

Biology Related Problems

1. Safer substitutes are available, but are they as effective? Design an experiment to compare the substitute with the commercial product. Spend some time thinking about how to define effectiveness. Also be sure to do some research ahead of time so that your hypothesis has a sophisticated rationale.

Air freshener	Cinnamon and cloves (simmered)
Bathtub and tile cleaner	Baking soda; vinegar and water
Decal remover	Vinegar (soak in white vinegar)
Drain cleaner	Plunger; baking soda & hot water; vinegar & hot water
Furniture polish	Lemon oil (or juice) and mineral oil
General household cleaner	Baking soda
Hand cleaner for paint/grease	Baby oil
Ink spot remover	Cream of tartar, lemon juice & cold water
Insects on plants	Soap and water
Oil stain remover	White chalk (rubbed into stain before laundering)
Rug cleaner	Club soda
Rust remover	Lemon juice and salt and sunlight
Shoe polish	Banana peel
Slug repellent	Diatomaceous earth
Spot remover	Club soda; lemon juice; salt
Window cleaner	Vinegar (in warm water)
Wine stain remover	Salt

2. Some industrial and commercial organic wastes can be recycled into effective fertilizers, but are they as effective as synthetic fertilizers? Design an experiment to test this. Some organic fertilizers you can try:

- * Fish fertilizer
- * Rabbit "tea" (rabbit manure and water)
- * "Garden Thriller" (a homemade organic fertilizer made up of blood meal, bone meal, phosphate rock, granite dust, and kelp)
- * Algae
- * Planting soil
- * Any balanced organic fertilizer
- * Create one of your own

3. Are roly-polies attracted to dampness? There are several ways to make a damp side and a dry side in each dish. You can use two half-circles of paper, one damp and one dry for each dish. Or you can use sand, dry on one side and damp on the other. Damp sand packed hard holds its shape very well. One problem with using damp sand on one side and bare dish on the other is that you can't be sure whether the roly-polies are reacting to the dampness or to the texture of the sand. They do like to burrow. You can put dry sand on the other side, but then you have to deal with the problem of the dry sand wicking moisture from the damp sand. A strip of aluminum foil or plastic on edge between the two sides will help that. There's the same problem if you use wet and dry paper, but it can be solved with either a low barrier or a space to stop the wicking. Put only one roly-poly in each dish because they influence one another's behavior when together. Decide at the beginning how long you're going to wait to check the roly-polies' choice of sides (Give them several hours). The more roly-polies you test, the greater will be your confidence in your results.

4. Are roly-polies attracted to darkness? The bottom of the dish should be uniformly damp. Paper is probably preferable because the roly-poly may burrow in sand and thereby avoid the light. If you use dry paper you may get a quicker response to the light, but be aware that your roly-poly may dehydrate and die quickly without dampness in the dish.

PROBLEM SOLVING EXPERIMENTS WITH PLANTS

5. Can shredded Christmas trees be used as a mulch to enhance the germination of seeds and seedling growth?
6. Will different soil-less media cause seeds to germinate and grow at different speeds and will it effect the health of the seedlings?
7. Does electricity have an effect on seed germination and seedling growth?
8. Can pencil shavings be a source of nutrients for seed germination and seedling growth?
9. What effect will different brands of chewing tobacco added to soil-less soil have on seed germination and seedling growth?
10. Does the pH level of soil with added herbicide effect seed germination and seedling growth?
11. What effect does water with a high nitrate level have on seed germination and seedling growth?
12. Will adding different concentrations of burned ashes to soil effect seed germination and seedling growth?
13. Will scarified seeds germinate faster than untreated seeds?
14. Are some tools better to scarify seeds than others? Is a nail clipper better than a file?
15. How does scalding seeds (pouring boiling water over seeds) affect germination?
16. How will different soaking times in Clorox (bleach water) affect seed germination?
17. How will different soaking times in hydrogen peroxide (3%) affect seed germination?
18. Is seed germination affected by flowerpot's shape?
19. Is seed germination affected by what flowerpot is made out of?
20. Is seedling growth affected by flowerpot's shape?
21. Is seedling growth affected by what flowerpot is made out of?
22. Do cacti grow better in a wide or narrow pot?
23. Is there a ratio between pot size and stem diameter?
24. Is a clear plastic pot better than an opaque plastic container to grow plants in?
25. Will seeds germinate and grow better in hydroponic solution rather than potting soil?
26. Effect of cigarette smoke on the seed germination and seedling growth.
27. Effects of carbon dioxide gas on seed germination and seedling growth.
28. Does colored light affect the speed of seed germination?
29. Effects of different kinds (or flavors) of sports drinks on growth of plant cuttings.
30. Effects of different concentrations of hog manure on population growth of aquatic life.
31. Effects of secondhand cigarette smoke on the activity level of insects (make sure the firsthand smoke is not coming from you!).
32. Will storing different kinds of a name brand popcorn at various temperatures effect the amount of popcorn that is popped?
33. Does the kind of hybrid popcorn seed make a difference in the popping process?
34. What factors affect the oxidation of fruit? How do they interact?
35. Effects of different concentrations of acid rain pH on seed germination and seedling growth?
36. How will soaking times in citrus fruit juices (tomato?, orange?) affect seed germination?
37. Is there any advantage to adding a vitamin (example-A, C, D, other?) to starting mix of soil less soil for seed germination?
38. Is there any advantage to adding a vitamin to the water for seed germination?
39. Is there any advantage of varying the dosage of the vitamin to affect seed germination?
40. What happens to seed germination if combination of vitamins are used?
41. What happens to seedling growth if combination of vitamins are used?
42. Will seedlings grow better if exposed at night to ultraviolet light?
43. Will seeds germinate better if exposed at night to ultraviolet light?
44. Develop a new and cheaper substitute for vermiculite (plastic packing material? coffee grounds?, etc. And test to see if it works as well or better.
45. Develop or invent a starting mixture that is better for germination and seedling growth than commercial preparations.
46. Is bone meal (an organic phosphate product favored by organic farmers) superior to super phosphate as source of phosphorus for plants?
47. Is it better to water house plants by adding water from the top or by adding water to pan that

plant and container sit in?

48. Will plants grow larger and be healthier if given tea or coffee instead of plain water?
49. Will seeds germination be affected if seeds are given tea or coffee instead of plain water?
50. Develop or invent an automatic watering system that will provide a constant supply of water so that a plant will be neither waterlogged or too dry.
51. What color of light improves germination percentage?
52. What color of light shortens germination time?
53. What is the effect of radiation on seed germination?
54. What is the effect of citrus repellents on seed germination?
55. What is the effect of home brewed insecticides on seed germination?
56. Will the magnetic field of a horseshoe magnet affect the germination rate of radish seeds?
57. Will the magnetic field of a bar magnet affect the germination rate of radish seeds?
58. Will the magnetic field affect the growth of the seedlings?
59. Will the magnetic field affect the size of the seedlings?
60. Will the magnetic field affect the color of the seedlings?
61. Do results differ if magnets are above and beneath germinated seeds instead of in horizontal plane?
62. What is the effect of acid rain upon growth of roots of leaf cuttings (coleus?)?
63. Will adding organic materials to soil affect the growth of young cacti?
64. What are the effects of the age of the compost on bean plant height?

PROBLEM-SOLVING EXPERIMENTS WITH ANIMALS

Things to Remember: In investigations with living organisms, it is important to allow time for discovery! You need time to discuss the study, prepare materials, and do a trial run to work the “bugs” out of the procedure. At all times animals should be handled and cared for with respect!

SENSORY PERCEPTION:

65. Test the sense of smell of animals: Will they respond to food placed several inches away? At what distance is there no response?
66. What is the response to a vibratory stimulus? Will they respond to vibrations?
67. What is the response to gravity? What effect does gravity have on their ability to move? Will they move horizontally and vertically at the same speeds? Is their weight a significant burden? Do those with heavier weights move slower than lighter one?
68. Do they have a “righting” reflex? (Will they turn over and right themselves if placed on their backs?)
69. Do they show any preference for rough or smooth surfaces--sand, mud, rocks with sharp points, or earth?
70. Test the sense of touch to touch (tactile response) using a feather or the blunt end of a glass rod to test various areas of body. --Are all areas of body equally sensitive to touch?
71. Test the effects of light. Set up the terrarium so that one end is dark and the other light. Where do not animals congregate? Experiment with light of different colors (wavelengths) by using colored cellophane paper or colored saran wrap. --Do they prefer red or blue light, or can they not tell the difference?
72. How do sow bugs respond to heat? (cover the outside of a jar with black paper and place a bulb 3-0 feet from it)
73. Testing echolocation ability. Place a barrier a determined distance from a blindfolded person. Tell the volunteer to locate the position of the barrier just by honking a horn in different directions and listening for differences in the echo of the horn. What are some of the ways by which a person might become better at echolocation? Repeat the activity to see if your volunteer’s ability to listen for the barrier gets better with practice.

LOCOMOTION:

74. Measure the top speed at which they can travel. Prepare a bull’s eye chart with concentric circles 5

mm apart. Start animal in the center and time its travel in one minute. Do this several times, rounding off the figure to the nearest millimeter. Is there much variation in distance traveled?

75. Devise a method to determine the weight a snail can pull. It is reported to be able to pull 200 times its own weight, which is equivalent to a man pulling eight full-sized automobiles. Place varying loads directly on the snail's back and determine the maximum load it can carry. How much weight can it pull up an inclined surface?

Example: with a thread, attach increasing amounts of plasticine to a vertically climbing snail until it comes to a stop. **Do not over stress the animal.** Observe its method of moving now. How much weight can it move in this way? How much can it lift relative to its body weight? Compare this to what a human can lift.

76. When a land snail is placed on a sloping surface, it will usually creep uphill, not down. If, as it moves uphill, the surface is rotated (from a central pivot) so the snail's body becomes horizontal and begins to move downward, the snail can reorient itself and begins an upward course. This is called a **geotactic** response. Conduct an experiment to show whether this response is due to air currents on the animal's tentacles or to other factors.

COPING WITH TEMPERATURE:

Temperature controls the speed of chemical processes, including those that affect the functioning of the organism.

77. Effect of temperature on memory of an insect.

78. Will behavior learned as a larva meal worm be retained in the adult or lost during metamorphosis?

79. Effect of thermal acclimation on temperature selection by an invertebrate.

80. Does temperature affect the speed of cold-blooded animals?

81. Will they move faster when the temperature becomes warmer?

82. What are the effects of temperature on the heartbeat of *Daphnia*?

FOOD PREFERENCES:

83. Will a food type not eaten in a choice experiment be eaten if it is the only food available?

84. Does the temperature of the environment alter food consumption?

85. Do adult animals that have stopped growing, eat more or less than younger growing animals?

OTHER IDEAS:

86. Will different concentrations of aloe vera plant juices effect the regeneration of planaria?

87. Will different colors of flour affect the behavior and activity of flour beetles

88. Can pollutants cause insects to grow larger? live longer?

89. Review the ideas above for projects with plants. Which ones could easily be altered to be done with an invertebrate rather than a plant?

Many of these problems could be done using a variety of invertebrate animals. Commonly used by my students are cockroaches, crickets, land snails, planaria, *daphnia*, ants, and earthworms & nightcrawlers.

PROBLEM SOLVING EXPERIMENTS WITH OTHER ORGANISMS

90. What effect will different brands of sunscreen have on the growth of bacteria exposed to UV radiation?

91. What effect will sunscreen have on the growth of bacteria exposed to different time doses of UV radiation?

92. Will sharing hairbrushes spread bacteria?

93. Effects of herbal extractions on growth of bacteria.

94. Compare effects of solar and boxed U-V radiation on yeast growth.

95. Effects of environmentally safe antifreeze on the growth of bacteria.

96. Effect of different pHs (acid rain) on aquatic protist life.

- 97. Effects of cigarette smoke on population density of yeast.
 - 98. Effects of car exhaust on population density of bacteria.
 - 99. Is there more bacteria in fast food restaurant ice or their toilet water?
 - 100. Review lists of ideas with plants and invertebrates. Which ones could easily be altered to be done with a fungus, protist, or monera?
- Many of these problems could be done using a variety of microorganisms.** Commonly used are different aquatic algae, different aquatic protozoa, mold, yeast, and bacteria.

MORE IDEAS

- 101. What are the effects of slope angle on the amount of erosion?
- 102. How do minerals in water affect its ability to form suds?
- 103. How does temperature affect the curdling of milk?

Most of these ideas are from:

Williams, Judy. Access Excellence. National Health Museum. 11 June 2005

<<http://www.accessexcellence.com/AE/ATG/data/released/0327-JudyWilliams/index.html>

NEED HELP THINKING OF YOUR OWN?

- * What materials are readily available?
 - * How does your test subject normally act?
 - * How can you change the set of materials to affect how your subject acts?
 - * How can you measure or describe the response of your subject to the change?
 - * Your Investigative Question: How does (the change) affect (your subject) ?
- * Brainstorm a list of possible factors you can control.
 - * What noticeable and measurable characteristics would possibly be affected by those factors?
 - * Form some possible "cause" and "effect" relationships between the two.
 - * Write some possible Investigative Questions...which one would you like to answer?