPS Science Fair will only accept investigative projects, teachers can utilize the other types of projects to make their science classes more

exciting and “hands-on” for the students.

Experimental Project

The experimental project was fully described earlier in the beginning of the paper. It involves the students coming up with a problem that they can investigate. Once the problem has been stated, the students design an experiment, collect and record data. They then analyze the data to formulate an accurate conclusion based on the information collected. Another type of science fair project includes demonstrations.

Demonstration Projects

Demonstrations allow the students to show how something works, explain a scientific phenomenon, or show how something is created naturally of in a laboratory. To be effective, the project must be self-contained whereas, the audience can operate or manipulate any controls or devices needed for the demonstration. The audience is also told of any materials used to make the item or items demonstrated so that they can present the same concepts to others.

Projects Related to Collections

The third type of science fair project, collections, allows students to show the diversity within a chosen field of science. For example, students can collect different types of leaves and explain what tree they came from, or categorize leaves into different groups. Collections should include as many different samples as possible to represent the diversity within the group or topic.

Research Oriented Projects

In a research oriented project, the students investigate a certain scientific topic using primary resources. This type of project can be as simple as having students read materials form library to a more elaborate project where students research and interview experts such as scientist, museum curators, etc… The major purpose of the project is to have students investigate a scientific area in depth and report the findings in an interesting way to the class. The final type of project is apparatus oriented project where students display some kind of scientific apparatus or instruments and describe their use or function in detail. The students have to state why the instrument is important to science and how it is used in the scientific arena.

Choosing a Topic or Problem for the Science Fair Project

We will now move into the area of getting started with the experimental or investigative project. One of the most difficult steps involved in being in a science fair is coming up with the problem to solve or a topic. There are many ways to come up with a topic (VanCleave, 1997). The easiest way to find a project is to select a topic from a book on science fair projects or science experiments. The only problem with using this method is that most of these books are highly used by other students, and you tend to find replicas of these projects in school wide science fairs. But, one could use the projects presented in these books as the foundation for an experiment. By adding your own additional ideas to the project it could result in an award winning science fair project. Another way of trying to come up with a topic is to look closely at the world around you. For example, I noticed that the majority of bees that visited my garden went to the most colorful flowers. From that

observation, I could design and experiment to see if bees are attracted to color of flower.

Two of the best ways is to look through science magazines or books and find topics or ideas that are of interest to the science fair participant. Using this method is one way of assuring that the project is original and give students the full experience of designing an experiment to find the answer to the problem that they are investigating. The second best way to come up with a topic is by attending lectures on topic of interest. The lecturer could make a profound statement which you may want to investigate on your own. For example, in my course with the Yale New Haven Teachers Institute we spent a lot of time discussing pesticides and their affects on the environment and people. This topic sparked my interest to design an experiment to see how pesticides affect our environment. Based on the research on pesticides and wanting to design an experiment to see how it affects our bodies, I decided to design an experiment on earthworms to observe the effects of pesticide on living things. This course also made me curious about other environmental concerns which led me to work in the area of environmental science with the additional experiments included in this unit.

Utilizing this Unit to Design Experiments

As with all scientific investigations once a topic is decided upon, an extensive research process must follow. It is suggested that you perform research on the topic before you state your hypothesis. Since my major focus in writing this unit is to assist both teachers and students in designing and completing a science fair project, I will use the following format with each of the investigations:

· Background Information
· Project Overview
· Materials List & Resources
· Procedures

The background information will include pertinent information about the subjects that are being investigated within this unit. It is my initial research on the subject and the items that I consider to be important and should be included in the research paper that goes along with the experiment. The project overview will describe what I am trying to find out in my investigation. Even though it is not written to be an official abstract of the experiment, most of the information found in this section can be used in the abstract of the student's research report of the experiment. The materials list will include all the materials that are needed to complete the experiment. If some of the materials are not easy to find, I will include the address where these materials can be found. Finally, the procedures are the steps that must be performed in order to carry out the experiments presented in this unit of study. Both the materials list and procedures are critical parts of display board and the research paper. Since I am trying to abide by the rules of the NHPS Science Fair, I will list the procedures in numerical order. The materials list can be used as stated within this unit, but the resource list should be excluded.

Experiment I: The Effect of Earthworms on Plant Growth

Background Information

Earthworms are members of the Animal Kingdom, belonging to the Phylum Annelida. They are commonly called night crawlers because of their nocturnal characteristics. Earthworms are characterized as having long tube-like bodies with many segments. There is an enlargement made up of several segments that house the clitellum, a glandular organ used for reproduction. These animals are hermaphroditic, so they can function as either male or female during reproduction.

These animals are extremely valuable resources to humans and the environment. They are a source of food, mainly protein, in many cultures. They can also be used as bait for fishing, and most importantly, they play an important role in conditioning the soil. Earthworms act as agents of soil aeration and provide nutrients to the soil.

Earthworms benefit the soil in many ways, mainly due to the physical and chemical effects of their casts and burrows. As earthworms burrow through the soil, they excrete waste made up of soil and digested plant residue. As these items pass through the digestive tract of the earthworm, their gizzard breaks them down into smaller particles. These casts modify the soil structural units that are made up of plates and blocks, into finer, spherical granules. The spherical granules of soil are further decomposed by other earthworms and microorganisms in the soil. The casts also provide nitrogen in a usable form for other organisms that decompose organic matter on the soil surface. Comparative analyses have shown soil surrounding worm casts to contain as much as five times more nitrogen, and even higher compositions of potassium, magnesium, phosphorous. The soil even contains one-and-one half times more calcium. Scientists credit the increase to the earthworms' ability to liberate nutrients from particles of both organic and mineral matter that would otherwise remain unavailable to plants. (Delahaut & Koval)

Project Overview

In this experiment, students will be asked to raise several varieties of bean seeds in containers. Each will use the same soil mixture; only one set of plant seeds will have worms in the container. The students will make a hypothesis based on the background information above and any other research they obtain concerning how the worms will affect plant growth. The students will make weekly observations for about two months, analyze the data and formulate a conclusion. Based on how elaborate the experimental design is, the students will decide on how many worms, container and types of seeds needed.

Materials

A variety of bean seeds
40 to 60 earthworms
Styrofoam cups or empty milk carton
Containers with proper drainage to plant seeds and/or house earthworms

Dry bean seeds can be purchased in supermarket in large quantities for about one dollar. Even though worms can be found outside, it will be better to use earthworms from a bait shop. You can usually buy them by the dozen for about one dollar and fifty cents per dozen. These worms are usually thick and healthy and are raised under fairly good conditions.

Procedures

Place a couple of small holes in the bottom of a stryrofoam cup or milk carton.
Fill each of the container half full with potting soil.
Place one bean seed in each of the containers.
Cover the seeds with potting soil, but do not fill the container to the top with the soil.
Water the seed, and do not allow the container to become dry. Be careful not to over water the seeds.
Allow the plant to germinate and grow approximately one to two inches.
While waiting for the seeds to germinate, prepare several worm farms to place with the repotted bean plants. (See direction for making a worm farm in the “additional lessons” section at the end of the paper).
Repot the plants into a container that can hold up to three of the plants. You may have to remove some of the soil around the plant. Be careful not to destroy the plants roots.
Gently pour the worm farm into a container with the three bean plants. Place additional soil in the container if needed.

Experiment II: The Effect of Pesticides on Earthworms

Background Information

Pesticides applied to soil in order to control pests or turf diseases may severely affect earthworms. Toxicity to earthworms varies widely among the different types of pesticides classified by use- insecticides and related compounds, fungicides, herbicides, fumigants and vermicides. Two groups of pesticides have been identified as being extremely toxic to earthworms and most other soil organisms. Fumigants such as chloropicrin, dichloropropane, and methyl bromide are one such group. Vermicides, which were designed to kill earthworms, such as ammonium sulphate, lead arsenate, mercuric chloride are detrimental to worms.

Since herbicides are designed to kill or regulate plant growth, they pose very little threat to earthworm toxicity. However, fungicides and insecticides are responsible for the most extensive pesticide impact on earthworms. Insecticides with carbamate compounds such as Turcam and Baygon significantly reduce earthworm populations and cause paralysis at normal doses. Other insecticides with carbamate compounds such as Carbofuran at sublethal responses leave earthworms with delayed clitellum development, low weight, and the absence of cocoon production using only recommended doses to the insecticide. (Delahaut & Koval)

Project Overview

This project will allow the students to see what type of effect that pesticides have on earthworms. They will use three different types of pesticide and examine the external and internal affects that each have on earthworms. The students will maintain earthworms in habitats sprayed with various pesticides for four to six weeks. Therefore, the students will have to dissect at least twelve earthworms for this project.

Materials and Resources

4 plastic or rubber storage containers with lids
40 earthworms
Peat moss or the same soil where the earthworms were collected (bedding materials)
Small box of cornmeal (earthworm food)
Three different types of pesticides
Dissecting pan and scope
Dissecting kit
Alcohol
Distilled water
Petri dishes
Rubber gloves
Pipettes

Procedures

Fill each of the tubs about halfway to the top with either topsoil or peat moss to act as a bedding material.

Place ten earthworms into each tub.

Mark each tub with the name of the pesticide added. Do not add pesticide to one of the tubs to serve as the control.

Place the tops on the tubs and allow the earthworms to get acclimated to their new environment (about 24 hours).

After approximately 24 hours, sprinkle about 1 tablespoon full of cornmeal over the surface of each tub to serve as a food supply.

Take the containers outside and apply the each of the pesticide to the appropriate tub according to the directions on the pesticide container.

After applying the pesticide, spray or sprinkle 200 ml of distilled water over the surface of each tub.

While outside, Spray or sprinkle 200 ml of water on the container marked control and replace the lid and let it set for one week.

Replace the lids on the containers and allow them to stand for one week.

After about one week, start making observations.

Wearing rubber gloves, observe the external anatomy of five of the earthworms from each of the tubs.

Record the skin color, texture of the earthworm and the overall condition of each of the worms.

Take a picture of the worm for your science fair project board.

Put them down and notice their movement. Record your observations.

Observe their heartbeat underneath a dissecting scope. Record your observtions.

Place the worms back into their respective tubs.

Find a picture of the internal structure of a normal earthworm. Use this to identify the parts of the internal structure of the earthworm.

Choose one worm from each of the tubs to dissect.

Place enough alcohol in a petri dish to fill it half way.

Place the worm into the petri dish. This will kill the worm and get it ready for dissecting.

After a few minutes, place the worm on the dissecting tray.

Dissect the earthworm, pay close attention to the digestive system, and reproductive structures such as the seminal vesicles

Take a picture of the worms for your science fair project board.

After a worm from each container have been observed, photographed and dissected, sprinkle about 1 tablespoon full of cornmeal over the surface of each tub to serve as a food supply.

Repeat steps 6 through 8. One week later, repeat steps 11 through 23.

Repeat steps 24 and 25 for 4 to 6 weeks before concluding the experiment.

Laboratory I: Earthworm Observation and Dissection

Materials

Safety goggles
Apron or Lab jacket
Rubber gloves
Dissecting Kit containing forceps, pointed scissors, scalpel. Blunt probe, dissecting pins
Dissection Tray
newspaper
Earthworm (prepared for dissection)

Procedures

Place the specimen ventral side down, dorsal side up on the dissecting tray.
Record data concerning the color of the earthworm.
Record data concerning the clitellum.
Using a scalpel, make a shallow medial incision about one cm long on the dorsal surface 1/3 of the way from the posterior end.
Then take the pointed scissors and cut all the way towards the anterior end.
Using dissection pins, pin all the skin back into the dissection tray.
Record data concerning the digestive system, and reproductive structures such as the seminal vesicles.
Remove the intestine from the point where you started the incision.
On either the underside or bottom of the intestine you will find the ventral nerve cord. Record your observations of this structure.
Dispose of the dissected worm by wrapping it in newspaper and placing in garbage.

Rinse off the dissecting tools and dry them thoroughly before returning them to the dissecting kit.
Rinse off the dissecting tray and lay upside down on newspaper in order for them to dry.
Repeat this dissection laboratory each week for the duration of the experiment.

Additional Lesson Plans

Science Fair Projects on the Mini-Board

Background Information

Two of the major problems in having all students in a classroom complete science fair projects are the price of the display boards, and storage in the classroom. A great way to eliminate this problem is to have students place their science fair projects on what I call a mini-board. In the past, I have had my students make a board out of the legal paper sized manilla folders. First it is extremely cheaper than purchasing a science fair project board and you can store the project in a cabinet in your room. You can even place their research paper and laboratory notebook inside the mini-board. The science fair mini-board is simply a miniature science fair project board.

I usually hold the classroom science fair in the library and have each student or teams of students explain present their projects to the entire class. They are scored based on the New Haven Science Fair Standards. The group with the highest score will represent the class in the School-wide Science Fair. Should there be a group of students with the same score; the class can decide who will represent them in the science fair. The winning mini-board is then placed on a regular size display board by increasing the font size and placing the information on the other board.

What is great about this experience is that everyone gets to participate and they get the chance to be

questioned in front of the group about their findings. This experience usually motivates kids to participate in future science fairs and get them thinking about future projects. Teachers can also keep the final products to show students examples of what an excellent project looks like compared to a poor or fair project. Therefore, they serve as a great teaching tool in preparing students for the science fair.

Project Overview

Once the students have completed their science fair investigation, they will place the necessary information on the science fair mini-board. As stated previously in the “Science Pair Project Board Section”, the students will place the following heading and the information associated with each on the mini-board: (a) Statement of the Problem; (b) Hypothesis; (c) Observations; (d) Results; (e) Limitations and (f) Applications.

According to the amount of information, the students will use a font size somewhere between nine to twelve font. They will design the board in the same method as they would have if using a regular sized project board purchased from a store. The middle part of the board can be simply adjusted by sliding the board to the left or right. The instructor should make sure the students understand that neatness and creativity in designing their board is an important aspect of their grade, along with accurate information and data.

Materials

2 legal size manilla folders
2 large paper clips
construction paper
cement glue

Procedures

Open two manilla folder and put them together so that you have a left and right flap and one center piece. (It should look like a small science project board).
Connect the two pieces together by placing a large paper clip on the top and bottom of the connecting center piece.
Type out the heading stated in the project overview.
Glue the first heading on the left flap, followed by the information that goes with that particular section. (Cement glue produces a better look and adhere to the board better than Elmer’s glue or a glue stick).
As you place the information that goes in the center of the board, adjust the center to hold all the necessary information.
Once the board is complete, tape the back of the board with masking tape and cement glue the center of the board together.

Worm Farm in a Jar

Background Information

See the background information in the previous section “The Effect of Worms on Plant Growth”

Project Overview

The students will make and maintain a worm farm in quart size glass jars. Up to twenty worms can be placed in a quart jar. Since these worms will be used in the experiment to see if worms have an effect on the growth of plants, have the students place 15 worms in each jar. In order to see the worm burrows, they will cover the jar with black construction paper. The students will feed the earthworms oatmeal throughout this experiment. They will place the jar of worms with the bean seed plants after they have germinated.

Materials

Quart size glass jars
Soil
Worms
Hammer
Large nails
Black construction paper
Uncooked oatmeal

Procedures

Place two inches of moist soil into the glass jar.
Sprinkle about a teaspoon of oatmeal on top of the soil.
Add one inch of moist sand on top of the oatmeal.
Repeat steps one and three until there is about two inches of open space remaining in the jar.
Set this aside, and nail several holes in the lid of the jar.
Place the fifteen worms in the jar and screw the lid onto the jar.
Cover the outside of the jar with black construction paper.
Place the worm farm in a dark, cool place away from direct sunlight.
After one week, remove the black paper from around the jar. You will be able to see some worm burrows against the sides of the jar.

Sprinkle about one teaspoon of oatmeal on top of the worm farm and return the farm to it station until ready to mix in with the bean plants.
Feed the worms weekly.

Bibliography for Teachers

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