



Leaves Can Make Photographs

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Topic

Photosynthesis



Time

30 to 45 minutes, 3 days prior to lab; 45 minutes to completion



Safety

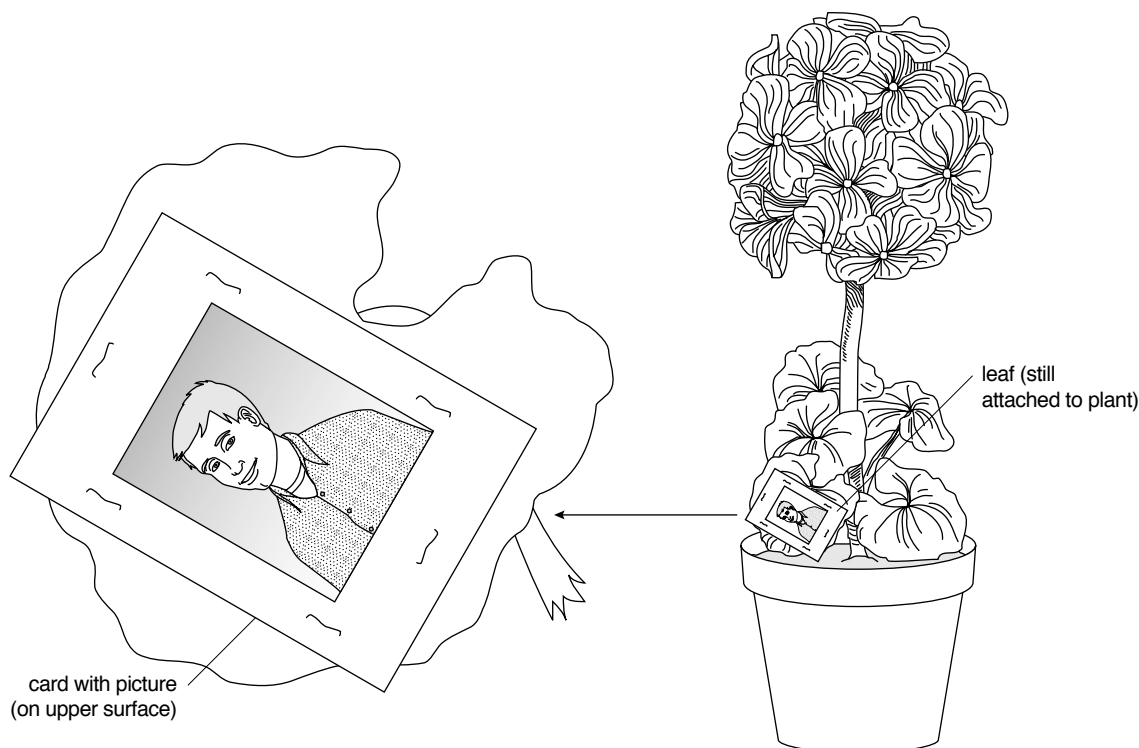
Adult supervision is required. Please click on the safety icon to view the safety precautions. Do not place the beaker of alcohol directly on the burner of the stove or hot plate; it might catch fire. Place the beaker in a pan of boiling water. Do not leave the apparatus unattended. Alcohol and iodine are poisons.

Materials

geranium plant (or any other plant with large, thin leaves)	fluorescent lamp
index card	tincture of iodine solution
black-and-white negative of a photo with a great deal of contrast (small enough to fit plant leaf)	isopropyl alcohol
stapler	hot plate (or stove)
scissors	Pyrex™ beaker large enough to fit plant leaf
tape	saucepan
	tongs
	small bowl

Procedure

1. Cut an index card in half. In one of the card halves, cut a hole large enough to create a frame for the negative.
2. Tape the black-and-white negative over the hole, and staple this card and negative combination to the upper surface of a leaf, without removing the leaf from the plant.
3. Staple the other half of the index card to the lower surface of the leaf (see illustration).
4. Place the plant in a dark cupboard for about 48 hr.
5. Remove the plant from the cupboard and place it under a fluorescent lamp for 26 hr.



6. Put about 1 in. water in a pan, and bring it to a boil.
7. Remove index card and film from the leaf. Remove the leaf from the plant, and drop it in the boiling water for 30 sec. Remove.
8. Put about 1 in. alcohol in a beaker. Place the leaf in the alcohol, and spread it out so that it is flat.
9. Put the beaker of alcohol in the pan of boiling water, making sure that the beaker is stable. You may have to pour off some water if it does not sit comfortably. Caution: Do *not* place the beaker of alcohol directly on the burner; it might explode and catch fire.
10. Boil the leaf in the alcohol until all the green color has been removed from the leaf (about 9 min).
11. Remove the leaf with the tongs and place it in a bowl. Cover it with a solution of tincture of iodine for 5 min.
12. Use clean tongs to remove the leaf, and rinse it in cold water. Record your observations.
13. Describe what you saw on the upper surface of the leaf when you finished the experiment. Explain how you think this happened.

What's Going On

The image from the negative is transferred to the upper surface of the leaf. This occurs because the negative allows varying amounts of light to pass through its light and dark areas to reach the leaf. Wherever light passes through, *photosynthesis* occurs. Wherever photosynthesis occurs, starch is formed. The iodine test shows the

presence of starch. Boiling the leaf in water kills the leaf's cells and prepares them for the next step—heating the leaf in alcohol, which removes its chlorophyll. This is done so that the chlorophyll will not mask the staining of the starch. Thus, the iodine reveals starch at the places that were under the light areas of the negative.

Connections

Photosynthesis is the process by which plants produce their own food. Plants use energy from sunlight to transform carbon dioxide taken from the air, and water taken from the soil, into carbohydrates: sugar and starch. These are the plant's sources of food energy. Food that is unused by the plant is stored in the cells of its leaves. This demonstration, testing a sample leaf for the presence of starch, shows the importance of light in the photosynthetic process.

Safety Precautions

READ AND COPY BEFORE STARTING ANY EXPERIMENT

Experimental science can be dangerous. Events can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. Basic safety procedures help prevent serious accidents. Be sure to follow additional safety precautions and adult supervision requirements for each experiment. If you are working in a lab or in the field, do not work alone.

This book assumes that you will read the safety precautions that follow, as well as those at the start of each experiment you perform, and that you will *remember* them. These precautions will not always be repeated in the instructions for the procedures. It is up to you to use good judgment and pay attention when performing potentially dangerous procedures. Just because the book does not always say “be careful with hot liquids” or “don’t cut yourself with the knife” does not mean that you should be careless when simmering water or stripping an electrical wire. It *does* mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, stop to find out for sure that it is safe before continuing the experiment. To avoid accidents, always pay close attention to your work, take your time, and practice the general safety procedures listed below.

PREPARE

- Clear all surfaces before beginning work.
- Read through the whole experiment before you start.
- Identify hazardous procedures and anticipate dangers.

PROTECT YOURSELF

- Follow all directions step by step; do only one procedure at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure that there is adequate ventilation.
- Do not horseplay.
- Wear an apron and goggles.
- Do not wear contact lenses, open shoes, and loose clothing; do not wear your hair loose.
- Keep floor and work space neat, clean, and dry.
- Clean up spills immediately.
- Never eat, drink, or smoke in the laboratory or near the work space.
- Do not taste any substances tested unless expressly permitted to do so by a science teacher in charge.

USE EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives and other sharp or pointed instruments with caution; always cut away from yourself and others.
- Pull plugs, not cords, when inserting and removing electrical plugs.
- Don’t use your mouth to pipette; use a suction bulb.
- Clean glassware before and after use.
- Check glassware for scratches, cracks, and sharp edges.
- Clean up broken glassware immediately.

- Do not use reflected sunlight to illuminate your microscope.
- Do not touch metal conductors.
- Use only low-voltage and low-current materials.
- Be careful when using stepstools, chairs, and ladders.

USING CHEMICALS

- Never taste or inhale chemicals.
- Label all bottles and apparatus containing chemicals.
- Read all labels carefully.
- Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves).
- Do not touch chemical solutions.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly.

HEATING INSTRUCTIONS

- Use goggles, apron, and gloves when boiling liquids.
- Keep your face away from test tubes and beakers.
- Never leave heating apparatus unattended.
- Use safety tongs and heat-resistant mittens.
- Turn off hot plates, bunsen burners, and gas when you are done.
- Keep flammable substances away from heat.
- Have a fire extinguisher on hand.

WORKING WITH MICROORGANISMS

- Assume that all microorganisms are infectious; handle them with care.
- Sterilize all equipment being used to handle microorganisms.

GOING ON FIELD TRIPS

- Do not go on a field trip by yourself.
- Tell a responsible adult where you are going, and maintain that route.
- Know the area and its potential hazards, such as poisonous plants, deep water, and rapids.
- Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold).
- Bring along a first-aid kit.
- Do not drink water or eat plants found in the wild.
- Use the buddy system; do not experiment outdoors alone.

FINISHING UP

- Thoroughly clean your work area and glassware.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Don't dispose of materials in the sink unless instructed to do so.
- Wash your hands thoroughly.
- Clean up all residue, and containerize it for proper disposal.
- Dispose of all chemicals according to local, state, and federal laws.

BE SAFETY-CONSCIOUS AT ALL TIMES