Table Of Contents

1. Measurement Lab

Materials

Distance: Metric rulers, Textbooks, Pipecleaners, Several small boxes, Straw or pencil, Sink, Trundle Wheels
Mass: Balance, pen or pencil, shells, metal cubes, wood or plastic cubes
Temperature: Thermometer
Volume: various graduated cylinders, plastic cylinder, small container or film canister, food coloring

Set-Up

Set out materials and measuring devices. I find it works best to create three (or three sets of two) large stations (mass, length, volume) and make temperature a "when you have time" station. We do the trundle wheels as a next day station.
Volume: use the food coloring to make three different levels of water in different sizes of graduated cylinders

Background

The word "measurement" is derived from the Greek word "metron" which means a limited proportion. In science, quantitative measurements, which provide numerical data, are considered more desirable than qualitative measurements, which tend to be observational or subjective (*ie*. big, cold, or blue). Making good measurements also requires using appropriate tools, such as a balance for mass, a graduated cylinder for volume, and a ruler for distance.

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2. Metric Cube Activity

Materials

7cm x 7cm cube die cut shape from construction paper or alternate 5cm x 5cm print out
Metric rulers Colored pencils or pens Calculator (optional)

Directions

All sides: Divide the edges of all sides up into seven 1 cm sections using a metric ruler.
Side 1: Write out the SI prefixes, their symbols and "factors". (ie**. c = centi = /100)**
Side 2: Calculate the area of one side of the cube (in cm^2) and the total volume of the cube (in cm^3).
Side 3: Write out the SI base units for mass, length, temperature, and volume. (ie. **mass = kg)**
Side 4: Write out 3 interesting facts about the metric system.
Side 5: Write out the freezing point and boiling point of water, and human body temperature in both Celsius and Fahrenheit scales. (ie. **100 °C = 212 °F**)
Side 6: Fill-in all the 1 x 1 cm boxes on this side. Write your name, period, and date over it.

Background

The metric system is an international decimalised system of measurement, first adopted by France in 1791 ("*Système International d'Unités*" in French, hence "SI" is its nickname). Metric units are widely used around the world for personal, commercial and scientific purposes. A standard set of prefixes in powers of ten may be used to derive larger and smaller units from the base units. It is the official system of measurement for all nations except for Burma, Liberia, and the United States. In the United States, metric units are widely used in science and industry, but customary units predominate in household use.

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3. Sponge Capsule Lab

Materials

One per group

Water-soluble sponge capsule (pack of 18 / $1 at Dollar Store)

125 ml beaker thermometer (optional) stop watch (or clock)

water

hot plate (optional)

Directions

1. Students fill their beaker with water (you can warm it with a hot plate if you wish).
2. Students place their sponge capsule in the water, starting the stopwatch.
3. Every 30 seconds, students should make an observation in their table.
4. When the plastic has pulled away from the sponge, the activity is finished.

Background

Observation is one of the most important skills for a scientist or science student. It is using your senses to gather information about the outside world. In science, it is important to record careful observations so that others can later look back on them. This can be vitally important if someone else is trying to replicate an experiment you have done. The two main types of observations are qualitative and quantitative. Of the two, quantitative observations are the more valuable because they deals with numerical data instead of subjective impressions.

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4. Scientific Method Exploration Lab

Materials

One per group

125 ml flask with vinegar, 125 ml beaker with corn starch, 125 ml beaker with baking soda, scoop(ula), 10-12" balloon, 8 oz plastic water bottle (empty)

Directions

1. Using the scoop(ula) put about 2 scoops of the desired powder into the balloon. Fill the bottom of the water bottle with the liquid (a depth of about ½ inch).
2. Place the open end of the balloon over the mouth of the water bottle without dumping the powder into the water bottle.
3. When ready, upend the balloon to dump the powder into the liquid. Watch for any reaction.
4. Rinse out the water bottle between each test, but DO NOT rinse out the balloon.

Background

This is the famous vinegar – baking soda reaction, but done at a smaller scale so as not to cause too much of a mess. Vinegar (acetic acid) is an acid and baking soda (sodium bicarbonate) is a base. They react to form sodium acetate (a salt) and carbonic acid, which quickly decomposes into water and carbon dioxide. The carbon dioxide causes the foaming / bubbling. This is also an example of an endothermic reaction which takes in heat. The cooling may not be detectable because of the the small quantities used or through the plastic water bottle.

$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2CO_3$: $H_2CO_3 \rightarrow H_2O + CO_2$

(vinegar) (baking soda) (sodium acetate) (carbonic acid) (water) (carbon dioxide)

5. String Observation Activity

Materials

One per student

1 string (2½ feet long) paper and pencil/pen

Directions

1. Take the piece of string and tie the ends together to make a circle.
2. Go outside and place the circle on the ground. Choose a place with a variety of items.
3. Write a 5 word description of the place you have chosen (sun, shade, grass, dirt, near tree, etc.)
4. Make at least 20 observations about things inside of your circle. These can be sights, smells, textures, colors, shadows, etc., and should include natural and man-made items. You may make 3 observations about each item you see (different types of grasses, rocks, etc., count as different items). So in all, you need 3 observations about 7 different items.

Background

(See info under Sponge Capsule Lab above)

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6. Porifera Open Inquiry Lab

Materials

Synthetic kitchen sponge (cut into pieces) Water

Natural sea sponge (cut into pieces) (available at hardware stores in the painting section)

Various lab equipment (beakers, flasks, graduated cylinders, beam balances)

Directions

1. Fill in the blanks of the background with the class. *(simple, Porifera, filter, sea slugs, skeleton*)
2. Challenge the students to think of a procedure to answer the question, which type of sponge will retain water the best? Have them write out the steps and get your approval before beginning.

Background

Sea sponges are some of the simplest animals and belong to the phylum Porifera. They are sessile (non-moving) filter-feeders that live in the water and can have soft or hard skeletons covered with a dual-layer of cells. What we see out of the water is their skeleton. There are between 5,000 and 10,000 known species of sponges. Most synthetic sponges are made from cellulose wood fibers or plastic polymers.

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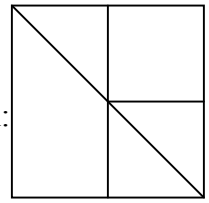
7. Tangrams Observation Activity

Materials

One per group

Tangram shapes cut from construction paper of various colors following the pattern:



Directions

1. Make each of the shapes using the 5 pieces shown.
2. Have the teacher initial each or draw the smaller shapes into the larger ones.
3. The two with stars are usually the easiest to begin with.

Background

(See info under Sponge Capsule Lab above)

8. Solar Bead Activity

Materials

Solar beads, 3 per student (available at arts and crafts stores – like Michael's)
Stop watches or clock with a second hand
3 different types of light bulbs in work light enclosures

Directions

1. Observe the solar beads in the room and outside in the indicated locations.
2. Record an observation about the color change (0 = no change, 3 = vivid color)

Background

These beads (sometimes called pony beads) contain various chemicals that change color in the presence of ultraviolet light (black light), a part of the electromagnetic spectrum.

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9. Color Disc Activity

Materials

One per student

Color disc template printed on white paper
Cardboard squares, approximately 5" x 5"
String or yarn, about 2 feet
Blue, red, green markers or colored pencils — Scissors
Glue stick or glue — Compass (optional)

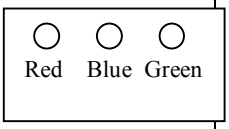
Directions

1. Print out the color disc templates.
2. Color the sections blue, red, and green. Fill in all the white paper.
3. Cut out the circle.
4. Glue the paper to the cardboard.
5. Trim the cardboard to match the circle.
6. Punch through the two holes (the scissors or the point of a compass work well).
7. Put the string or yarn through the holes and tie the lose ends to make a circle.
8. Put one finger through each side of the circle of string and wind up the disc by swinging it with a forward-to-backward motion. Once it gets wound up you can keep it going by gently pulling your hands apart. When it really gets up to speed, you will hear a fan-like sound and should see the three colors blend toward white (or at least grey). Be careful – you can easily break the string and if you pull too tightly or for too long the string may cut your fingers.

Background

The human eye contains cone cells which absorb light in the red, blue, and green portions of the visible light spectrum. When these three colors of light mix, they produce white light.

10. Light and Color Lab

Station	Materials	Set-Up
A. Material Types	Textbook or dictionary	None.
B. Color Filters	**Color filter cards**. - 3x5 cards (5) - Scotch tape - 3 colors of transparency paper (red, blue, green,) Objects with various colors, such as cards, pictures, etc.	Color filter cards - Punch 3 holes in the upper side of a 3x5 card. - Tape a small piece of colored transparency paper over each hole. 
C. Eye Anatomy	Textbook or model of the eye.	None.
D. Color Prints	Several magazine pages with colored pictures. Magnifying glasses (5)	None.
E. Bending Light	Small beaker (250 ml) Water Pencil	Fill the beacker ¾ with water and place the pencil in it.
F. Glasses and Light	**Several used pairs of glasses**, the thicker the better (try Goodwill)	None.
G. Reflection of Light	Curved piece of aluminum or stainless steel. A **recessed soap holder** works well.	None.
H. Blending Colors of Light	Three flashlights with red, green, and blue cellophane inserted in front of the bulbs. A small-to-medium sized box.	None.
I. Binocular Vision	Stereoscopic pictures Definition of binocular vision	None.
J. Blind Spot	Blind spot cards Ruler (optional)	Create the cards by drawing a + sign on the left half of a 3x5 card and a small dot on the right half.
K. Stroop Effect	Stroop effect testing page	None.

Background

This lab takes students through various properties of color, light, and eyesight.

11. Element Rebuses

Materials

Periodic Table of Elements (optional)

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12. pH Rainbow Chemistry Lab

Materials

One set per group

6 test tubes test tube rack (or 1 well plate)

dropper bottles of … vinegar sodium hydroxide universal indicator

Directions

!!! Students must wear safety goggles during this experiment!!!

1. Put 10 drops of vinegar (ACID) in each test tube or well. (Important to put in only 10 drops.)
2. Add 1 drop of the universal indicator to each test tube or well. Record the starting color (#1).
3. Add the sodium hydroxide (BASE) to the first test tube or well one drop at a time. Count and record the number of drops until the color of the liquid turns orange. (You may need to gently swirl the test tubes each time to mix the chemicals.)
4. Continue to the next test tube and count the number of drops to get to the next indicated color.
5. Target colors are : Red, Orange, Yellow, Green, Blue, Purple
6. Once the target colors have been reached, use a piece of pH paper to determine each pH.

Background

The pH scale is a measure of the amount of dissolved hydronium (H_3O^+) ions in a solution. It ranges from very acidic (0) to very basic (or alkaline) (14). Pure water is neutral (7). Universal indicator is composed of several chemicals. It changes in color depending on the pH level of the solution, from red (strong acid) to orange (acid), green (neutral), blue (base), and purple (strong base). Vinegar (acetic acid) is considered a weak acid (pH = 3) and sodium hydroxide (NaOH) is a strong base (pH = 14, depending on concentraion).

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13. Cell Observation Lab

Materials

Microscopes

Textbook or poster labeling parts of the microscope

Prepared animal and/or plant tissue slides

Blank slides

Cover slips

***Elodea* (or *Anacharis*), a water plant with thin leaves**

Pond water

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14. Cell Structure Shrinky Dinks

Materials

Rough-n-Ready Shrinky Dink sheets (cut one 10x8 sheet into 4 pieces – you can buy them in a pack of 10 from Michael's, so 1 pack works for 40 students)

Colored pencils, pens, etc.

Directions

The point of this exercise is to point out that while cells are very very, very, very small, they have even smaller, incredibly detailed structures within them (organelles).

1) Draw and color a plant or animal cell on your shrinky dink.
2) It works best (I think) to draw on the rough side.
3) Try mixing colored pencils, pens, and markers for interesting effects.
4) Choose 7 of the following 10 organelles to draw and label:
   nucleus, cell membrane, mitochondria, chloroplast, lysosome, vacuole, golgi body, endoplasmic reticulum, ribosome, cell wall
5) When finished, neatly write your name in one of the corners.
6) You may cut your shrinky dink to the shape of your cell or leave it in a rectangle.
7) If you want to make a necklace out of your shrinky dink, punch three holes close together with a one-hole punch (punch three holes because the holes will shrink as well!).
8) Hand your shrinky dink to your teacher for them to place in the toaster oven (or you can take it home and use a regular oven set at 250°F – just keep an eye on it while it shrinks!).

Background

Shrinky dinks are thin sheets of polystrene plastic. When heated, the plastic fibers return to an original, thicker form. Shrinky dinks will shrink to about 5/8ths their original size and become thicker.

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15. Cell-Sell Activity

Materials

Various poster making supplies

Directions

Students create an advertisement for a cellular organelle. It must include a jingle (or slogan), a picture of the organelle, the organelle's name, three facts, and be neat and colorful.

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16. Cell Simile Activity

Materials

Various poster making supplies

Directions

Step A. Think of a "theme" simile that compares a cell to something else, like a town or a school. It works best if you choose a thing that has many parts to it.

Step B. On the back of your poster:

- Write out the simile on the top of the page.
- List the organelles and their examples, as shown below.
- Include at least eight of the following organelles: nucleus, cell membrane, mitochondria, chloroplast, lysosome, vacuole, golgi body, endoplasmic reticulum, ribosome, cell wall

1. The _____ is like a _____ because they both _____.
2. The _____ is like a _____ because they both _____.
3. ...

Step C. On the front of your poster:

- Draw and color your simile idea. Remember that neatness counts!
- Include the examples for each organelle.
- Label each example with the name of the organelle.

Background

Students learn in English class that a simile is a figure of speech that "compares two things using the words like or as". Ask someone to define it in class. You'll always get at least one student who has the definition memorized word for word.

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17. Explode-a-Grape Lab

Materials

table grapes (2 per group)	plastic cups or 35 mm film canisters (2 per group)
water	salt (non-iodized)
large flask (1000 ml)	masking tape
measuring tape	magnetic stir plate (optional)

Directions

1. Mix the non-iodized salt with water in the 1000 ml flask (you can use a magnetic stir plate to fully saturate it). Mix in as much salt as possible – the more, the better!
2. When the students begin, have them label both cups or canisters with masking tape and designate one "Salty" and the other "Fresh".
3. Students should measure and record the circumference of each grape, then place them in the cups or canisters.
4. Students should fill each cup or canister with the designated type of water, making sure the grapes are covered.
5. Students should place their grapes in a safe place ad check them over the next 2-3 days (a weekend works great).
6. When you decide the lab is done, have students dump their water out, measure their grapes and dispose of them in the trash. Cups / containers should be discarded or washed with soap.

Background

Diffusion is the movement of particles from an area of high concentration to an area of low concentration. Osmosis is the diffusion of water, often across a semipermeable membrane, such as the cell membrane or a grape skin. Solutions that are hypertonic cause water to leave cells (or grapes), while hypotonic solutions cuse water to flood inside of the cells (or grapes). The barrier creates osmotic pressure in the fresh water grape, causing the skin to rupture or split. The water moves out of the salt water grape, causing it to shrivel up or shrink. An interesting side point is to discuss which one is similar to your fingers in the bathtub. The answer is the fresh water grape: the fresher water of the bath goes into the layers of your skin, causing them to swell up, but because they are attached only at certain points to the underlying tissues, they get wrinkly and seem to have shriveled.

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18. Chromatography Lab

Materials

One set per group

Leaves (about 5, not dried up) — Mortar and pestle

125 ml flask — 125 ml beaker or 35 mm film canister

Chromatography paper, blotting paper, or coffee filter paper (each group needs a ½" x 5" strip)

Acetone (simple fingernail polish remover works well) or rubbing alcohol (about 1000 ml / class)

1000 ml flask (1)

Masking tape

Safety Goggles (** STUDENTS MUST WEAR SAFETY GOGGLES)

Directions

1. Fill the 1000 ml flask with acetone or rubbing alcohol to make it easier to pour out (optional).
2. Have each group get 5-6 medium-sized non-dried-up leaves. They can bring them from home or find them around your campus.
3. Pour about 100 ml into each group's 125 ml flask.
4. Using the mortar and pestle, each group should grind the leaves with the acetone or rubbing alcohol. Rip the leaves into smaller pieces, folding them if necessary, and slowly add a small amount or the liquid as you grind with a twisting motion. **TELL THE STUDENTS NOT TO POUND WITH THE MORTAR AND PESTLE.
5. Once they have a dark green color to their liquid, students should pour th eliquid into their beaker or film canister.
6. Place a strip of paper inside the container so the bottom is in the liquid. You can use masking tape to attach the back of the strip to the outside of the container so it doesn't fall in.
7. Check the strip every 30 minutes. Stop the lab by pouring out the liquid if the colors are moving too far up the paper.

Background

Chromatography is a chemical technique for separating colors in mixtures. As the liquid moves up the filter paper by capillary action, it draws along the colored pigments, the lighter ones moving farther. Chlorophylls are the green-colored pigments in the chloroplasts of plants that absorb the red and blue parts of sunlight for photosynthesis. Chloroplasts also contain carotenoids, which may show a reddish-yellow color, depending on the type of leaves the students use.

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19. CIA Foldable Activity

Materials

One piece of 12" x 18" white costruction paper (per student)
Colored pencils, pens, rulers, etc.

Directions

1. Fold the construction paper as shown in the diagram, cutting the two folded sides.
2. Write the CIA question on the outer flap and decorate each flap.
3. Write an answer to each question inside the flap using vocabulary words.
4. Draw an answer to each question on the inner side of the paper.

Background

CIA (in this case) stands for Cells In Action. The four focus questions are (diffusion) Why do fish drink water?, (photosynthesis) Why are pants green?, (respiraiton) Why do muscles burn when you workout?, and (mitosis) Why do we need haircuts?

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20. CO_2 Breathing Lab

Materials

125 ml beaker (one per group)
drinking straws (one per student)
indicator solution (phenol red works well)
stopwatch or clock with a second hand

Directions

1. Students should pour the beaker about half full of the indicator solution.
2. While one student times, the other places one end of the straw in the indicator solution, takes a deep breath, then breathes into the straw.
3. The student that is blowing should stop when the indicator solution changes color or they run out of breath and write the time in the table. *** MAKE SURE STUDENTS ARE CAREFUL NOT TO DRINK THE INDICATOR SOLUTION.
4. Students should switch places, then repeat the procedure after completing a physical activity (running, jumping jacks, etc.).
5. When finished, students need to calculate the average for each part of the lab and find the difference.

Background

Phenol red is a pH indicator that turns yellow below pH 6.8 and pink above pH 8.2. It is often used in home swimming pool test kits. When we exhahle, our breath contains large amounts of carbon dioxide, a toxic waste product of cellular respiration. Then you breath into the water/indicator mixture, the CO_2 changes the pH (acid / base measure) of the mixture from a weak base (pink) to a weak acid (yellow).

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21. Yeast Balloon Lab

Materials

Clean plastic bottles (one per group)
Various juices (apple, orange, grape)
Water
Masking or electrical tape
Dry active yeast
Soda
Balloons

Directions

1. Students should pour 125 ml of their chosen liquid into the plastic bottle.
2. Quickly add about 100 grams of dry active yeast to the bottle and cover the top with the balloon.
3. Tape the balloon around the top of the bottle to prevent leakage.
4. Place the bottle in a safe place to observe for 3-4 days.
5. When finished, dispose of the entire setup in the trash.

Background

Cellular respiration takes a source of trapped chemical energy (food) and releases the stored energy for use by the organism. It occurs in mitochondria. If oxygen is present it is called aerobic respiration and if oxygen is absent it is called anaerobic respiration (or fermentation). Yeast are a member of the Fungi kingdom. They are used in many food and beverage producing industries, such as baking and brewing. The yeast will consume the sugar (if any) in the liquid and, as a byproduct of anaerobic cellular respiration, produce carbon dioxide (which fills u pthe balloon) and alcohol (non-drinkable – I tell my students it would put them in the hospital because it is the wrong temperature, the wrong yeast, the wrong container, the wrong sugar, the wrong everything. It still smells like alcohol, though!).

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22. Mitosis Graphing Activity

Materials

Activity print out

Directions

Step 1. Mark the plant cells based on their phase of the cell cycle.
Step 2. Count up the number of cells in each phase and graph them in the grid . Create a bar graph, placing Phase of Mitosis on the X-axis and number of cells on the Y-axis.

Background

Mitosis is the main visible part of cell division, being really the division of the duplicated chromosomes and the creatio nof two new cells. As a side note, I use a mnemonic hand device to help students remember the order of mitosis. Their fingers act as chromosomes. Fingers crossed = **p**rophase when chromosomes a**pp**ear. Fingers pressed together = **m**etaphase when doubled chromosomes line up in the **m**iddle of the cell. Hands pulled apart with fingers facing toward each other = **a**naphase when chromosomes are pulled **a**part. Hands apart in fists = **t**elophase when you have **t**wo new cells.

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23. Mitosis Yarn Activity

Materials

Activity print out (one per student or one per group)
Yarn (2 colors, approximately 12" per student or group)
Tape or glue or glue stick Colored pencils

Directions

1. Students draw and color the background of each stage of the cell cycle, including the nucleus, centrioles, and spindle fibers, but NOT the chromosomes.
2. Students write out a short description of each stage of the cell cycle.
3. Students use the yarn and tape to show the structure and location of the chromosomes through the consecutive stages.

Background

(See info on Mitosis Graphing Activity above)

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24. M&M Natural Selection Activity

Materials

Bag of M&M's (two medium bags per class)
Various colored and patterned backgrounds (cloths, papers, towels, etc.) (one per group)
Small plastic bowls (2 per group)

Set-Up

Spread out your background environment.
Get your M&M's from the teacher in a plastic bowl.
Count out 4 of each color and spread them out on your "environment".
Place the remaining M&M's in one bowl (these are replacements).
Choose one person in your group to be the "predator" first.

Directions

Initial (I)

A. Count and record the number of each M&M species (colors) in the **I** column.

Predation (P)

B. Have the predator close their eyes for one second, then open their eyes and quickly take the first M&M that they notice from the "environment" and put it in the second cup.
C. Have the predator repeat this behavior 2 more times (for a total of 3 times in all).
D. Count and record the numer of each remaining M&M species in the **P** column.

Reproduction (R)

E. Every two M&M's of the same species can reproduce. Divide the number of each species remaining (**P**) by two, rounding down if you get a decimal. Record this number in the **R** column.
F. Add in the correct number of baby M&M's for each species (color). Check to make sure the **I** number for the next round is equal to the **P** + **R** from this round.

G. Repeat Steps A-F for a total of five (5) rounds.

25. Alien Space Baby Activity

Materials

Alleles cut into squares (card stock works best)
Trait Rules Card (one per group)
Paper bags or small plastic bowls (8 total)
Colored pencils or pens

Set-Up

Students should do this lab in partner groups.

Print and cut the alleles into squares. One sheet for every two groups, so 8 printed sheets for a class of 32. It helps to sort the letters as you cut them out into piles.

Print and cut out the Trait Rules Cards. One card per group, so 4 printed sheets for a class of 32.

Label the outside of the bags or bowls according to the following list and place the appropriate cut out alleles inside:

Height =	T and t	Antennae # =	A and a
Eye # =	E and e	Body shape =	S and s
Eye color =	C and c	Body color =	B and b
Leg # =	L and l	Teeth # =	N and n

Directions

1. Each student should pick an allele from each bag or box.
2. Record it in Table 6.3 , then return it to the bag or box.
3. Record your partner's allele pick also.
4. Write out the phenotype according to the Trait Rules Card.
5. Then draw your alien space baby's chromosomes (see your textbook for help) and their picture.
6. Students can continue the next generation filling in Table 6.4. This time they can pick an allele to be passed on from each "parent".

Background

Each offspring receives half of their genome from each parent. This activity looks at "simple" traits, ones which follow Mendelian laws of inheritance (typical dominant, recessive traits).

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26. Coin / Dice Probability Lab

Materials

Coins (one per group, pennies are cheapest!)
Dice (2 per group, so 32 for a class of 32 working in partners)

Background

Probability is the likehood that a particular event will occur. The more that an event is carried out in the real world, the closer the results come to the mathematical model. While students "know" they have a 50/50 chance of getting heads each time, they should see through the lab that the expected percentage only appears as they filp the coin more and more times. With genetics, offspring have a probability of inheriting a trait from each parent. So if parents carry a certain trait (eye color, disease, flower petal color, etc.) we can usually calculate the probability of their offspring receiving that trait.

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27. Flower Dissection Lab

Materials

Flower with simple stamen, one per student (snapdragon
Tweezers
Scissors, tape

Directions

1. Draw, label and color the following parts of a flower (use a textbook or printout).

Petals	Stamen (anther and filament)
Sepals	Pistil (stigma, style and ovary)
Stem	Pollen grains

2. Carefully dissect your flower using tweezers and /or scissors when appropriate.
   - Begin by removing the petals and sepals.
   - Once they are removed you should see the stamen (anther stalks) and the pistil still connected to the stem. The anther stalks may have come off with the petals.
   - Carefully remove the pistil from the stem, trying to keep the ovary attached.

3. When finished, tape the flower parts over (or next to) the parts on the drawing you made. Shake some of the pollen off of the anthers to tape down as well.

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28. Human Trait Wheel Activity

Materials

None

Directions

1. It is helpful to explain the traits to the students as you go through the activity.
2. Starting in the center, have the students shade in the part of the circle that describes them. For instance, beginning with "widow's peak", if they have a widow's peak they shade in "widow's peak"; if not, they shade in "no widow's peak".
3. Once they shade in a certain direction, they keep moving in that direction. For example, if they first shade in "widow's peak", they can only end up as number 1-16. You can have them "X-out" the left-hand side of the wheel.
4. You can explain to the students that each of these traits are complex and come in various degrees.
5. "Thumb" means you have a hitchhicker's thumb. "Ear" means your ear lobes hang free.
6. When finished, have the students circle the numer that describes them.
7. Record the number of students from the class that arrived at each number on the overhead.
8. Make a bar graph of the data. Leave out any "0" numbers.
9. Discuss the following questions with the students.
   - Why do so few of the numbers have more than 3 or 5 people?
   - What if we checked four more traits – would anyone be the same number?
   - Which number came up the most?
   - Looking at your graph, what can you say about the students in this class and widow's peak?
   - Whould these numbers be the same in another class? What about at another school? Another part of the world?

29. Family Tree Activity

Materials

Pencil and/or pen
Ruler or straightedge
Family pictures (optional)

Directions

1. Model for the students how to draw out a family tree. Use your own family to help engage their interest.
2. Points to remember:
   Members of the same generation should be on the same "level".
   Husband is usually shown first (on left) if possible.
   Children are usually shown in birth order.
   Boyfriends, girlfriends, pets do not show on a family tree!
   You may include adoptions in this family tree, since it is not meant for genetic diagnostics.
3. Remember to start with yourself and build your family tree out (which usually means up).
4. Use a ruler to keep the lines neat and in the correct levels.
5. Include first names for each person shown. (For large families, it may be helpful to number each person and include a list on the back.)
6. Choose a simple genetic trait (eye or hair color, roll tongue into a taco) and trace it through your family tree. Indicate the presence of the trait by filling in the square or circle.
7. Form a hypothesis as to whether the trait you chose to trace is recessive, dominant, simple, complex, or sex-linked.
8. You may include pictures if desired (or for extra credit).

Background

Family trees (sometimes called pedigree charts) have been used for centuries to trace relationships. In science, they can be helpful in tracing a particular genetic trait back through generations. This helps scientists understand the rules by which the phenotype (physical presence of the trait) operates. Simple traits are ones which follow Mendel's basic recessive-dominant relationship. Many traits in humans are not simple, such as eye color, hair color, skin color, and height, because they (1) are controlled by multiple genes and/or (2) they have many gradations, not just Mendel's classic "tall or short".

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30. DNA Model Activity

Materials

DNA cut out pieces (card stock works best)
Colored pencils or pens, tape, scissors

Directions

1) Legend- put the legend on a half sheet of paper.
2) Color the pieces.
3) Cut out the pieces.
4) Color the other sides of the cutout pieces.
4) Tape them together across, then up and down, keeping it as neat as possible.
5) Twist them, attach to the half sheet of paper, and make sure your name(s) are on it.

Background

In 1953 James Watson (American) and Francis Crick (English) discovered the structure of the deoxyribonucleic acid molecule (with unintended help from Rosalind Franklin). This followed half a century of furious studies into the nature of DNA by many scientists. In the half century since Watson and Crick's famous discovery, DNA studies have revolutionized the field of medicine and spawned whole new scientific fields, such as genetic engineering, biotechnology, bioinformatics, and proteomics. All of these multi-billion dollar industries trace their roots back to the simple sugar-phosphate-base structure of the DNA nucleotide.

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31. Karyotype Activity

Materials

Patient Cards (one per student, so 4 sheets for a class of 32)
Scissors
Tape or glue sticks

Directions

1. Write your Patient's Number in the space provided.
2. Carefully cut out the individual chromosomes on the handout from your teacher.
3. Create the karyotype by regrouping the missing chromosomes with their pairs in the template below, based on length and banding pattern. Tape or glue each chromosome onto this paper. Remember that each of these patients has a problem with their chromosomes!
4. Have the teacher check your completed karyotype and initial below.
5. Answer the questions on the back of this page.

Patient Answer Key

Patient #	# of Chrs	Diagnosis	Syndrome	Gender
34	47	extra #18	Edward's	girl
35	47	extra #18	Edward's	boy
36	47	extra #21	Down	girl
37	47	extra #21	Down	boy
38	47	extra #13	Patau	girl
39	47	extra #13	Patau	boy
40	45	missing X	Turner	girl
41	47	extra X	Klinefelter's	boy

Background

A karyotype is a picture taken through a light microscope of the chromosomes from the nucleus of a cell. To see the chromosomes (which is condensed DNA), the cell has to be in the mitosis stage of the cell cycle. Normal human somatic (body) cells have 46 chromosomes made up of 22 autosomal pairs and 2 sex-chromosomes which are paired in females (XX) and distinct in males (XY). Many well-known genetic disorders are caused by missing or duplicated chromosomes. These can be caused by nondisjunction, where the duplicated chromosome pairs fail to separate completely during meiosis (which is the formation of sperm and egg cells). Extra chromosomes are generally labelled trisomy (Downs, Edwards, Patau) and missing chromosomes are labeled monosomy (Turner, Klinefelters).

32. DNA Extraction Lab

Materials

- **Package of peas** (1/2 per class)
- Non-iodized salt (10 mg)
- Water, distilled, cold (about 1 liter per class)
- Dishwashing detergent (250 ml)
- **Meat tenderizer** (10 mg)
- Rubbing alcohol, ice-cold (200 ml)
- Wooden stir stick, small (one per student)
- **Blender**

One lab set-up per group

- 2 small beakers (250 and 150 work well)
- strainer
- 100 ml graduated cylinder
- test tubes (one per student)
- test tube holder

Set-Up

Blending

Put about ½ a package of peas in the blender.
Add in a sprinkle of salt (about 1/8 tablespoon or 1 mg).
Pour in 1 cup of cold water (about 200 ml).
Blend the mixture on high for about 30 seconds. (It's works well to have a volunteer push the button.)

Directions

Part A – Beaker (3-4 students in a group)

1. Get about 100 ml of the pea soup mixture in your smaller beaker.
2. Strain the mixture into your larger beaker. *(Record an observation in your Data Table.)*
3. Add about 25 ml of dishwashing soap to your mixture and swirl it to mix. (The soap helps break open lipid membranes.) *(Record an observation.)*
4. Let the mixture sit still for 5-10 minutes. (This is a good time to answer the questions.)

Part B – Test Tube (individual students)

5. Carefully fill one test tube ½ way with your mixture.
6. Add a pinch of meat tenderizer to your test tube and stir it gently. (The meat tenderizer is an enzyme that cuts proteins out of the DNA so it can clump together.) *(Record an observation.)*
7. Tilt your test tube and slowly pour a layer of ice-cold rubbing alcohol on top of your mixture. DO NOT shake or stir the test tube. *(Record an observation.)*
8. Let your tube sit for 2-3 minutes. You should begin to see strings or floating specks of white precipitating in the clear alcohol layer. You can also use your wooden or glass stir stick to pull the specks up into the alcohol layer. This is clumped together DNA. *(Record an observation.)*

Lab taken from http://learn.genetics.utah.edu/content/labs/extraction/howto/index.html

Background

The blending helps break the cells apart from each other. The detergent breaks down the cell and nuclear membranes. The meat tenderizer removes the histone proteins that help DNA keep it's characteristic shape, allowing it to clump together. Finally, the cold alcohol brings the DNA out of suspension so it can be viewed.

33. Where's the CAT? Activity

Materials

DNA Sequences and Gel Print Outs (1 per partner group)
Colored pencils or pens, tape, scissors

Set-Up

Step 1 : lightly color the DNA sequences according to the following key:

Standard : white Surrogate Mother : yellow Infertile Woman's Husband : orange
Surrogate's Husband : green Child : blue

Step 2 : cut out the strips of **DNA sequences** then tape them together by color at the numbers.

Label the DNA Strands: scan each strip for the probe sites: CAT. Wherever the sequence CAT appears, color a red box over it. (Students should have 2 CAT's per colored strip and 8 CAT's on the white one.)

Cut the DNA Strands: scan each strip for the enzyme site: GGCC. Make a mark between the 'GC' in the center. Then, cut each strip between the 'GC' on the mark you just made.

Separate the DNA fragments: count the number of bases (letters) in each fragment. Tape them onto your "Electrophoresis Gel Sheet" in the correct place.

Adapted from a DNA Profiling Simulation By Ellen Mayo, Co-Authored By Anthony Bertino.

Background

DNA profiling (highlighted on shows like Jerry Springer) has been used since 1984, when Alec Jeffreys first used the process to solve a crime in England. This simulation is an example of paternity testing. In the real thing, electricity is used to separate DNA fragments within a gel matrix. The larger fragments move less far, the smaller ones move farther. A marker is usually applied to specific sites in the DNA (like CAT) before the electrophoresis is done. Afterwards, a stain can be applied or a UV light can be used to cause the markers to fluoresce.

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34. Odds-n-Ends Taxonomic Key

Materials

Seven different "junk drawer" items (one set per group)

Directions

- Find seven (7) items from around your house that are different. You might look in the "junk drawer". Items that work well include a paperclip, brush, penny, straw, cotton ball, rubber band, book, nail, pencil, washer, etc.
- Write out a scientific-sounding name for each item. For example, you might name a cotton ball Fluffius whitius. Make sure you underline and capitalize the first (genus) name. Number each item.
- Make a "sorting tree" that separates the items out. A possible example is shown below:
- Give each bubble question a number and translate the "sorting tree" into a classification key. The questions from above should be made into statements.
- For extra credit, draw a picture of each item you classified!

35. Taxonomic Key Activity

Materials

Taxonomic creature print out or Access to internet or magazine pictures to cut out (optional)
General poster supplies

Directions

Students are to create a 9-step taxonomic key to classify 10 related items. The prepared ones are all mythical creatures. The "official" names are (across from top left) centaur, cerberus, griffin, hydra, unicorn, basilisk, wyvern, manticore, phoenix, and sphinx. Alternatively, students may choose their own related groups to classify, such as athletes, cars, superheroes, video games, animals, friends, etc.

Step 1. Create a description for each of the mythological creatures above. Include at least 5 distinguishing features about each one. Check the slide show for their names. Use 1-2 sentences each.

Step 2. Create a Dichotomous Key for the 10 mythological creatures. Use their common names (don't worry about scientific names – they don't really exist). Your key should have 9 numbered statements.

Step 3. Copy your Classification Key onto a poster paper and paste the colored pictures of the creatures around it. Write the descriptions you created below each picture.

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36. Heart Rate Lab

Materials

Wristwatch or stopwatch (1)

Directions

1. Help students find their pulse at their carotid artery (front – side of neck) and/or at their radial artery (wrist).
2. Set up a series of destinations for your students to walk to and then take their pulse. Include resting phases and quasi-exercise phases.
3. When finished, students graph their heart rates using a line graph.

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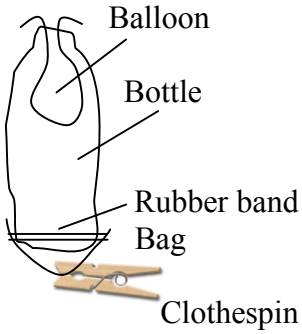
37. Make-a-Lung Activity

Materials

1 setup per group
Plastic bottle with bottom cut off (1 pint or 1 qt water bottles work well)
Rubber band
10"-12" balloon
Small plastic bag
Clothespin (optional)



Directions

Students are to make a working lung model with the materials they receive.
The teacher can give help or not, as the class requires.
It is helpful to point out groups that are heading in the correct direction.
When students correctly assemble the model, pulling the plastic bag downward will cause the balloon to inflate inside of the bottle.

38. Digestive System Brochure

Materials

Brochure print outs (should be printed back-to-back)
Colored pencils or pens
Textbook

Directions

Students create a "travel Guide" through the digestive system. They should draw and color pictures of each of the five major organs and fill in the information below. The whole brochure should be colored and neat.

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39. Frog Dissection Lab

Materials

Frogs (one per group of 3-4 students)
Dissection supplies (scalpel, scissors, T-pins, dissection pans, latex gloves, probes)

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40. Sense - Response Lab

Materials

Toothpicks (10 per setup) 3x5 index cards (4 per setup) tape ruler flashlight

Station	Setup	Directions
Touch • Areas of Sensitivity	• Cut three 3x5 index cards in half. • Label 5 of them A, B, C, D, and E. • Tape 2 toothpicks to each card so that their tips are the required distance apart (2, 1.5, 1, & 0.5 cm). • Tape only one toothpick on card E.	• Person 1 closes their eyes while Person 2 lightly touches a random card to the area of the skin. • Person 1 states how many touches they feel for Person 2 to write down.
Reaction Time • Ruler Drop	None.	• Person 1 holds the top of ruler lightly between 2 fingers, preparing to drop it. • Person 2 holds their thumb and index finger about 1 inch apart from each side of the ruler at the bottom edge of the ruler. • Person 1 says "ready", and drops the ruler within the next 2 seconds. • Person 2 will catch the ruler as soon as they see the ruler begin to fall. • Look at the ruler right where Person 2 caught it--this is the distance (in cm). • Convert this distance to time (in milliseconds) Table A and record it in the Table 2.

Station	Setup	Directions
Sight • Blind Spot	• On one 3x5 index card draw a circle in the mid-left side and a plus (+) in the mid right side.	• Hold the paper at arms length from your eyes. • Close one eye and focus on the "+" sign. • Slowly move the paper toward your face. • Stop when the dot on the left hand side disappears.
Pupil Observation • Light Response	None.	• Person 1 looks at the eye of Person 2 and draws the size of their iris (colored portion of the eye. • Repeat this procedure while Person 1 shades their eyes and with a flashlight shined near their eyes. • Record an observation in words telling how the pupil or iris has changed.

41. Make-an-Arm Activity

Materials

3x5 index cards (1 to 2 per group)
straw (1 per group)
scissors
scotch tape
string or yarn

Directions

Each group makes a model of the upper and lower arm bending at the elbow. Students can make the model however they wish. The step-by-step directions can be used or not as the class may need.

42. Femur : Tibia Ratio Activity

Materials

Tape measure or meter ruler

Directions

Using the tape measure, measure the length of your _femur_ from hip bone to top of patella in centimeters. Next, measure the length of your _tibia_ from bottom of patella to outside "ankle bump". Share your data with the class, fill in the table, and graph your results.

To find the Femur : Tibia ratio, divide the Femur total by the Tibia total and place the result over "1".