

Schoolyard Investigation Plan

Mulch Madness

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Part I

Investigation Title: Mulch Madness

Grade Level: Secondary (9-12)

Time Frame: 4 class meetings (Standard period length) 2 Block period meeting *

*(Does not include post activity time for presentation development)

Part II Lesson Goals

Investigation focusing on how pH levels found in soils may affect the proper growth of plants and the pH range required for a variety of plants. This activity is a simulation rather than a true life investigation, unless you actually have plants doing poorly and would like to investigate pH levels to determine if improper pH is playing a role in the plant growth decline. This simulation allows students to investigate how different mulches may affect soil pH and therefore plant growth.

General Science Performance Standards (Georgia) addressed are:

SCSh 2 Safe lab and field investigations

SCSh 3 Scientific Investigation of problems

SCSh 4 Tool/Instrument use for observing, measuring, etc.

SCSh 5 Computation/Estimation for analyzing and explaining data

SCSh 6 Clear Communication of science investigations and information

SCSh 8 Understand/Use process of scientific inquiry

Subject Specific Performance Standards (Georgia) addressed are:

SPS6. Students will investigate the properties of solutions.

- a. Describe solutions in terms of concentration
- d. Compare and contrast the components and properties of acids and bases.

Other objectives addressed from courses other than Physical Science:

SEC4. Students will analyze biogeochemical cycles and the flow of energy in ecosystems.

- a. Compare and contrast the carbon, water, oxygen, phosphorus, nitrogen, and sulfur cycles, describing their flow through biotic and abiotic pools, including human influences

SB4 b Explain flow of matter (Cycling Nutrients)

SEV1. Students will investigate the flow of energy and cycling of matter within an ecosystem and relate these phenomena to human society.

- a. Interpret biogeochemical cycles including hydrologic, nitrogen, phosphorus, oxygen, and carbon cycles. Recognize that energy is not recycled in ecosystems.

Part III Materials

1. pH testing kits/ narrow range pH paper covering 4.0 to 8.0 in 0.1 increments.
2. Soil Samples, one each for each plant species to be investigated, pH outside of plant tolerance range
3. Mulch Samples, one each for each mulch material to be investigated
4. Data recording sheets

Part IV Implementation

A) Student Engagement: The Hook

Depending on your content area, this may occur in Fall, Winter or Spring months which may affect how you approach the hook. Discussion of fertilizers and soil conditioners in Spring or over-winter feeding in the Fall may provide entry into the topic and lead students to consideration of the various factors that have an effect on plant growth, finally focusing in on pH requirements. One sure way of encouraging pH discussions is to bring up the Hydrangea, a plant which has different color flowers depending on the pH level of the soil it is planted in, blue in acidic soil and pink in less acidic soil and white in basic soil.

B) Developing the investigative question(s)

The Hydrangea should lead students to wonder if pH has anything to do with the reason the plants are doing poorly by posing questions such as” Did the new mulch cause a pH change in the soil affecting the plant growth?” or “Do different mulches change pH of soil in different ways or to differing levels?”

C) Hypothesis Development

As questions are generated, hypotheses should follow quite naturally so the first question above might generate the generate a hypothesis such as “Acidic mulch materials will

adversely affect plants that require basic or near neutral pH levels in the soil.” Or its opposite about basic mulches and acidophilic plants.

D) The Prediction

Predictive statements should follow the If...Then form and state what the student expects to observe if the hypothesis were to be true. So the statement “If acidic mulch makes basic soils acidic, then plants needing basic soil will not grow as well” might be produced.

Part V Methodology

Since this is a simulation, sampling area and protocols are not a concern for the students though you could certainly set up the activity in such a way as to require true sampling techniques from the students. I might suggest you save that for a true evaluation of planting beds in and around your school at a different time, possibly as an extension or independent project.

To create your soil samples, take soil from any source you have and create a basic soil, 7.5, a neutral soil, 6.5 – 7.0, a slight acid soil, 5.5 – 6.5, and a moderate acid soil, 4.5 -5.0. First get the soil and test pH by mixing a small amount of soil and distilled water to form a paste and placing paste on pH paper sensitive enough and with a broad range to evaluate 4.0 to 8.0 or use a commercial pH test kit following kit directions. To turn acid soil to base, you may add some quick lime or you may add chalk, white clay or Kaolin or even baking soda until the soil sample reads neutral to basic when tested. For turning basic soil to acidic soil, add peat moss, a commercial Sulfur containing pH adjuster or an Iron containing pH adjuster.

Find mulch samples by going to your local garden center, home improvement center or nursery. You may be able to ask if you could have a couple of pounds of each mulch from broken bags or damaged shipment containers, but even if you have to purchase the materials, you should be able to get small amounts for very little money.

Test the mulch by putting each type of mulch, a small amount (1-2 tablespoons) and an equal amount of water in a zip-lock and allowing to sit overnight and testing pH as you did with soil by pH strip OR follow pH kit directions.

Recommendations of which mulch to put on which soil will depend on the plant species paired with an incompatible sample soil pH. For the plant soil matching, make sure you match plants with sample soils that have a pH other than the one preferred by the plant species, so Azaleas would want to be paired with the soil sample with a pH in the neutral to basic range while Daylilies would be paired with a low pH soil of 4.5 or so.

Data and Results/Conclusions

Data collected will be pH reading of soil and of mulch which, when coupled with plant pH preference, will allow the student to draw conclusions about the appropriate mulch to use on the planting bed(s) they were assigned. Recommendations should be presented orally by presentation or can be communicated via a written report to the landscaping crew or Board of Education as the teacher allows.

Resources

For the information needed for this activity, the pH range a plant grows best in, searches uncovered many commercial garden/nursery sites and few government or professional society pages, much less peer reviewed materials. Role of pH in plant health may be searched and more objective information found but it doesn't really apply for the research required for this activity. The commercial sites mentioned are:

<http://homeharvest.com/>

http://www.gardenexpress.com.au/growing_guide/soil_ph_guide/soil_ph_guide.html

Budget

The majority of cost associated with this investigation is the pH testing kits if you chose to use them. Otherwise, pH testing paper is relatively cheap and you probably have it in stock in your Chemistry department. You may also consider a soil pH meter, cheap one from about \$6 at Lowes, I can't comment on accuracy or range but it looks like it measures from mid acid range (4.0) to slight basic (8.0). You may have to get ziplocks (cheap) and the mulching materials may be obtained from nurseries or garden stores for free from open/damaged bags or relatively cheaply in small batches. The leaves and cit

grass you can get free, make sure the grass had not been fertilized recently. Overall, I would guess the cost of the activity to be less than \$30. Below is the listing of possible plant and mulch materials to use in the simulation. pH preferences can be found online from the sites provided.

Plant Listing

Plant	Preferred pH Range	pH of soil	Recommended Mulch
Azalea			
Day Lilly			
Holly			
Hydrangea			
Juniper			
Petunia			
Privit			
Rose			
Wisteria			

Mulch Listing

Mulch Type	pH Value	Mulch Type	pH Value
Pine Bark		Peat Moss	
Pine Straw		Lava Rock	
Wood Chips (Oak)		Limestone Chips	
Leaves (Oak)		Pea Gravel	
Cypress Bark		Plastic Sheeting	
Cedar Bark		Recycled Tires	

If I can be of any assistance in helping you plan or implement this plan, feel free to contact me at the email addresses listed on the front cover page of this plan. Enjoy!