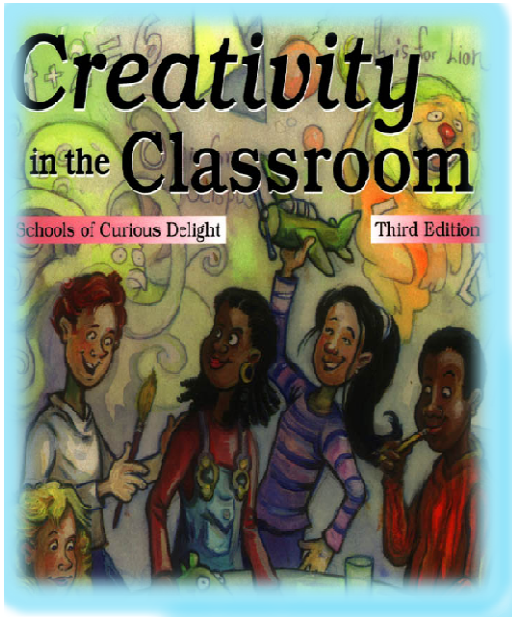

Choosing a science fair project idea

-Memilah ide untuk proyek festival sains

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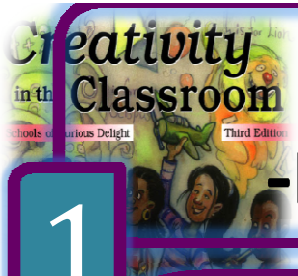

Choosing a science fair project idea
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1

Start by asking yourself some simple questions. What school subjects are your favorites? Biology? Chemistry? Physics? Or is it gym class? What are your hobbies? What do you enjoy doing? What books do you read? What are your special talents or skills? You may get some ideas by looking through magazines and newspapers, or visiting libraries or museums. "Brainstorm" as many topics as possible, and write them all down.

- Mulailah dengan mengajukan pertanyaan-pertanyaan sederhana pada diri anda.

Misalnya: Pelajaran apakah yang paling anda sukai, biologi, kimia, ataukah fisika? Apakah hobi anda? Pekerjaan apa yang anda senangi? Buku apa yang anda baca? Apakah bakat dan kemampuan anda?

- Selain bertanya pada diri sendiri, ide juga bisa didapat dengan membaca majalah atau koran, maupun mengunjungi perpustakaan atau museum.

- Carilah ide sebanyak-banyaknya dari beragam topik, dan tuliskanlah agar ide yang telah didapat tidak terlupakan.

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2

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Once you have a general subject you are interested in, you must narrow it down. For example, you may have a biology science fair idea, but that is much too general a subject. Even plants is too general a science fair topic. Narrow it down to something more specific, for example: "Which type of plant food produces bigger tomatoes?" Put your question into a form like: What happens when....? or Which is bigger, better, faster, easier....? or Why does something happen? or Can changing this cause that to change? Remember, the more specific the question, the better.

- Ketika telah menemukan tema besar yang dirasa cocok, anda harus mengubahnya menjadi topik yang lebih spesifik.

Sebagai contoh, ketika anda memilih tema 'biologi' sebagai tema proyek, tema tersebut masih terlalu luas; anda harus mengubahnya menjadi topik yang lebih spesifik. Topik 'tumbuhan' pun masih terlalu luas untuk sebuah topik proyek pada festival sains.

- Apa yang harus dilakukan? Gunakan sebuah pertanyaan untuk menuntun anda menemukan topik yang lebih spesifik; misalnya saja "Apakah tipe makanan-bagi-tanaman yang menjadikan tanaman tomat menghasilkan buah yang lebih besar?".
- Lalu bagi pertanyaan tersebut dalam pertanyaan-pertanyaan lain yang berbeda, seperti ; Apa yang terjadi ketika. . . ? atau Manakah yang lebih besar, lebih baik, lebih cepat, lebih mudah. . . ? Atau mengapa itu terjadi? Atau Bisakah mengubah ini untuk menyebabkan itu berubah?
- Hal yang perlu diingat adalah: semakin spesifik pertanyaan, maka akan semakin baik

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3

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After you determine your question, you need to develop a hypothesis, which is your best guess about the answer to your question. For the tomato example, your hypothesis might be: I think the plant food with the most nitrogen will produce the biggest tomatoes. Or it might be: I think the plant food with the most trace minerals will produce the biggest tomatoes. It is a good idea to do a little bit of research so that you can make an "educated guess" when deciding on your hypothesis.

- Setelah itu, buatlah sebuah hipotesis yang merupakan perkiraan terbaik anda untuk menjawab pertanyaan tersebut.

- Sebagai contoh,
hipotesis anda bisa saja: saya pikir makanan-bagi-tanaman yang paling banyak mengandung nitrogen menjadikan tanaman tomat menghasilkan buah yang paling besar, atau, saya pikir makanan-bagi-tanaman yang paling banyak mengandung mineral menjadikan tanaman tomat menghasilkan buah yang paling besar

- Sebuah tindakan yang baik ketika anda melakukan penelitian pendahuluan untuk membuat sebuah hipotesis yang lebih terarah

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4

Choosing a science fair project idea
-Memilah ide untuk proyek festival sains

There are two other things that are important to consider when choosing your science fair project idea. First, make sure the experiment is do-able: Are the information and materials for your topic available? Is there enough time? (Growing tomatoes will take several months, which would be a problem if you only have a few weeks until the fair.) Can you do the project yourself, or will you need a lot of help? And the second thing to consider is to make sure that it will be safe to do your experiment.

Ada dua hal yang harus dipikirkan ketika memilih topik untuk proyek festival sains:

- Pertama, pastikan proyek tersebut dapat dilakukan: Apakah informasi dan bahan untuk topik proyek tersebut tersedia? Apakah tersedia cukup waktu? Dapatkan proyek tersebut dilakukan sendiri atau memerlukan bantuan orang lain?

- Kedua, pastikan proyek tersebut aman untuk dilakukan

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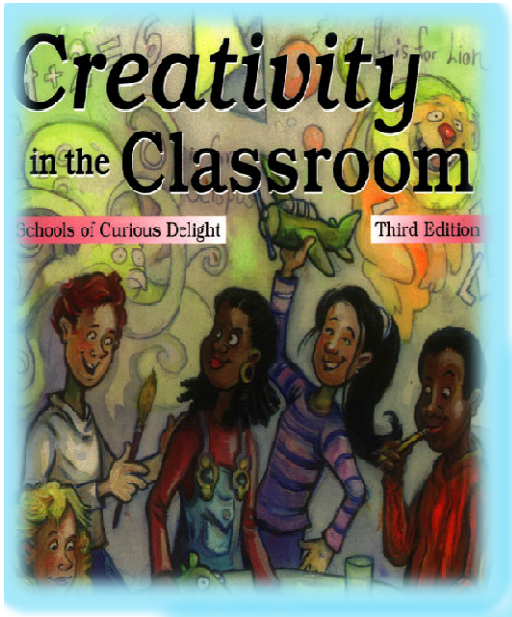

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1 -M

Make a list of the variables that will influence your experimental outcome. In the case of the tomatoes, this would include soil, light, water, temperature and, of course, fertilizer. Your experiment will have two or more similar parts. All of the variables, except the one you are testing, must remain the same for each of these individual tests. If more than one variable changes, then you will not know which one caused the results you observe.

- Buatlah daftar variabel yang mempengaruhi hasil eksperimen. Misalnya: tanah, cahaya, air, suhu, dan pupuk.

- Eksperimen anda akan memiliki dua atau lebih bagian yang sama.

- Semua variabel, kecuali satu yang diujicobakan, haruslah sama pada setiap aspeknya. Jika lebih dari satu variabel berubah, maka anda akan kesulitan menentukan apa penyebabnya

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2 -M

In the tomato example, all of the plants must get identical amounts of water, light, heat and soil. Insect damage must be minimized. The only difference would be in the amount of carefully measured fertilizer each plant would receive. One set of plants should get no fertilizer; these plants are called the "control group."

- Sebagai contoh, semua tanaman haruslah mendapatkan porsi yang sama dalam hal jumlah air, cahaya, panas, serta tanah. Serangan serangga haruslah diminimalisasi.

- Satu-satunya porsi yang berbeda adalah jumlah pupuk yang diterima setiap tanaman.

- Pada salah satu kelompok tanaman tidak diberi pupuk sama sekali; kelompok tanaman inilah yang disebut sebagai *kelompok kontrol*.

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3 -M

You must also decide ahead of time what you will measure to determine the outcome of the experiment. In this case, it could be the number and/or size (circumference, weight) of the tomatoes.

⌗ Anda juga harus menentukan kapan eksperimen dinyatakan berakhir. Dalam hal ini, bisa saja berupa jumlah dan/atau ukuran (keliling, berat) tomat

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4 -M

Write down the procedure for your science fair experiment, and include a schedule for completing all the steps and a list of materials you will need.

- Tuliskan tahapan eksperimen; termasuk di dalamnya jadwal pelaksanaan serta daftar bahan yang dibutuhkan

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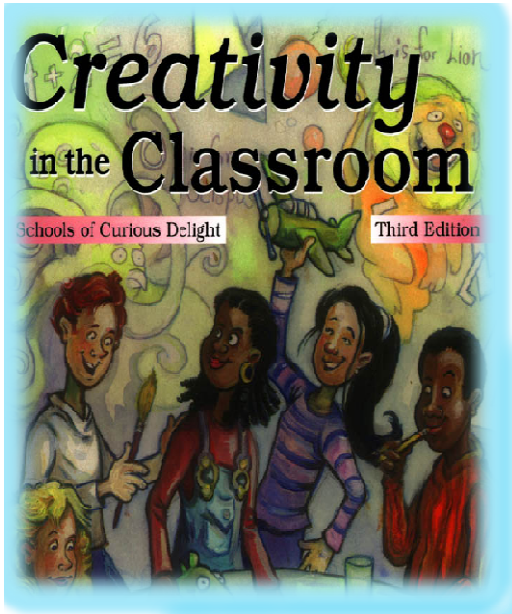

Choosing a science fair project idea

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1

Whether you are doing an elementary science fair project, or a high school or middle school science fair project, there are several important things to keep in mind while you perform your experiment. It is extremely important to make careful and detailed observations and measurements. There are two kinds of observations you can use; quantitative observations and qualitative observations.

- Berikut ini beberapa hal penting yang perlu diperhatikan saat pelaksanaan eksperimen.

- Sangatlah penting untuk melaksanakan observasi dan pengukuran secara hati-hati dan mendetail. Terdapat dua jenis observasi yang bisa dilakukan: observasi kuantitatif serta observasi kualitatif

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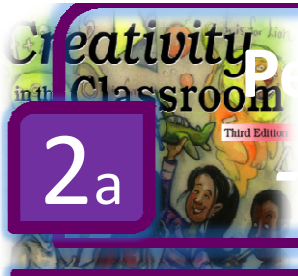

2a

1. Quantitative Observations. This involves measuring variables, which could be size, weight, time, distance, number of things, etc. In the tomato example, there are many variables you could measure: the height of the plants, the number of leaves, the number of tomatoes, the circumference and weight of the tomatoes. Which of these variables are most important to testing your hypothesis?

- Observasi kuantitatif merujuk pada pengukuran variabel, bisa saja berupa ukuran, berat, waktu, jarak, jumlah, dsb.
- Sebagai contoh, beberapa variabel yang dapat diukur; tinggi tanaman, jumlah daun, jumlah tomat, keliling dan berat tomat.
- Namun, dari beberapa kemungkinan tersebut perlulah dipilah mana yang paling penting untuk menguji hipotesis

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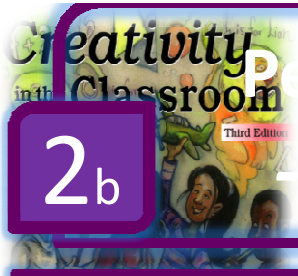

2b

2. Qualitative Observations. This is describing your observation in words. How did something look, or smell or feel? What happened when you did or changed something. If possible, draw a diagram or take a picture or video to help record and explain what you see. You should also record any problems you have. For the tomato example, this could include a description of which plants are bushier or seem more vigorous, which have greener leaves, which tomatoes are brighter red, whether there were any insect problems, etc.

- Observasi kualitatif merujuk pada pendeskripsian observasi menggunakan kata-kata.
- Hal ini tentang bagaimana sesuatu terlihat, bau, serta rasa. Juga tentang apa yang terjadi ketika dikenai perlakuan atau perubahan.
- Gambaran berupa diagram, foto, ataupun video juga dapat digunakan untuk merekam serta menjelaskan apa yang dilihat.
- Pada contoh, observasi ini dapat saja berupa deskripsi tanaman yang lebih lebat, daun yang lebih hijau, tomat yang warna merahnya lebih cerah, yang memiliki masalah serangga, dsb

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3

ALL parts of your science fair experiment MUST be recorded in a notebook or journal of some kind. This includes all the experimental steps you perform and all of your observations. Record the entries in the notebook immediately; do not wait until later, and then have to rely on your memory. For the tomato example, record how many seeds are planted and when, how much fertilizer is given to which plants, when the plants are watered, how many flowers you see, and finally, the measurements of the harvested tomatoes.

- Semua bagian pada eksperimen haruslah terekam dengan catatan pada sebuah buku khusus; termasuk semua tahapan eksperimen dan semua observasi yang telah dilakukan.

- Segeralah mencatat data yang ada dan jangan menunda.

- Pada contoh, catatlah berapa biji tomet ditanam dan kapan, berapa pupuk yang diberikan pada tanaman yang mana, kapankah tanaman disiram, berapakah bunga yang nampak, dan ukuran tomat yang telah dipanen

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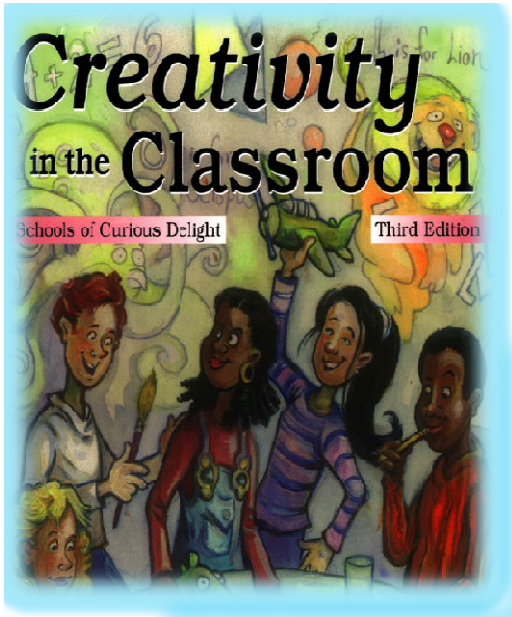

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1

Now that the experiment is done, it is time to analyze your results and draw conclusions. The results may support your hypothesis, but don't get discouraged if they do not. Negative results are common in science experiments, and will not adversely affect how judges view your science fair project. Do NOT try to change any data to support your hypothesis.

- Saat ekperimen telah selesai, maka analisis hasil dan pengambilan kesimpulan dilakukan.
- Hasil eksperimen dapat saja mendukung ataupun tidak mendukung hipotesis.
- Hasil yang tidak mendukung hipotesis (atau disebut sebagai hasil negatif) adalah sesuatu yang wajar dan tidak mempengaruhi pandangan penilai terhadap proyek yang telah dilakukan.
- Dilarang mengubah data eksperimen untuk mendukung hipotesis.

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2

You must take the raw data - the observations and numbers you recorded- and analyze it to draw a conclusion. Perform any calculations needed. Make graphs or charts to show changes or compare outcomes. Which variables had the biggest effect? Summarize your results and state a conclusion.

- Data mentah (data hasil observasi dan jumlah yang tercatat) diperlukan untuk dianalisis guna mendapatkan kesimpulan dari eksperimen.
- Penghitungan juga perlu disertakan. Grafik dapat pula digunakan untuk menunjukkan perubahan atau membandingkan hasil.
- Ringkasan hasil eksperimen dan observasi serta pengambilan kesimpulan siperlukan teutama untuk mengetahui variabel manakah yang memberikan pengaruh terbesar

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3

Was the outcome what you expected? If so, that's great. Your conclusion would be that your data support your hypothesis. It is important to note that you can NOT PROVE the hypothesis with your experiment. You can only say that the data support or do not support the hypothesis.

- Bagus jika hasil eksperimen sesuai dengan yang diharapkan sehingga sesuai dengan hipotesis.

- Namun, hal itu tidak dapat dikatakan bahwa ‘hipotesis terbukti/tidak terbukti melalui ekperimen yang dilakukan’ namun hanya dapat dikatakan bahwa ‘data mendukung/tidak mendukung hipotesis’

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4

If the results were not what you expected, you should review your hypothesis, experimental design and procedures to try to determine why not. Was there an error in your design or the way you conducted the experiment? Was your hypothesis incorrect? Analyzing why your results were different than expected is a necessary and important part of any science experiment.

- Jika hasil tidak sesuai dengan yang diharapkan, maka perlu dilakukan *review*/tinjauan ulang terhadap hipotesis, desain eksperimen, serta tahapan pelaksanaan eksprimen untuk mengetahi mengapa ketidaksesuaian tersebut terjadi.
- Apakah ada yang salah dengan desain atau pelaksanaan eksperimen? Apakah hipotesis kurang tepat?

- Analisis terhadap penyebab berberbedanya dengan yang diharapkan merupakan sesuatu yang juga penting dan diperlukan pada eksperimen sains.

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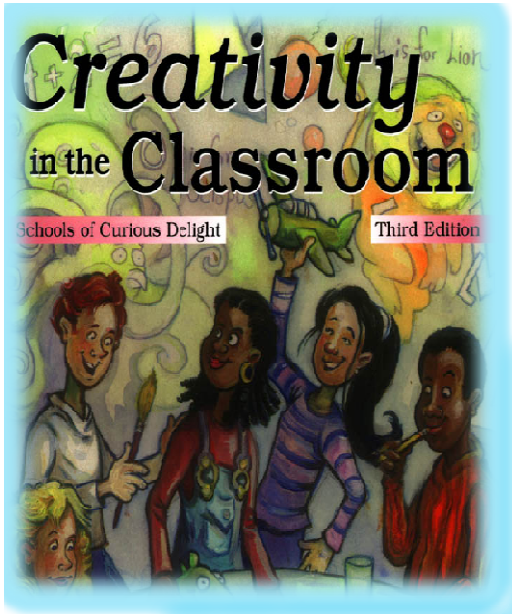

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Your science fair display board will be the way you present your project to the world. It is how your project will be viewed and judged. You worked hard to pick a great project, design and conduct a valid experiment and reach conclusions. Now, make sure to put the same care and thought into your display and presentation.

- Papan pajang merupakan cara mempresentasikan proyek pada banyak orang.

- Dengan papan pajang, proyek anda akan dilihat dan dinilai.

- Kesungguhan anda saat menentukan topik, merencanakan, melaksanakan, dan menyimpulkan hasil eksperimen pada proyek ini juga perlu ditunjukkan saat pameran dan presentasi.

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2

The keys to a good science fair display are simplicity, clarity and neatness. Make sure that the judges can understand your hypothesis, experiment and conclusions quickly and easily. Everything must be neat, organized and lined-up well. No sloppy work, crossed-out words, erasure marks, pictures falling off, etc. And triple-check your spelling!

⌗Kunci utama pada display festival sains yang baik terletak pada kesederhanaan, kejelasan, serta kerapihan.

⌗Jadi, pastikan tim penilai memahami hipotesis, eksperimen, serta simpulan dengan cepat dan mudah.

⌗Semua hal haruslah rapi dan terorganisir; hindari kerja yang tidak rapih, kata yang kacau, bekas tulisan yang telah dihapus, gambar yang jatuh, dsb.

⌗Satu hal yang tak kalah penting: pastikan ucapkan kalimat presentasi dengan benar

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1-2A Field Trip to the Schoolyard — Core Lab

Skill Check

- Observing
- Predicting
- Measuring
- Working co-operatively

You can find living things almost anywhere if you look carefully. Even if your schoolyard is mostly paved over, there is a good chance there will be dandelions and grass growing somewhere. Almost certainly there will be birds, insects, and small organisms living in the soil. The abiotic parts of the ecosystem affect each of these organisms.

Question

What abiotic and biotic factors can you observe and measure in your schoolyard ecosystem?

Safety

- Do not handle any organisms with bare hands.
- Handle the magnifying glass and thermometer carefully so they do not break.
- If you disturb the habitat, be sure to return it to its original condition.
- Do not harm organisms in your study site.

Materials

- notebook
- drawing paper
- pen or pencil
- magnifying glass
- binoculars
- camera
- thermometer
- light meter
- wind-speed recorder
- field guides

Procedure

1. Choose an area of your schoolyard suitable for study, where you can observe some living plants and animals.
2. Brainstorm possible questions to investigate when studying the schoolyard ecosystem. For example, make a list of organisms you predict you might observe. How might the amount of sunlight affect the types of plants growing there? How might soil conditions affect animals such as earthworms?
3. In groups, decide how you will make and record your observations.
4. Prepare tables in your notebook to record the measurements you will take.
5. When you arrive at your study site, sit quietly and observe it. Record the general abiotic conditions and list any organisms you see. Note any signs of organisms such as spider webs, burrows, feathers, or seeds.
6. Walk slowly around your study site and record all of the organisms that you encounter. Use field guides to help you identify them if you have time. You may sketch or photograph organisms for later identification.

   NOTE: Do not pick or break plants or damage flowerbeds. If you turn over a rock or log to see what is underneath, replace it afterwards.
7. Record and measure some of the abiotic conditions where each organism is found. For example, what is the temperature of the air or soil? Is the location exposed to light or is it shaded? Is the area damp or dry? Is the soil sandy or clay-like?

Analyze

1. Make a list of all the organisms recorded by your class. Compare it with the list of organisms you predicted might be present.
2. Briefly describe how the abiotic conditions you recorded might affect one type of (a) animal and (b) plant.

Conclude and Apply

1. Explain why you might get different results if you conducted your study during the summer holiday.
2. Name an animal or plant that you know lives in your province but does not live in your schoolyard ecosystem. Explain why it does not live there.
3. Suggest some ways in which your schoolyard ecosystem might change if a pond was added to it.

2-2C The Dirt on Decomposers

Skill Check

- Observing
- Predicting
- Controlling Variables
- Interpreting Data

Safety

- Do not handle the soil with bare hands.
- Dispose of soil and vegetable matter as directed by your teacher.

Materials

- 2 identical large plastic pots (approx. 750 mL) with drainage holes
- saucers to go under pots
- pieces of window screen or similar mesh
- magnifying glass
- small stones
- labels for pots
- garden soil (not sterilized)
- sterilized soil
- water
- measuring cup
- approximately 500 mL of waste vegetable matter such as peels from carrots, apples, or potatoes, or leaves from cabbage or lettuce

Most decomposers are microscopic and cannot be seen with the naked eye. However, you can see the results of their work in this activity!

Question

How do different variables affect the activity of decomposers?

Procedure

1. Based on what you know about decomposers, predict what will happen to waste vegetable matter when buried in
   (a) garden soil.
   (b) sterilized soil. (Soil has been sterilized by placing it in a hot oven to kill any organisms in it.)
2. Work in small groups. Place each pot on a saucer and put a few small stones over the drainage holes in each pot.
3. Add garden soil to one pot until it is about half full. Add the same amount of sterile soil to the second pot. Label each pot.
4. Place half of the vegetable matter in each pot.
5. Cover the material in each pot with more garden soil or sterilized soil as appropriate until the pots are nearly full.
6. Estimate the volume of water you can add to each pot before water begins to empty from the drainage holes. Measure this volume into a measuring cup. Add the same amount of water to each pot.
7. Cover both pots with a piece of window screen.
8. Place the labelled pots in a secure location where they can remain for three or four weeks. Moisten the soil every few days if necessary, adding the same amount of water to each pot.
9. After a week, remove the uppermost layer of soil and observe the condition of the vegetable matter in each pot. Use a magnifying glass. Record your observations. Replace the soil.
10. Continue your observations until there is a clear difference between the vegetable matter in the two pots.
11. Wash your hands thoroughly after completing each part of the experiment. Clean up your work area as your teacher directs.

Analyze

1. Did either of the samples have little or no sign of decomposition? Suggest why.
2. Did your observations support your hypothesis in step 1? Explain.
3. What variables were controlled in this activity? What was the responding variable?

Conclude and Apply

4. What factors might speed up the decomposition of the materials you studied?
5. What factors might slow down the decomposition of the materials?
6. Based on this activity, design an experiment to observe the effect of one of the following variables on the growth of micro-organisms: temperature, moisture, light, acidity, or salinity. Outline your materials and procedures, using diagrams if necessary.

5-2C Race for the Top

Skill Check

- Observing
- Predicting
- Controlling variables
- Evaluating information

You already know that liquids expand when heated. You have used laboratory thermometers that can measure temperature because the liquid expands by a known amount. Thermometers are calibrated so that the degree marks match the amount of increase in the volume of the liquid when the temperature increases by one degree. Do all liquids behave in exactly the same way? (Your teacher may choose to demonstrate some or all of the steps for you.)

Safety

- Ethanol is poisonous. Be careful to wipe up any spills.
- Be careful when handling hot water.

Materials

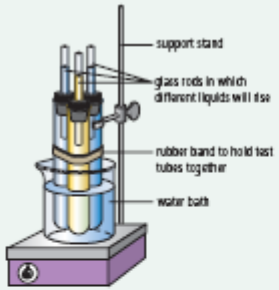
- 3 liquids (coloured water, ethanol, and cooking oil)
- 3 large test tubes
- 3 one-hole stoppers with 50 cm pieces of glass tubing inserted
- laboratory stand and clamps
- rubber bands
- markers
- 2 large tin cans or 500 mL beakers
- very hot water
- ice-cold water

Question

Do all liquids expand by the same amount when they are heated?

Hypothesis

Make a hypothesis about the expansion of different liquids when they are heated to the same temperatures.



Procedure

1. Completely fill one test tube with coloured water, the second with ethanol, and the third test tube with cooking oil. Insert a stopper in each test tube so that there are no air bubbles and the liquid rises a few centimetres up the glass tubing.
2. Hold the test tubes together with the rubber band so that the liquids are at the same level in the glass tubing.
3. Arrange the apparatus as shown in the diagram.
4. Use the markers to mark the starting height of each liquid on the glass tubing.
5. Pour the hot water into the beaker around the test tubes. Watch the heights of the liquids closely as the liquids warm.
6. Before the liquids overflow the glass tubes, lift the apparatus out of the hot water and put it into the ice-cold water.
7. Continue to watch the height of the liquids as they cool.

Analyze

1. Did all of the liquids expand by the same amount as they warmed? If not, answer the following questions.
   (a) Which liquid expanded the most?
   (b) Did the liquid that expanded the most as it warmed also contract the most as it cooled?
2. At the end of the activity, did the liquids return to their original heights in the tubes? Did you expect them to do so? Explain.

Conclude and Apply

3. Based on your observations, do all liquids expand and contract the same amount when they are heated and cooled?
4. Explain which of the liquids that you tested would be most suitable for making a thermometer that could be used to
   (a) show small changes in temperature clearly
   (b) measure large changes in temperature without the thermometer being too large
   Explain the reasoning for your answers to (a) and (b).
5. Examine the laboratory thermometer and the home thermometer below. Have you noticed that all liquid thermometers have a large bulb of liquid at the bottom?
   (a) What do you think is the purpose of the bulb of liquid?
   (b) What part of your apparatus performs the same function as the bulb on thermometers?
   (c) Why do you think that the diameter of the tube in which the liquid rises affects the accuracy of the thermometer?

5-3C The Plateau Problem — Core Lab

Skill Check

- Observing
- Controlling variables
- Graphing
- Working co-operatively

Safety

- Use oven mitts, hot pads, or tongs to handle the beaker of boiling water.
- Unplug the hot plate at the end of the investigation and let it cool before putting it away.

Materials

- 2 laboratory thermometers
- stirring rod
- hot plate
- kettle
- 2 beakers (250 mL)
- clock or watch
- crushed ice
- ice-cold water
- hot water (almost boiling)

Puddles of liquid water on the road can freeze on a wintry night but this does not happen instantly. Water boiling in a kettle is turning into water vapour but this takes time. What is happening while the water is changing state?

Question

What happens to the temperature of water while it changes state?

Hypothesis

Think about familiar situations in which ice is melting or liquid water is boiling. Then, form two hypotheses by completing the following two statements. Add reasons for your hypotheses.

(a) While water melts from solid ice to liquid water, the temperature will (drop/stay the same/increase), because…

(b) While water boils from a liquid to a gas, the temperature will (drop/stay the same/increase), because…

Procedure

1. Prepare a table for data like the one shown here. You will need space for at least five observations (more if time permits).

Time (min)	Temperature of Melting Ice (°C)	Temperature of Boiling Water (°C)

2. Fill one beaker with hot water from the kettle and put it on the hot plate to boil.
3. In the other beaker, make a slush of crushed ice and a little cold water.
4. With a stirring rod, stir the contents of each beaker for several seconds. Then, measure and record the temperature. Lift the thermometer off the bottom of the beaker to ensure that you are measuring the temperature of the contents and not the container.
5. Repeat the temperature measurements every 3 min. For a fair test, make sure that you stir and measure exactly the same way each time. Record each result.
6. Stop heating the boiling water *before* it all boils away. Unplug the hot plate, and carefully set aside the hot beaker to cool.

Analyze

1. In this activity, you measured time and temperature.
   (a) What was your dependent variable? (Which value was unknown until after you made an observation?)
   (b) What was your independent variable? (What value did you select before making an observation?)
2. Draw two line graphs to show your temperature–time observations: one for the melting ice and one for the boiling water. Instead of joining the points dot-to-dot, draw a smooth line or curve that passes through or between the points (a best-fit line).
3. On your hot-water graph, mark the part where
   (a) the water was hot but not yet boiling
   (b) the hot water was boiling vigorously (called a "full rolling boil" in cooking)
4. Label any plateaus (flat, horizontal segments) on your graph.
5. Compare the temperature of your melting slush with the "official" temperature you saw in Chapter 4.
   (a) If the two temperatures are almost the same, any small differences might be caused by errors in your equipment or measurements. Suggest at least two specific errors of this sort that might occur.
   (b) If the two temperatures are quite different, the conditions in your laboratory or your sample might be responsible. Suggest at least two specific conditions that might cause this type of error.
6. Imagine that you combined both parts of this investigation. Sketch a third graph that shows what would probably happen if you heated one sample from ice to water and then to water vapour.
7. On the temperature scale of your third graph, mark the melting point and the boiling point of your samples, according to your observations.
8. Combine all the results from your class to find the average melting point and the average boiling point for water. Are they closer to the expected values than your individual group values? If they are closer, explain why.

Conclude and Apply

9. From your observations, write a clear answer to the question at the beginning of this investigation.
10. How well do your observations support your hypothesis?
11. (a) Identify any problems you had with the apparatus, procedure, or the way that you organized and worked together in your group.
    (b) Describe one improvement that your group could make the next time you work together.

8-2A How Does Temperature Affect Solubility?

Skill Check
- Predicting
- Measuring
- Controlling variables
- Graphing

Do you think heating a solvent will affect the amount of solute that will dissolve in it? The data table below shows the solubility of three different solutes in water at various temperatures. In this activity, you will examine these data to develop a hypothesis about how temperature affects solubility. Then, you will design an experiment to test your hypothesis.

Safety

- It is not safe to taste any substances in the science classroom, even if you think they are safe. Containers or substances that look clean may still contain invisible traces of harmful chemicals left over from a previous activity

Materials

- balance
- graduated cylinder
- thermometer
- small beakers or test tubes with stoppers
- stirring rod
- measuring spoon
- solute of your choice (for instance: table salt, Epsom salts, flavoured drink powder, baking soda)
- clock or stopwatch

Question

How does temperature affect the solubility of a solid solute in a liquid solvent?

Procedure

Part 1—Analyzing Solubility

1. Draw the axes for a graph. Label the *y*-axis Solubility (g/L). Label the *x*-axis Temperature (°C). Mark the scale for the *x*-axis to go from 0 to 100.
2. Plot the data in the table below. Use a different colour for each solute. Include a legend to show the solute that each colour represents.

Temperature versus Solubility for Three Solutes

Temperature (°C)	Solubility in Water (g/L)*		
	Sugar (Sucrose)	Potassium Chlorate	Ammonium Chloride
10	1910	50	320
20	2040	70	370
30	2200	110	410
40	2390	150	460
50	2610	210	500
60	2870	270	550
70	3200	340	600

* Values have been rounded to the nearest 10.

3. Connect the points for each solute by drawing a line of best fit.
4. Use dashes to extend (extrapolate) the line for each solute so that it crosses 100°C.
5. Give your graph a title.
6. Answer Analyze questions 1, 2, and 3, and answer Conclude and Apply question 1.

Part 2—Design Your Own Solubility Study

1. Based on the evidence from Part 1, how does temperature affect solubility for a solid solute that is mixed with a liquid solvent? Write a hypothesis.
2. Design an investigation to test your hypothesis. Here are some other tips and reminders that you might find useful.
   - There is more than one safe way to increase the temperature of a liquid.
   - Heating a liquid is not the only way to investigate the effect of temperature on solubility.
   - Which variables will you control? Which variable will you change (independent variable), and which variable do you expect will change in response (dependent variable)?
   - How will you guarantee safety for yourself and everyone else in the class?
   - How will you record your data?
3. Write the procedure for your investigation. Get your teacher's approval. Then, carry it out.
4. Clean up and put away the equipment you have used.
5. Answer Analyze question 4, and answer Conclude and Apply question 2.

Analyze

Science Skills

Go to Science Skill 1 for tips on drawing graphs.
Go to Science Skill 2 for tips on how to work with variables.

1. Describe the shape of the lines on your graph.
2. What happens to the lines as temperature increases?
3. Predict the solubility of each solute at 90°C. (Use your dashed line to help you make your prediction.)
4. How did the solubility in warmer water of the substance you tested compare with its solubility in colder water?

Conclude and Apply

1. What happened to the solubility of each solid solute as the temperature of the water increased?
2. How well did your results support your hypothesis?

8-2B How Much Is Too Much? Find Out ACTIVITY

Is there a limit to the amount of solute that can dissolve? In other words, can a solution be made more and more concentrated, with no limit? Does it matter what the solute is? You will explore these questions in this activity.

Safety

Materials

- graduated cylinder
- 250 mL beaker
- measuring spoon
- about 40 g of salt
- Petri dish (or piece of paper)
- water
- stirring rod
- balance
- additional substance provided for testing (for example, sugar, bluestone, calcium hydroxide)

What To Do

1. Use the graduated cylinder to measure 100 mL of cold tap water. Pour the water into the beaker.
2. Pour the salt into the Petri dish. Place the Petri dish on the balance. Measure and record the mass of the salt and dish. Use a table like the one below to record your measurements. Remember to include the units of mass. Then remove the Petri dish from the balance.

Measurements for Determining the Amount of Salt that Dissolves in 100 mL of Water

A. Mass of salt and Petri dish before mixing with water	
B. Mass of salt and Petri dish when salt no longer dissolves in the water	
C. Mass of salt that dissolved in 100 mL of water (Hint: A – B = C)	

3. Use the measuring spoon to add a small amount (about 2.5 mL—half a teaspoon) of salt to the water. Stir the mixture until all the salt is dissolved.
4. Repeat step 3. After each stirring, check to see if there is any salt that does not dissolve. Keep repeating step 3 until you see that some of the salt will no longer dissolve.
5. When you reach the point at which no more will dissolve, place the Petri dish with its remaining salt on the balance. Measure and record the mass in your table.
6. Find the mass of salt that dissolved in the water. Record this mass in your table.
7. Your teacher will provide you with one more substance. Follow all safety guidelines for this substance provided by your teacher. Test this substance in the same way that you did with salt. Prepare a table like the one you used for salt to record your observations.

What Did You Find Out?

1. (a) What was the volume of water that you used to dissolve the salt?
   (b) What was the total mass of salt that you were able to dissolve in this volume of water?
2. (a) What was the volume of water that you used to dissolve the second substance?
   (b) What was the total mass of this substance that you were able to dissolve in this volume of water?
3. Did different students get different results? If so, suggest reasons for the different results.

8-2C Concentrations of Consumer Products Find Out ACTIVITY

In this activity, you will look for concentrations on consumer products that are solutions.

Safety

Handle each product carefully as you observe its label. As a precaution, have an adult with you while you do this activity.

What to Do

1. In your home, look for five products that show their concentration on the label. The chart below shows some ways to recognize how concentration may be expressed on a label.
2. Use a table with the following headings to record information about each product.

Name of Product	Solute	Solvent	Concentration

What Did You Find Out?

1. In the products you listed, what is the most common solvent?
2. Why do you think the manufacturer provided concentration information on the label?

Unit of Concentration	What It Tells about the Solution
g/L	tells how many grams of solute per litre of solution
ppm (parts per million)	tells the ratio, 1:1 000 000, of the mass of solute in the mass of solution
%	tells the percentage of solute in the solution by volume (in other words, the volume of the solute divided by the total volume of the solution)
%	tells the percentage of solute in the solution by mass (in other words, the mass of solute divided by the total mass of the solution)

8-2D Dissolved Carbon Dioxide Find Out ACTIVITY

Soda water is water with dissolved carbon dioxide gas. In this activity, you will make observations about solubility with your ears and eyes.

Safety

- Use sealed, plastic bottles of pop.
- Compare cold and warm (not hot) bottles.

What to Do

Design an experiment to compare the solubility of carbon dioxide gas in cold water with its solubility in warm water. You will not be able to measure the solubility in grams of solute per litre of solvent. You will need to find another way to compare the two solutions. (Hint: What do you hear when you open a can or bottle of pop? What causes the noise?)

What Did You Find Out?

1. If you wanted to have a very bubbly bottle of pop when you open it, would you store it in a cold fridge or in a cupboard? Explain answer.
2. The ocean waters around the North Pole and the South Pole have more sea life than the ocean waters near the equator. Infer a reason why. (Hint: All ocean life depends on oxygen that is dissolved in the water.)

- Bagaimana kapal mengapung?
- Mengapa daun berwarna hijau?
- Bagaimana cara kerja kulkas?
- Mengapa aku sakit?
- Apakah plastik itu?
- Bagaimanakah kerja lampu bohlam?
- Mengapa aku bernapas?

- Apakah pelangi itu?
- Bagaimana beragam cuaca dapat terjadi?
- Mengapa beberapa orang membutuhkan kacamata?
- Bagaimana suara bisa terdengar olehku?
- Bagaimana baterai bisa bekerja?
- Bagaimana pesawat bisa terbang?
- Apakah yang ada di dalam bumi?
- Mengapa permukaan es licin?