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| Experimental Procedure:  Materials used:  1) 144 radish seeds (Raphanus sativus), scarlet white tip, Lilly Miller brand.  2) 4 level tablespoons of rye grass seeds.  3) Four 3 Liter plastic boxes measuring 10.5îX15îX5.5î.  4) A (metric with inches as well) ruler to take measurements.  5) Power drill  6) Thermometer  7) A barbecue was used to heat the soil  8) Redwood compost  9) Garden soil  10) 4 Garbage bags  11) Large metal baking dish the same size as the plastic boxes in number 3.  12) Microscope  13) Camera  14) Small shovel  15) Sharpie  16) Masking tape  17) Potholders  18) Knife  19) Paper towels  20) Scale  21) Sandwich bags  22) Pipette  23) Slides and cover slips  Trial One:  10/8/00:  1) Use a power drill to drill 6 evenly spaced holes for drainage in the bottom of each of the plastic boxes. Set aside.  2) Mix a large amount of soil and redwood compost so that it is one part garden soil to two parts redwood compost using the small shovel.  3) Pour enough of this mixture into a plastic bin to fill it two inches from the top. Pour this soil into the metal baking dish.  4) Turn the barbecue on to 400 degrees Farenheit. Put the metal baking dish of soil into the barbecue after it has warmed up for about 10 minutes. Let the soil sit for 10 minutes, then remove carefully from the barbecue using potholders. Measure and record the temperature of the soil by inserting the thermometer in the middle of the dish.  5) After letting the soil cool to approximately room temperature, I poured it into a garbage bag and labeled it, tying the top in a knot.  6) Repeat steps 3 through 5 letting the soil remain in the 400 degree oven for 20 and 30 minutes, respectively. These batches of soil heated for different lengths of time will be used to show any pattern that may exist in plant growth due to the heat.  7) Create a control sample in the same way but with no heating. This control will show what would occur if no changes occurred. If the control was not present, any growth shown in the other boxes could not be compared accurately.  If the prediction is correct, then I would expect to see the most growth in the control box, then slightly less growth in the 10 minute box, even less in the 20 minute box, and the least amount of growth in the 30 minute box.  Note: Because I was using the greenhouse at school I carried all the supplies need for planting to school. This is why the garbage bags were needed. Due to certain circumstances I was unable to plant until the 14th. Also, while I was heating the soil our barbecue ran out of propane and the batch of soil had to be rushed into the house. The oven may not have had the same affect. Another worry was that the soil did not actually reach temperatures high enough to kill certain bacteria and organisms. This was a major concern in my experiment. People that I asked for advice at Orchard Supply in Livermore and a local nursery in Pleasanton had said that if soil is heated too high certain elements may change and actually become poisonous. They also said that I should not use any soil I do not know the history of. If it had been sprayed with pesticides or had fertilizers in it, harmful fumes could result from heating. Because of this I did not want to heat the soil to too high a temperature, but it is unlikely a barbecue could reach that high a temperature anyway.  10/14/00:  8) Open the bags and pour the contents into separate boxes, labeling each with the time heated on tape with sharpie.  9) Make 12 holes evenly spaced, 6 holes by 2. Make them a half inch in depth and plant 3 seeds in each hole. Cover the seeds, pat gently.  10) Water each box with a liter of water.  I had wanted to have a regular watering schedule, but it was difficult because some days the boxes seemed to need more or less water. I made a list of how much I watered and when after the 14th:  10/16/00--1 liter per box  10/17/00--1 liter per box  10/24/00--1 liter per box  10/25/00--.5 liter per box  10/26/00--1 liter per box  10/27/00--.5 liter per box  10/31/00--.5 liter per box  11/2/00--1 liter per box  11/9/00--1 liter per box  11/14/00--.5 liter per box  11/16/00--.5 liter per box  11/19/00--1 liter per box  11/25/00-1 liter per box  11/28/00--1 liter per box  10/21/00:  11) On this day I began to thin out the radishes. I consistently pulled up the smaller looking of the extra radishes in each space, leaving a total of 12 in each box.  10/23/00  12) I finished thinning out the radishes.  Note--In one box, two of the radishes that had been left after thinning were mysteriously dead. This was probably due to another student using the greenhouse. The significance is merely that the sample size was minimized.  Due to winter break (11/20--11/28) I had to take the experiment home. During the move of the radishes, one plant was damaged slightly and due to the different environment the plants suffered slightly. They fell victim to aphids and were sprayed with insecticide on 11/26/00. Because they all received the same treatment I hoped that the data would not be significantly altered.  12/1/00:  13) I took measurements on the radishes.  For each box: Pull up the radishes and rinse clean under water. Pat dry with paper towels. Save some soil collected from each corner of the box to examine later by sealing it in a labeled sandwich bag.  For each radish: place the radish on the scale, using a beaker if necessary. Record mass. Take the next measurements in centimeters. Measure the length of each leaf; record. Measure the length of the root from the tip to the base of the leaves; record. Cut the radish root on its circumference at the widest point so that the diameter may be recorded. Use a camera to take any pictures that may be helpful.  12/8/00:  14) I used a school microscope to examine the soil for microorganisms. It was difficult to find a way to sample the soil in a legitimate way. This is a major flaw in the experiment. To make slides, I added water to the bag of soil, moving it around the entire bag. I extracted a few drops of the water with a pipette and examined it for living organisms and sketched any that I saw. I made several slides for each boxís dirt, but, as I said, it was difficult to do this in a structured way. If I did not find any life after 5 slides I would move onto the next box. When I did find something living I would sometimes return to other boxes to look again, but this was a tedious way to look for microorganisms.  Trial Two:  For the second trial I decided to use rye grass because the results from the first trial convinced me I needed a larger sample size. Rye grass also grows fast and does not have leaves as large as radishes which were difficult to measure. The soil mixture I used for this trial was also different. This time there was a higher percentage of garden soil. I hoped that this way I would be able to see more microorganisms and that their effects, if any, would be more obvious.  2/4/01:  1) Clean the boxes from the previous trial and set aside.  2) Make a mixture that is 25% redwood compost and 75% garden soil.  3) Follow the same steps 3 and 4 from Trial One.  4) Instead of transporting the soil in garbage bags I transferred it directly into the plastic boxes.  2/5/01:  I carried the boxes to school and stored them in the greenhouse.  2/9/01:  5) Remove a half in of soil from each box.  6) Scatter a tablespoon of rye grass seeds evenly in each box, replace the soil and pat gently.  7) Water each box with a liter of water.  Here is the watering log for the second trial:  2/14/01--.5 liter per box  2/16/01--1 liter per box  2/21/01--.5 liter per box  2/23/01--.5 liter per box  2/27/01--.5 liter per box  3/1/01--.5 liter per box  3/2/01--1 liter per box  3/5/01--1 liter per box  3/7/01--1 liter per box  (After this point I was sick and the boxes were neglected. When I returned they were in poor shape, so the next few weeks I spent reviving them. It was also much warmer in the greenhouse and they dried out more than the first trial had in the winter. Most excess water simply drained out.)  3/12/01--2 liters per box  3/13/01--2 liters per box  3/14/01--1 liter per box  3/15/01--1 liter per box  3/16/01--2 liters per box  3/19/01--2 liters per box  3/20/01--1 liter per box  3/21/01--1 liter per box  3/22/01--1 liter per box  3/23/01--2 liters per box  3/26/01--2 liters per box  3/28/01--2 liters per box  3/29/01--1 liter per box  3/30/01--2 liters per box  4/2/01  I took measurements. The roots of the rye grass were very fibrous (as the photo shows) and I could not pull them up without damaging them, so the only measurements I could take were on the blades of the grass. I took 20 from different areas of the box, for each box. I would pull up the grass, then rip off any roots below the green portion of the stem. It was difficult to tell where the ground level was on the plant because some of the white grew above the ground and there was no other reference point on the plant, so I just ripped off the white portion by the roots. I massed each plant and recorded the values. I measured the length of the plant as well. I saved some of the soil from each box in sandwich bags to examine later. I used a camera to take pictures of the grass and roots as I took my measurements.  4/7/01:  On this day I examined the soil from the second trial in the same manner that I did for the first trial. I found the same number of organisms (about 2 in all boxes after over 20 samples).    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