CAROLINA®
Teamed with Teachers

WISCONSIN
FAST PLANTS

Growing Instructions

Rapid-cycling *Brassica rapa*

- Suitable for all grade levels
- Illustrates all aspects of plant biology
- Short, 35-day life cycle (seed-to-seed)
- Yellow flowers in 12 to 14 days

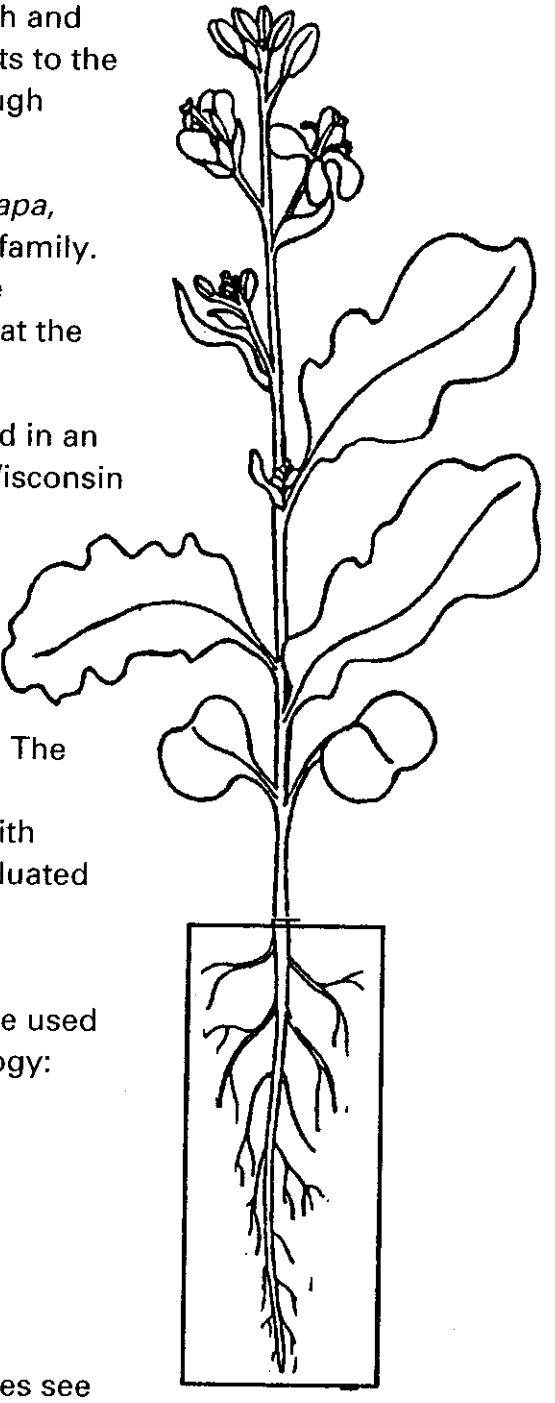
Table of Contents

Introduction to Wisconsin Fast Plants™ Materials

Wisconsin Fast Plants™ materials offer a unique teaching tool for exploring plant growth and development while introducing students to the process of scientific investigation through hands-on, inquiry-based activities.

Fast Plants are rapid-cycling *Brassica rapa*, members of the cabbage and mustard family. Wisconsin Fast Plants™ materials were developed by Professor Paul Williams, at the University of Wisconsin in Madison.

The efforts of Dr. Williams have resulted in an exciting, revolutionary teaching tool, Wisconsin Fast Plants™ educational materials, centered around a plant with a life cycle of 35–40 days (seed-to-seed).



The Wisconsin Fast Plants™ group has developed a series of classroom exercises using these plants. The exercises are suitable for all levels of education and are developed directly with teachers. Each exercise is used and evaluated in classrooms and revised after teacher evaluations.

Wisconsin Fast Plants™ materials can be used to teach the major aspects of plant biology:

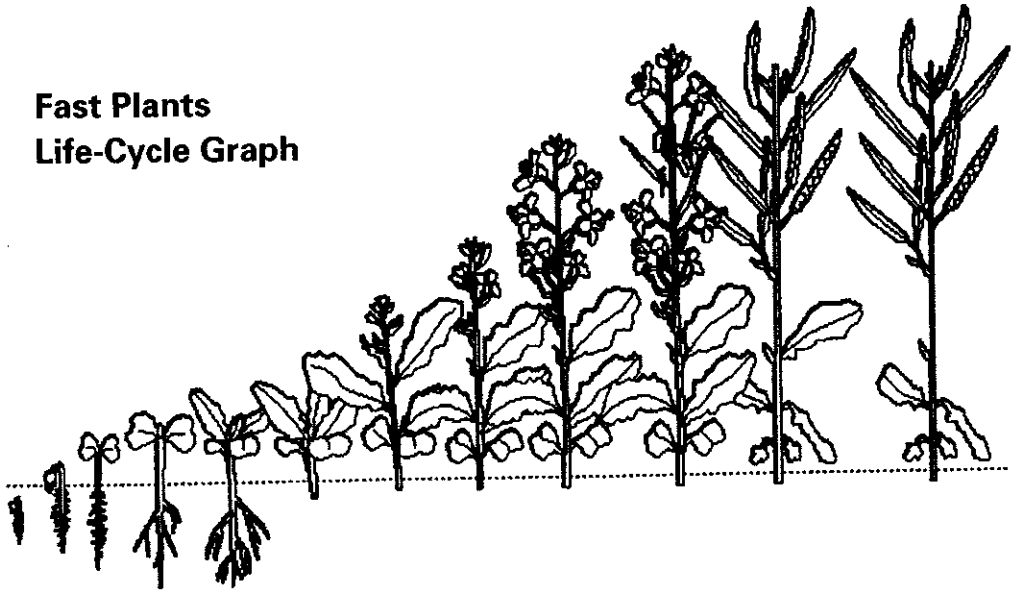
- anatomy
- pollination
- reproduction
- physiology
- growth and development
- genetics
- tropism
- ecology
- nutrition

For more information on specific activities see pg. 18.

Time Requirements

The entire life cycle takes 35–40 days, from planting to harvesting the seeds you have produced. The amount of time required to care for Fast Plants each day varies, depending on the task. On the days when students are just observing the plants, checking the water level in the reservoir, or making notes in their logs, only a few minutes are required. On other days when your students are planting, taking measurements, or pollinating, it may take an entire class period. And once the students have pollinated, the plants require little care (except for watering) until the day of harvesting the seed. (See Grower's Calendar, pg. 12).

Fast Plants
Life-Cycle Graph



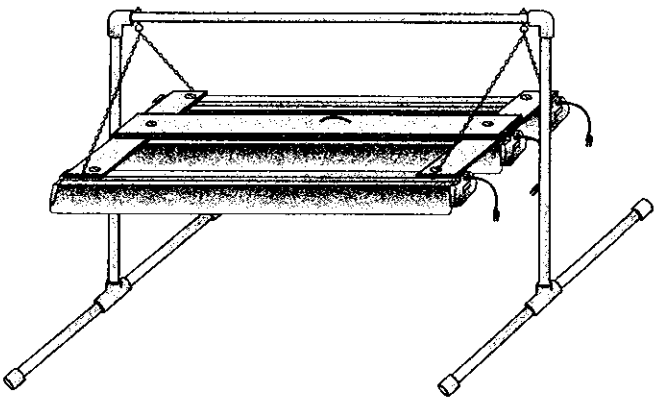
Fast Plants Life-Cycle Graph (Number of Days After Planting)

What You Need

- A Wisconsin Fast Plants™ Kit or your own growing system with seed. For alternative growing systems, see the Wisconsin Fast Plants™ Program website, www.fastplants.org.
- A bank of cool-white fluorescent lights—a minimum of 6 bulbs—is recommended for a light bank. You also may use circular fluorescent lights.
- A light rack or plant cart to suspend lights above the plants.

Lighting

You need *fluorescent lights*. Wisconsin Fast Plants™ grow best near an intense source of light. They will not be grown successfully with the light available on a windowsill or in a greenhouse. To grow strong, healthy plants that complete the life cycle in 40 days, you must consider the following:



Light Bank and Light Rack

- Use 4-foot, cool-white fluorescent bulbs, either the original 40-watt bulbs or the updated 32-watt energy savers. **Cool-white fluorescent lighting is necessary 24 hours a day during the entire life cycle.**
- A light bank should have at least six 4-foot cool-white bulbs.
- For other lighting options, see the Plant Light House, pg. 25, or check out the Wisconsin Fast Plants™ Program website.

The Wisconsin Fast Plants™ Kit

Most Classroom Kits are designed for use by up to 32 students (working in pairs). The Student Kits are designed for classroom demonstrations, or for use by up to 6 students (great for home schooling or science fairs).

Each kit contains the seed, an automatic watering system, planting units (quads or pots), pollination materials, plant stakes, pot labels, fertilizer, activities, and Growing Instructions.

The Wisconsin Fast Plants™ materials are low maintenance. The automatic watering system provides sufficient water to last 3–4 days, and the slow-release fertilizer is only applied once, at planting. Many of the Classroom Kit components are reusable, and refills are available from Carolina Biological Supply Company.

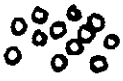
If you have not purchased a kit, then be sure to check out the more detailed growing instructions on the Wisconsin Fast Plant™ Program website at

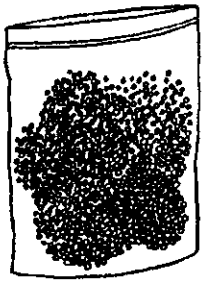
www.fastplants.org

for information about different soils and fertilizers that can be used in growing the plants.

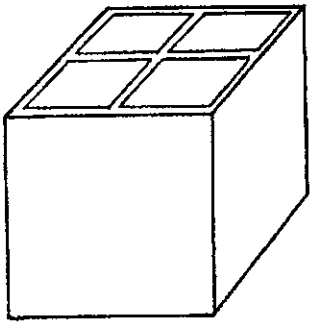
Wisconsin Fast Plants™ Kit Materials (not drawn to scale)

A. Wisconsin Fast Plants™ Seed—rapid cycling *Brassica rapa* (Rbr). Seeds are small and have to be handled with care.



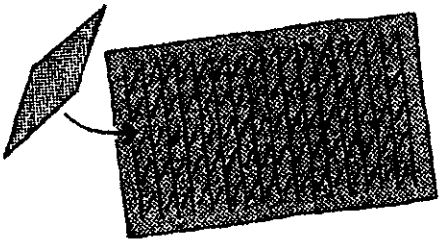


B. Quads—planting units made of 4 individual compartments called cells. Each cell holds one plant.

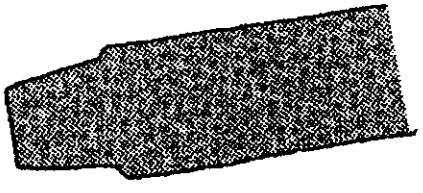


C. Potting Mix

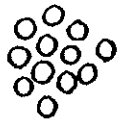
D. Diamond Wicks—conduct water from water mat to soil in cell of quad.

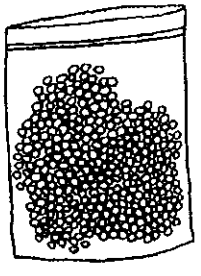


E. Water Mat—conducts water from reservoir to wicks.

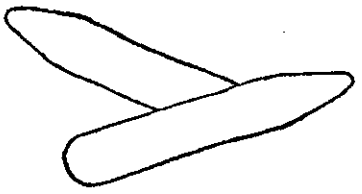


F. Fertilizer Pellets—slow-release source of nutrients: nitrogen (N), phosphorus (P), and potassium (K). **Note: Pellets are larger than the seeds.**



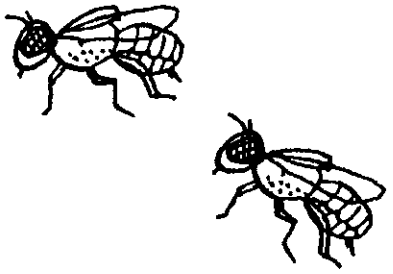


G. Plant Labels—to record student name, planting date, and experiment.

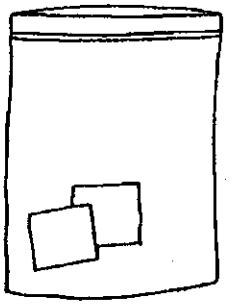


H. Pipet—to water cells from above when necessary.

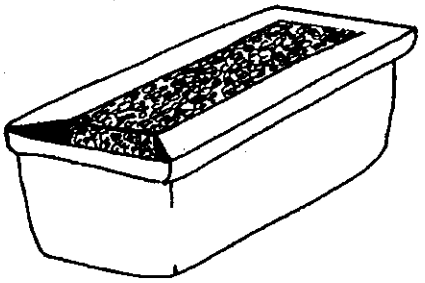
I. Dried Honeybees—to make beesticks for pollinating



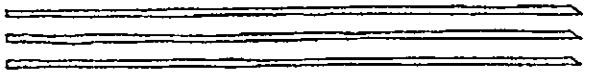
J. Anti-Algae Squares (tinged blue)—contain copper sulfate to prevent growth of algae in reservoir.

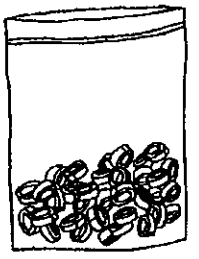


K. Water Reservoir



L. Wooden Stakes and Plastic Support Rings—to support the plants if necessary.





Items required for growing Wisconsin Fast Plants but not included in kit:

toothpicks with a sharp end

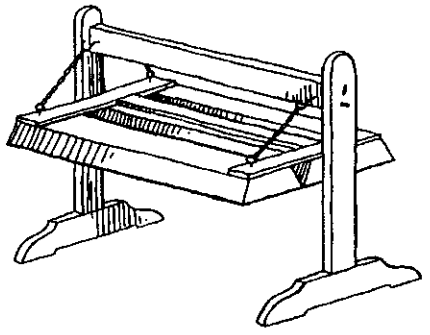
glue

light source

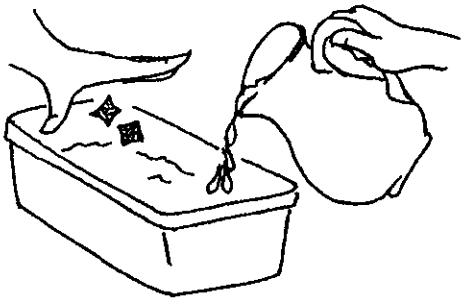
Illustrated Growing Instructions

Getting Ready

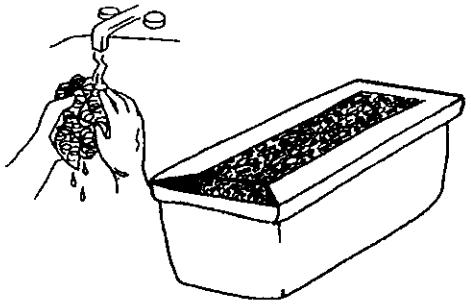
1. Set up your lighting system



2. Fill reservoirs with water and drop in blue algae-control squares. Snap on lid.

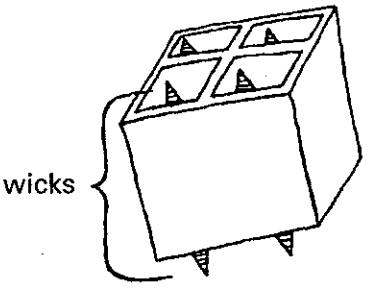


3. Saturate water mat and lay it on reservoir lid with end of mat extending into water. **Note: Be sure mat is thoroughly wet.**

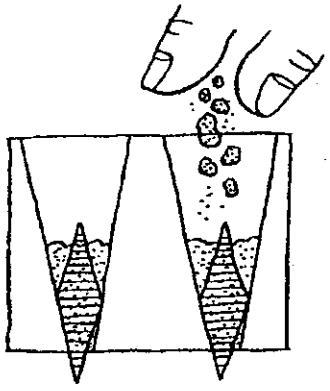


Planting: Day 1

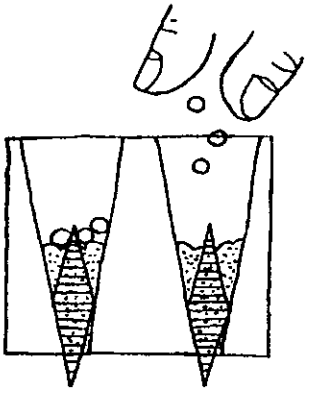
4. Drop one wick into each cell so that the tip extends halfway out of the hole in the bottom (about 2 cm).



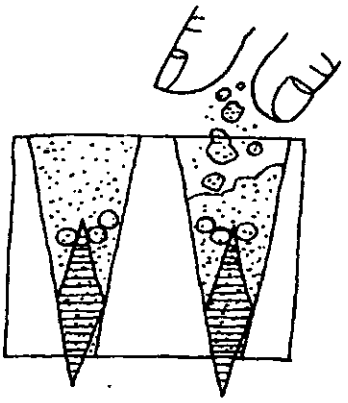
5. Moisten soil *slightly*. Fill each quad cell halfway with soil.



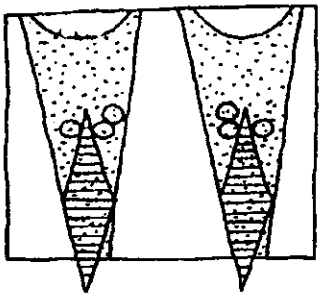
6. Add 2–3 fertilizer pellets to each quad cell.



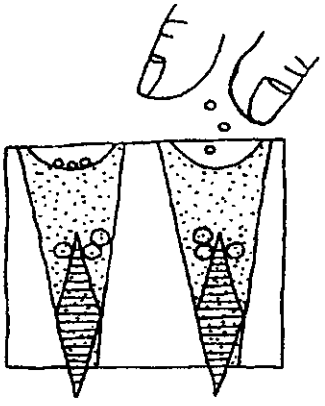
7. Fill each cell to the top with moistened soil.



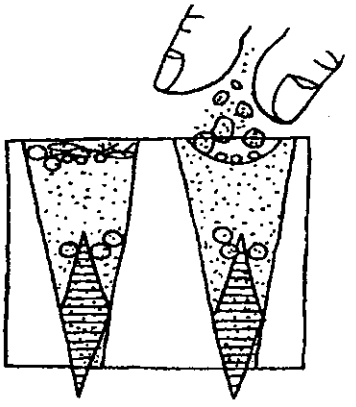
8. Make shallow depressions on top of each cell. Do not press hard and compact soil.



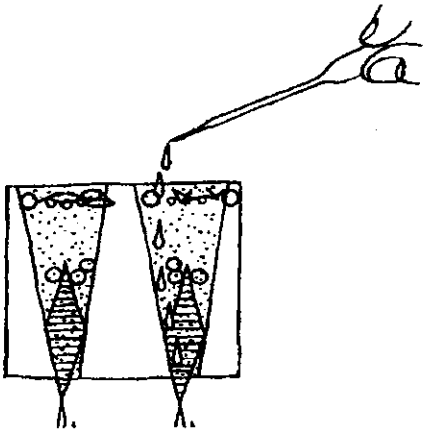
9. Drop 2–3 seeds in each depression.



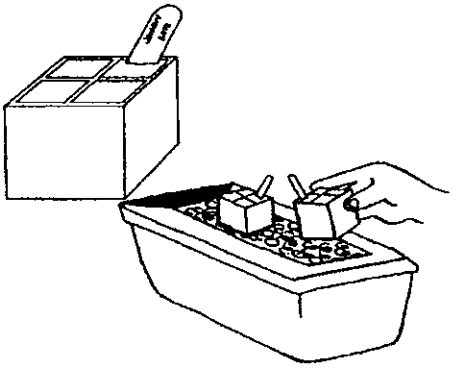
10. Sprinkle enough potting mix to cover seeds in each cell.



11. Water very gently with pipet or squirt bottle until water drips from each wick. Be careful not to wash seeds out of cells.

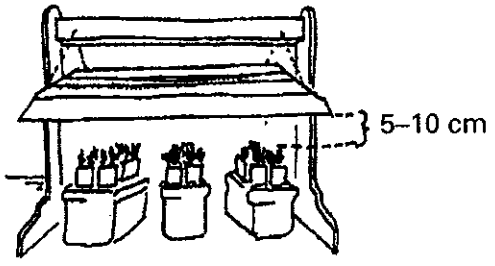


12. Label each quad with date and student's name. Place quads on water mat.



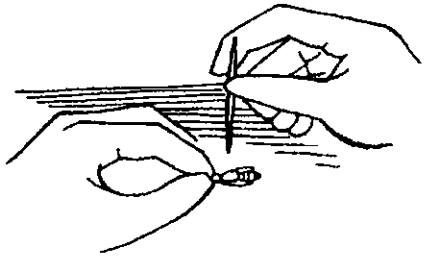
Illustrated Growing Instructions (continued)

13. Position top of quad 5–10 cm below the lights. Water from the top with pipets or a squirt bottle for the first 3 days. Remember to keep the reservoirs full.



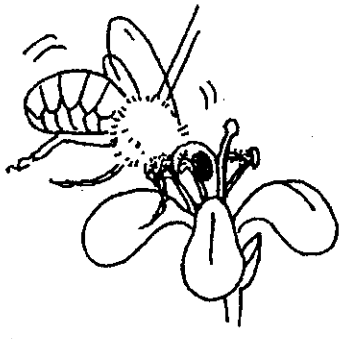
Making Beesticks: Day 12

15. Place a drop of glue on the tip of a toothpick. Push the toothpick into the bottom of the thorax (middle section) of one bee to create a beestick.



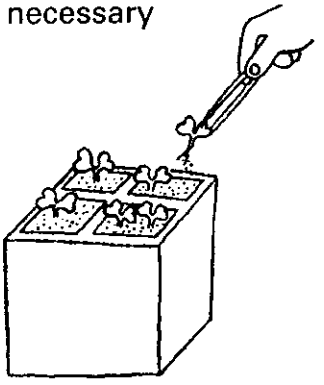
Pollinating: Days 13 to 16

17. Pollinate with beesticks by brushing the bee over flowers to pick up and distribute pollen.

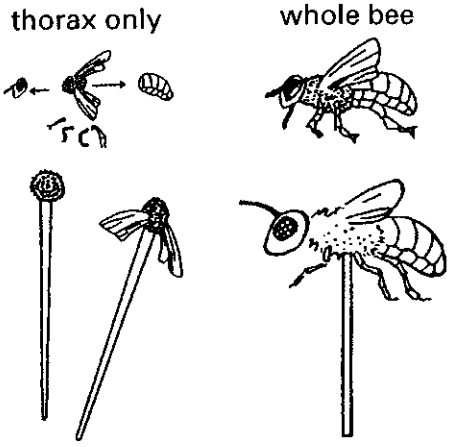


Thinning Plants: Day 4 or 5

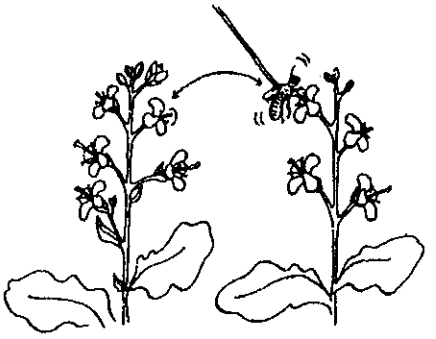
14. Thin to one plant per cell. Transplant extra seedlings to cells without plants if necessary



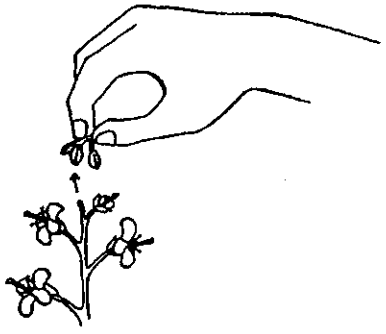
16. Let beesticks dry before use.



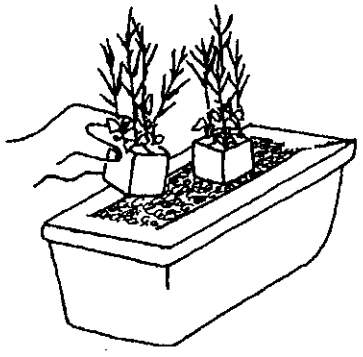
18. Pollen must be transferred back and forth among different plants (cross-pollination). The plants do not self-pollinate.



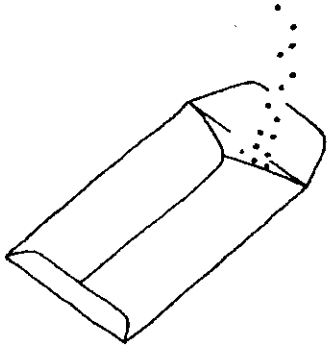
19. Pinch off unopened buds on the last day of pollination and write the date on the plant labels.



21. Twenty days after the last pollination, remove plants from water and allow to dry for 5 days.



23. Place the seeds in labeled envelopes. Store seeds in a cool, dry place.

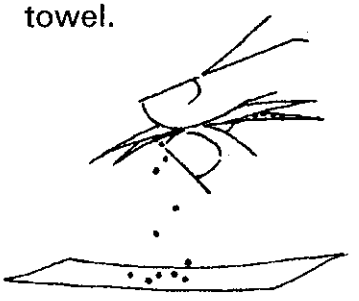


Observing Seed Pod Development: Days 17 to 35

20. After pollination, seed pods and seeds develop. Seed pods begin to elongate within 3–5 days, and flower petals drop off. Seeds mature in 20 days.

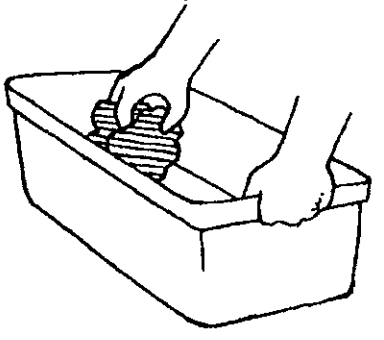
Harvesting: Day 40

22. Harvest seeds by gently rolling dry seed pods between hands over a paper towel.



Cleaning Up

24. After harvesting, clean water reservoirs, platforms, and quads by soaking in 10% bleach solution. Scrub and rinse. Let air dry.

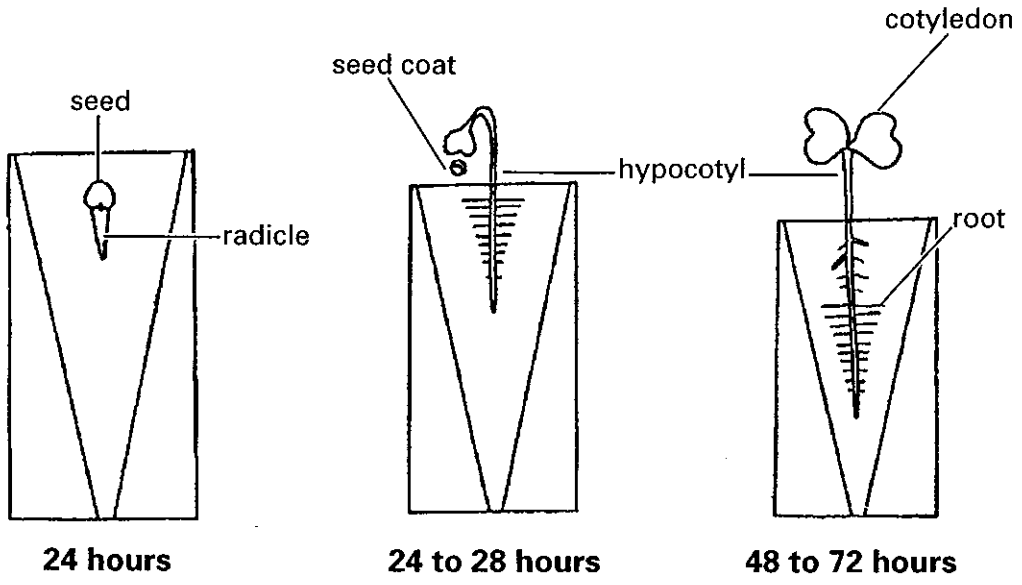


Grower's Calendar

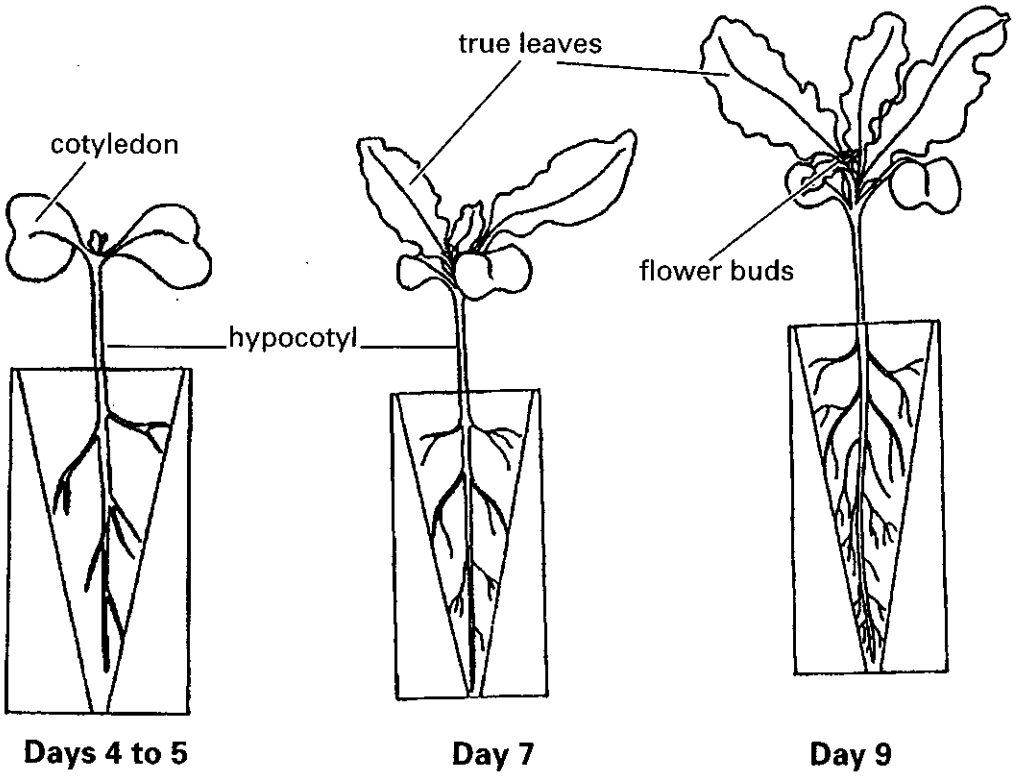
Day of Cycle *(time required)*	**Activities**
Preparation (1.5 hours) Date:_____	Assemble light bank and rack. Set up reservoirs. Saturate water mat according to growing instructions. Arrange all plant materials.
Day 1 (1 hour) Date:_____	**Plan to plant seeds on a Monday or Tuesday.** Plant seeds. Water from above, label, and set quads on water mat with top of quad 5–10 cm from the lights.
Day 2–3 Date:_____	Water from top with pipet. Cotyledons emerge.
Day 4–5 (40 min) Date:_____	Thin to 1 plant per cell. Transplant if necessary to obtain 1 plant in every cell. Check the water level in the reservoir!
Day 6–11 (15 min/day) Date:_____	**Check plants and reservoir level daily throughout the rest of the life cycle.** Observe growth and development.
Day 12 (30 min) Date:_____	Make beesticks. Flower buds begin to open.
Day 13–18 (15 min/day) Date:_____	Pollinate for 2–3 consecutive days. On the last day of pollination, pinch off any remaining unopened buds.
Day 17–35 Date:_____	Observe seed pod development Embryos mature in 20 days.
Day 36 Date:_____	Twenty days after the last pollination, remove plants from water mat. Allow plants to dry for 5 days.
Day 40 (30 min) Date:_____	Harvest seeds from dry pods. Clean up all equipment. Plant your own seeds or store them appropriately.

Stages in the Wisconsin Fast Plants™ Life Cycle (not drawn to scale)

Days 1–3: The radicle (embryonic root) emerges. Seedlings emerge from the soil. Two cotyledons (seed leaves) appear and the hypocotyl extends upward. Green (chlorophyll) and purple (anthocyanin) pigments can be seen.

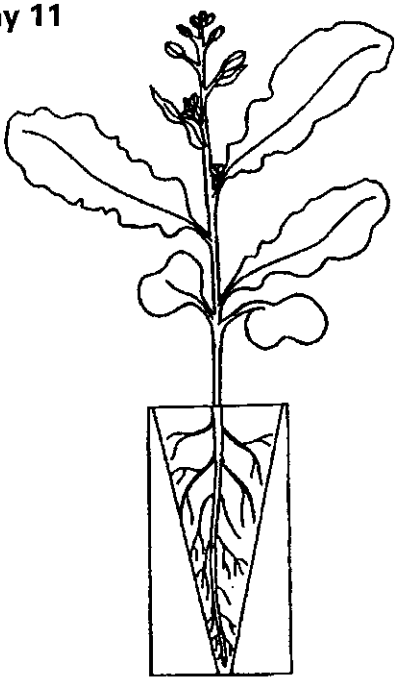


Days 4–9: Cotyledons enlarge. True leaves emerge and develop. Flower buds appear in the growing tip of the plant.

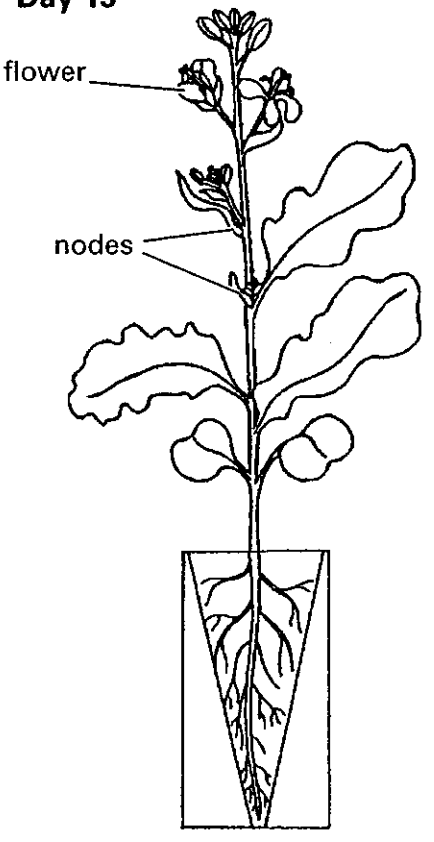


Day 10–12: Stem elongates between the nodes (points of leaf attachment). Flower buds rise above the leaves. Leaves and flower buds continue to enlarge.

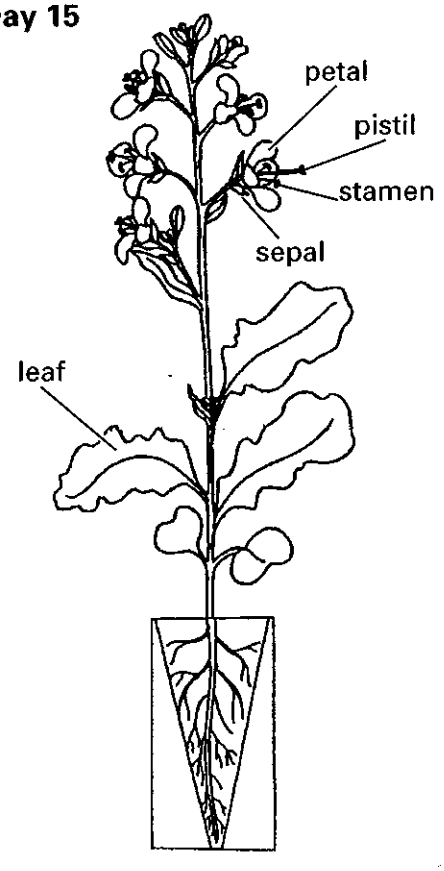
Day 11



Day 13



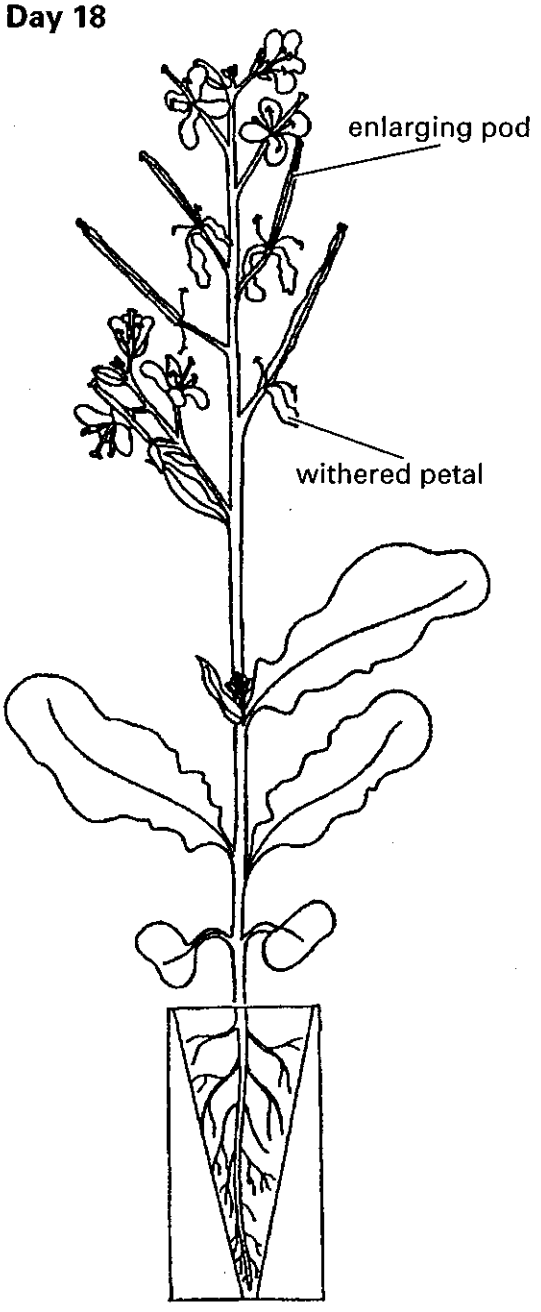
Day 15



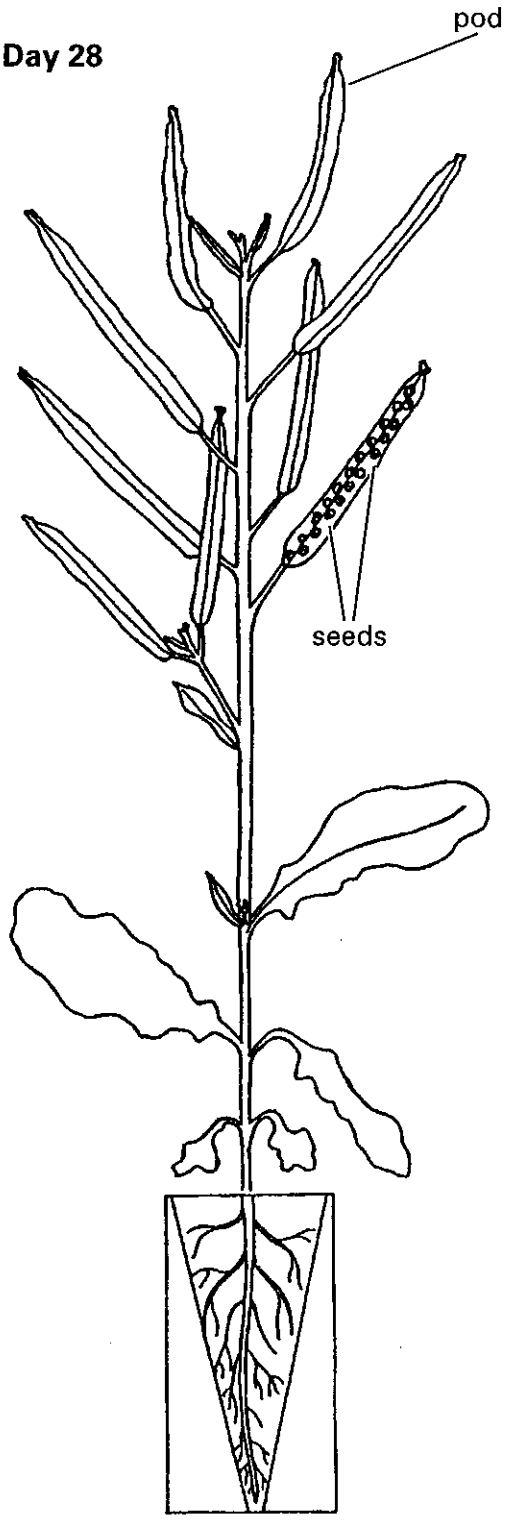
Days 13–17: Flowers open. Floral parts can be identified. Flowers can be cross-pollinated (from one plant to another) for 3–4 days. Pollen is viable for 4–5 days, and stigmas remain receptive to pollen for 2–3 days after a flower opens. After final pollination, prune off the remaining **unopened** flower buds and side shoots. Pruning directs the plant's energy into developing the seeds on pollinated flowers.

Day 18–22: Petals drop from the pollinated flowers. Pods elongate and swell. Development of the seed will continue until approximately day 36.

Day 18



Day 28



Days 23–36: Seeds mature and ripen. Lower leaves yellow and dry. Twenty days after final pollination (about day 36) plants should be removed from water.

Days 36–40: Plants dry down and pods turn yellow. On day 40, pods can be removed from dried plants and seeds can be harvested.

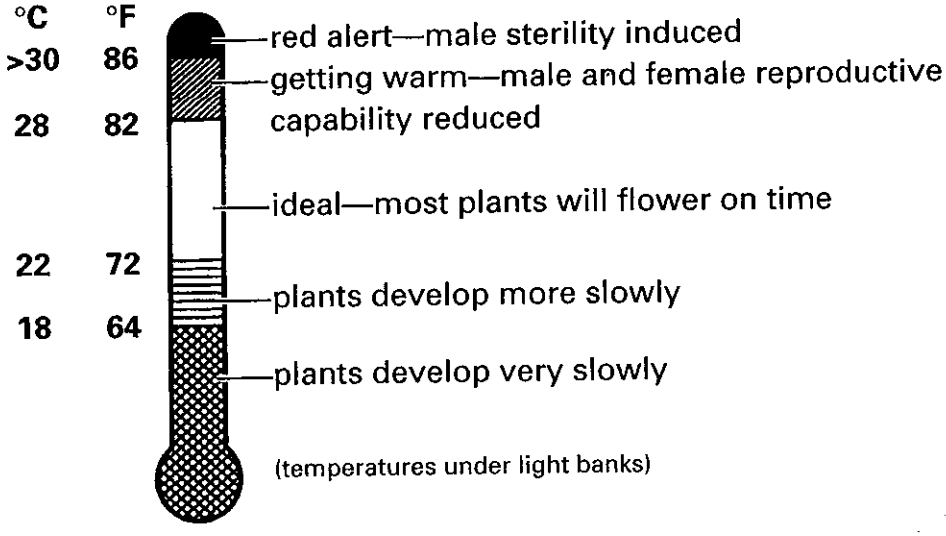
Growing Tips and Suggestions

- Before you start, set up light banks. (For information on construction of a light bank, see pg. 22–24). Then, complete Steps 2 and 3 of the illustrated Growing Instructions (pg. 8).
- **Twenty-four hour lighting is essential for the success of your Wisconsin Fast Plants™ projects.** Follow the equation below. For more information on lighting, go to the Wisconsin Fast Plants™ website at www.fastplants.org

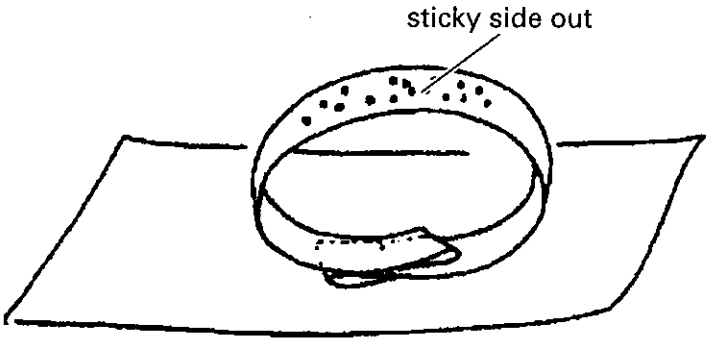
Lighting Formula for Successful Growth

Six 40-W bulbs (or 32-W high-efficiency bulbs), **supplying 24 hours of light per day.** + Rotate your plants under the light. Light is most intense near the center of the light bank. + Keep tops of plants between 5 and 10 cm from the lights. = **Healthy plants**

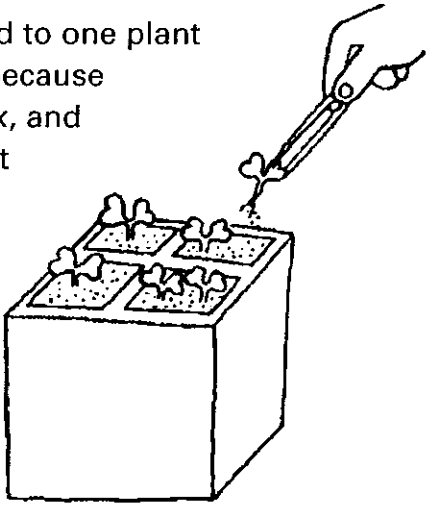
- Temperature can influence the growth and development of your plants. The optimal temperature range for your plant environment is 72–82°F. Remember that the temperature in the plant canopy under lights may be 1–3°F warmer than the room's air temperature.

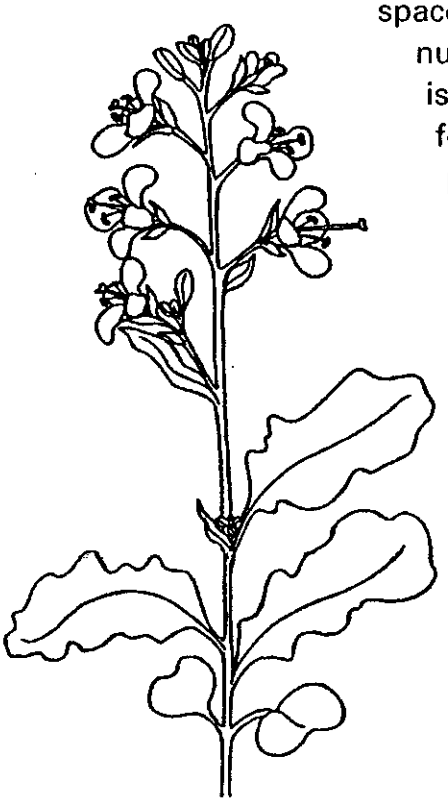


- Fertilizer pellets are larger than Wisconsin Fast Plants™ seeds.
- For easier seed handling, sprinkle a few seeds on a piece of clear tape. Make a loop of the tape (sticky side out) and attach to a paper card. Each student can pick seeds off the seed tape when planting.



- The watering system is based on wicking (capillary action). The wet water mat draws water from the reservoir onto the platform. Wicks in the bottom of each cell draw water into the moistened potting mix.
- Water carefully with pipets or squirt bottles to keep seed from washing out.
- Check plants and water level daily. Fill the reservoir to the brim before weekends.
- Fast plants must be thinned to one plant in each cell of the quad because space, potting mix, and nutrient content is calculated for only one plant per cell.



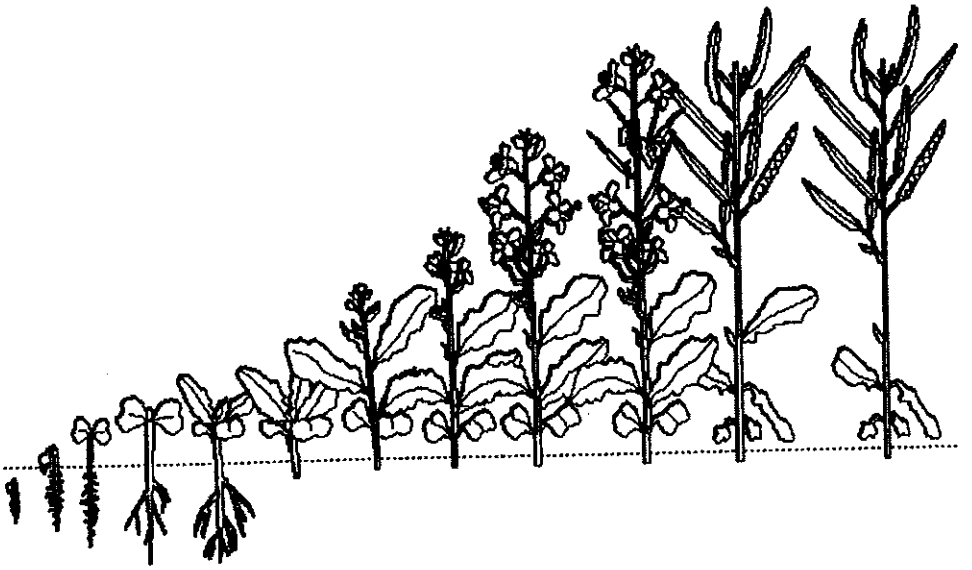


- Staking plants as they get taller is optional.
- Wisconsin Fast Plants™ are edible, flowers and all.

Suggested Activities with Wisconsin Fast Plants™ for Various Stages in the Life Cycle

Day in the Life Cycle	Activity
Day 1–2	Bioassays
Day 1–3	Germination experiments
Day 1–4	Tropism experiments Effects of salt or chemicals
Day 5–17	Count developing leaves
Day 5–20	Measure plant height
Day 7	Modify atmosphere —with volatiles —with particulates
Day 7–21	Nutritional studies
Day 12	Make beesticks
Day 13–16	Study flower parts Pollinate Plant breeding experiments
Day 17–35	Seed pod development
Day 40	Harvest pods

For more information on these activities and others, contact the Wisconsin Fast Plants™ website (www.fastplants.org) or call 1-800-462-7417.



Educational and Research Topics with Wisconsin Fast Plants™

Growth and Development

- Seed germination (2 days), leaf development, stem elongation, flowering (13 to 16 days), fruit (pod) and seed maturation
- Growth responses
- Plant morphology: root, stem, leaf, flower

Reproductive Biology

- Flower development: male and female flower parts
- Pollen and pollination: role of bee sticks
- Fertilization
- Embryogenesis

Genetics

- Mendelian: gene expression, dominance, interaction
- Mendelian: gene assortment, interdependence, linkage; F_1, F_2 testcross
- Non-Mendelian: maternal inheritance
- Non-Mendelian: continuous variation, quantitiative traits
- Selection
- Evolution

Physiology (mechanisms for underlying growth and development)

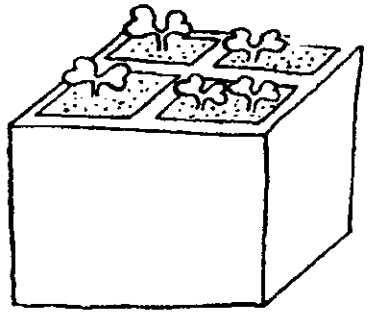
- Using numerous physiological mutants
- Growth hormone responses
- Photosynthesis
- Nutrition: effects of major and minor elements on growth and reproduction
- Water relations: excesses and deficiencies
- Photoresponses: light intensity, photoperiod and flowering, tropism

Ecology

- Effects of chemicals in environment on plant growth and development:
  - salt injury
  - herbicide resistance
  - pollution effects
  - acid rain impact
- Disease resistance:
  - effect on plants
  - microbe-plant interactions

Troubleshooting

Poor Germination (no seedling emergence)

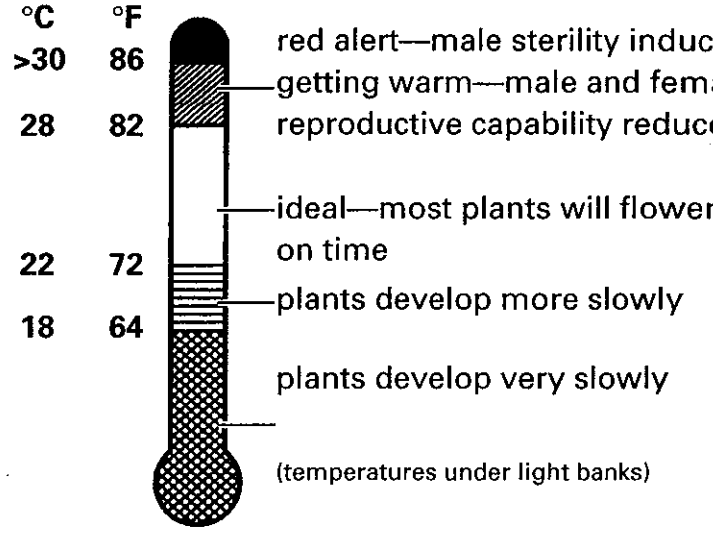


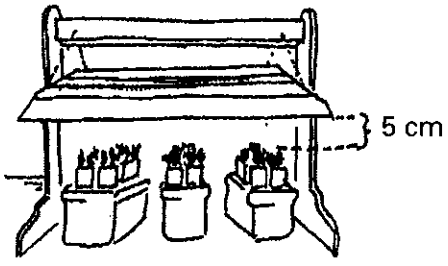
- Seeds planted too deep in quad
- Potting mix compacted, or too wet when dropped into planting container
- Quad not watered carefully from the top for the first 3 days
- Seeds washed out of quad
- Room temperature below 60°F (15.5°C)
- Fertilizer pellets were planted instead of seeds

If seedlings do not appear by day 4, start over.

Slow Growth

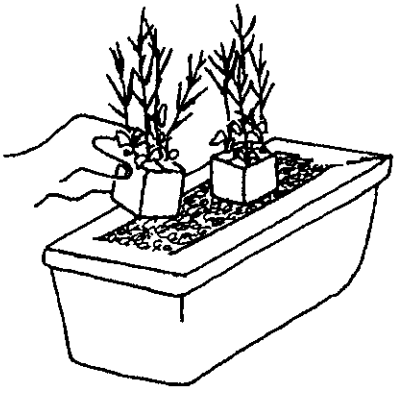
- Lower temperature in school than normal on nights, weekends, and holidays
- Fewer than 6 cool-white fluorescent bulbs in light bank
- Plants growing at lower temperature due to location near window in winter





Spindly Plants

- Less than 6 cool-white fluorescent bulbs in light bank
- Aphids or other pests
- Lights too far away from plants (should be 5–10 cm from growing tip)
- Fertilizer not added to each cell (insert fertilizer pellets at corners of cell and push below potting soil surface)
- Too much fertilizer added to each cell

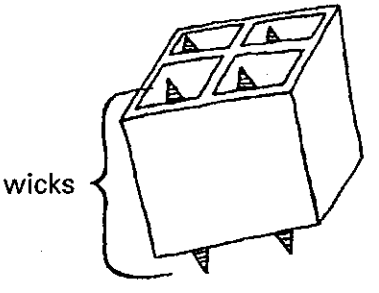


Plants Wilt

- Plants are left unwatered (over the weekend, for example). If plants are wilting (but not yet crisp), you may be able to save them. Fill reservoirs with water and float the quads in the water while adding water from above with pipets. Allow the quads to float on the water until plants are turgid again. Re-soak the water mat and return the quads to the mat.
- Wicks are not in contact with the water mat.

Plants Die

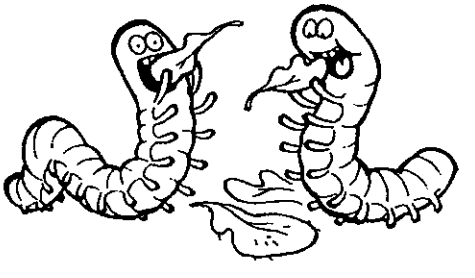
- Wicks not placed correctly in bottom of quads
- Water mat not touching water (may be stuck to bottom of platform)
- Water mat not wet thoroughly and/or all air pockets not removed when watering system was set up
- Water mat clogged and not wicking water (wash mat in 5% vinegar solution and rinse thoroughly)
- Quad not completely on water mat (check quads at end of each day)
- Water in tray ran out over weekend (always check water on Fridays!)



- Plant damaged during thinning (handle gently)
- Plant damaged during movement (as plants grow taller, stake and secure them with plastic rings)

Insects

- Lady beetles can be used as a biological pest control. (Order some from Carolina Biological Supply Company.)
- Remove the insects from your plants by hand and pinch them.
- Use an insecticidal soap.
- Consult a garden store.



Constructing a PVC Light Rack and Light Bank

Note: Available from Carolina (15-8998) (some assembly required)

Tools

flathead screwdriver

Phillips screwdriver

pliers

Hardware

3 fluorescent light fixtures (each holding 2 48" tubes)

4 3/16- × 1½" bolts and 4 nuts

2 3/16- × 2½" bolts and 2 nuts

4 eye screws (size 6)

2 3/16- × 2½" eye bolts and 2 nuts

4 18" lengths of chain

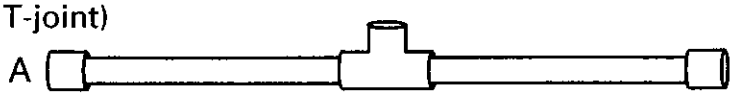
8 S-hooks

1 power cord

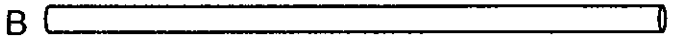
1 sash handle with screws

Parts list*

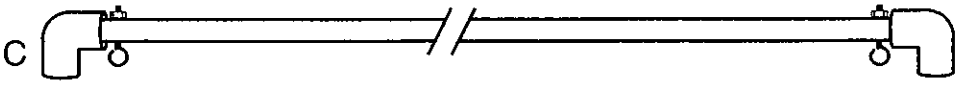
A. 2 bases (each consisting of 2 10" lengths of 1" PVC pipe, 2 end caps, and a T-joint)



B. 2 side supports (24" lengths of 1" PVC pipe)



C. 1 cross bar (51½" length of 1" PVC pipe, 2 elbows, and 2 eye bolts with nuts)



D. 2 ¾- × 3½- × 17" boards (with metal eye screws on each end)

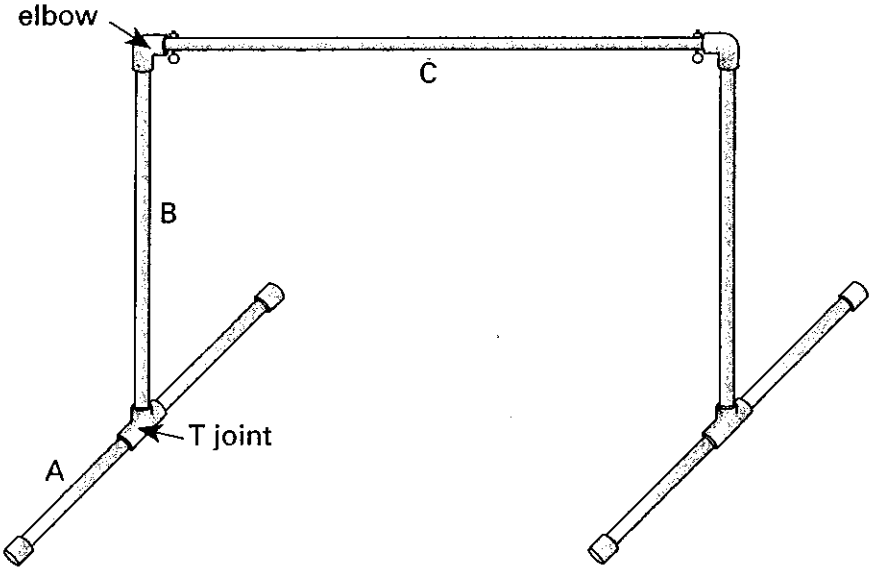
2 holes drilled 1½ in from each end and 1 hole in center, all 1 in from one side

E. 1 1- × 2- × 46½-in board, holes drilled 2½ in from ends

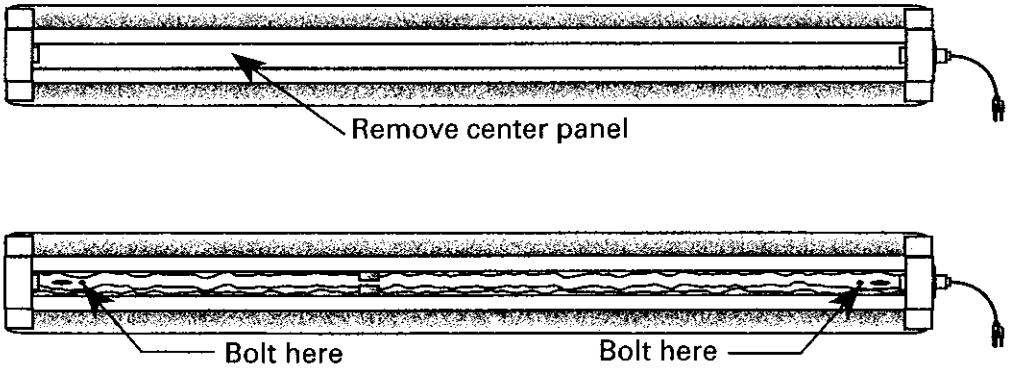
***Note:** The PVC pipe and lumber in the Fluorescent Light Bank Kit (15-8998) come predrilled and partially assembled. The components of parts A and C have been glued with PVC cement. If you are supplying your own materials, purchase them according to the above descriptions of parts A–E, along with necessary hardware.

Instructions

1. Push end of side piece B into opening of T-joint in base A. Repeat with other B and A. Then push the other side of piece B into the elbow of the cross bar C to complete the support frame.



2. Remove all light fixtures from boxes. Using a screwdriver, remove center panel from underside of fixtures, exposing holes in light fixtures that will be used for attaching fixtures to boards D and E.

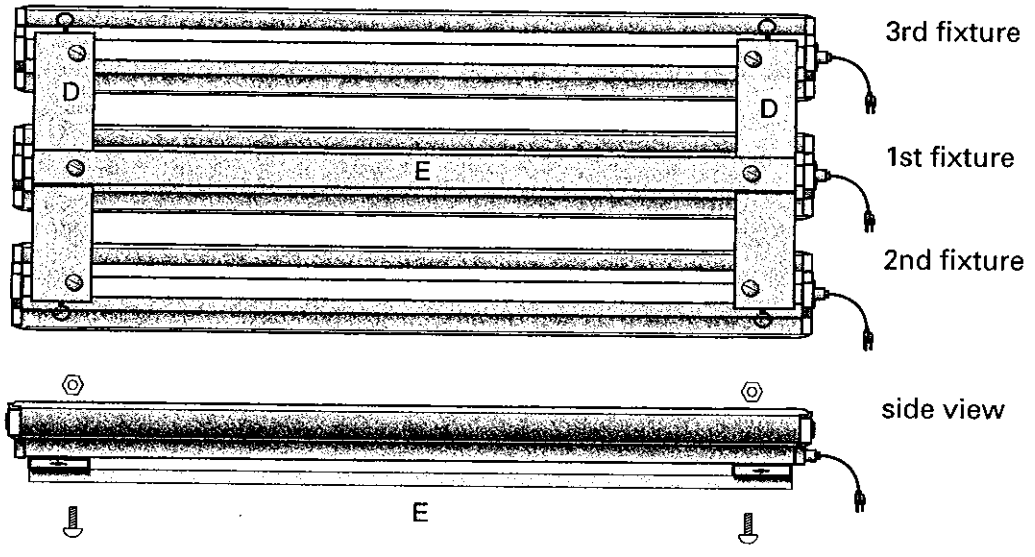


3. Place board E on a table. Place a board D on each end of E so that each hole on board E lines up with the center holes of the boards D. Place the 1st light fixture on two boards D and the ends of board E as shown below. Bolt the three pieces together using two 3/16- × 2½" bolts and two nuts.

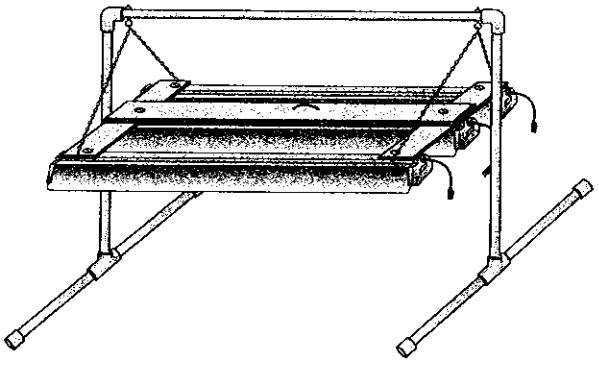
4. In the same manner, attach the two other fixtures to the ends of boards D using four 3/16- × 1½" bolts and four nuts. Replace center panels on underside of fixtures.

5. Attach the sash handle to center of board E using the screws that come with the handle. This completes the light bank.

6. Attach light bank to support frame using four chains and S-hooks.



This arrangement allows you to adjust the height of the light bank as the plants increase in height. Keep growing tips of plants about 5–10 cm from the bulbs. Gradually raise the lights as plant height increases. At maturity, plants and quads need 35.5–40.5 cm of space below the bulbs.

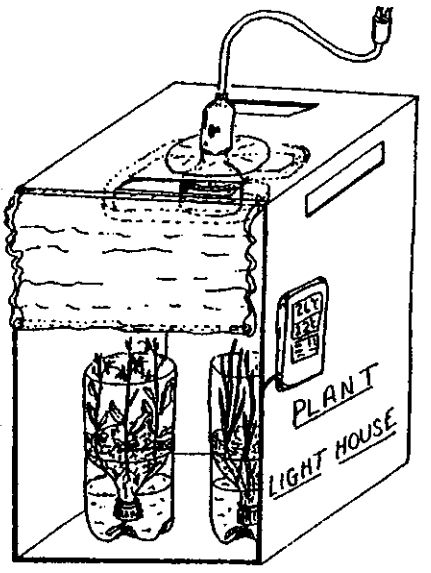


The plants will complete their life cycle in 40 days only with 24 hours of light per day and with the recommended light intensity. If your light source has less than six 40-watt bulbs or you allow more than 5–10 cm from growing tip to bulb, plants will grow tall and spindly, and the time to complete the life cycle will be extended several days. Fewer seeds may also be produced.

Constructing a Plant Light House

Materials

an empty copy paper box
aluminum foil
electrical cord with socket
small plastic plate or lid
glue stick
clear tape (¾")
scissors
30-W fluorescent circle light
(Lights of America) or a
39-W GE circle light



Construction

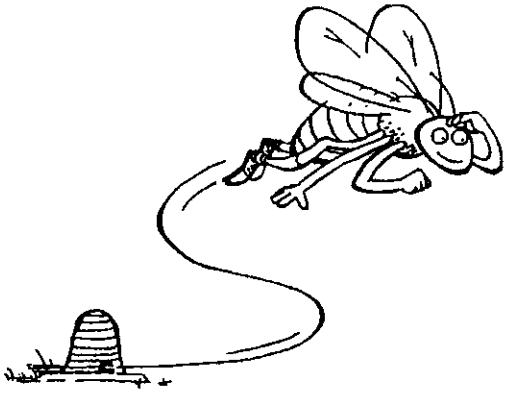
1. Cut a 1" hole in the center of a plastic plate and trim off edges to make approximately a 4–5 inch disk with a center hole.
2. Cut two 4- × 14-cm ventilation slots in top, upper side, and back of box as shown.
3. Cut a 1" diameter hole in the center of box side. This will become the top of the light house.
4. Apply glue stick to each inner surface and past aluminum foil to cover entire inner surface. Use clear tape to reinforce corners and edges if you wish.
5. Insert light fixture base through hole in top and through plastic plate. Secure fixture by attaching socket.
6. Tape an aluminum foil curtain over the open side of the box. This will become the front.
7. Strengthen curtain edges with tape. Tape or clip weights (e.g., wood strip) on bottom of curtain. Your Light House is ready!

Remember: Fast Plants require 24 hours of light. Keep plants 10 cm from the light source.

Wisconsin Fast Plants™ Manuals and Resources

Exploring with Wisconsin Fast Plants™

This manual is an elementary/middle school teacher resource. This fully indexed version includes new activities and a new section entitled "Variation, Heredity and Evolution." "Concept" statements have been added to the beginning of four sections: these statements are meant to assist teachers in aligning Fast Plants™ activities with the AAAS Benchmarks and the National Research Council's Science Standards. This teacher resource manual emphasizes an open-ended, process-centered science approach. Originally targeted to lower grade levels, it is widely used as a source of ideas by high school and college educators and for inservice training. This manual contains all information for growing Wisconsin Fast Plants™ seeds as well as ideas for explorations of the plants' life cycle, physiology, and ecology. 288 pages. Carolina catalog number: 15-8951.



Bottle Biology

Grades 2 and up. Developed by the Wisconsin Fast Plants™ Program, this innovative book is a perfect companion to *Exploring with Wisconsin Fast Plants.*

Bottle Biology is full of ways to use plastic soda bottles and other recyclable materials to teach about science and the environment. The projects promote science as a tool everyone can use to explore the world. Use Wisconsin Fast Plants™ materials or other living organisms to model a rainforest, create a spider habitat, explore an ecosystem, or learn about composting. Each chapter contains background information, activities, and teaching tips. 127 pages. Carolina catalog number: 15-8959.

Wisconsin Fast Plants™ Manual

This complete manual contains background information, taxonomy of brassicas, growing instructions, and procedures for Wisconsin Fast Plants™ exercises and activities designed for middle and high school. Although not all activities may be suited for lower grade levels, many can be adapted for younger students by simplifying the instructions and leaving out the more sophisticated portions of some exercises.

Includes activities:

- *Investigating Growth and Development.* Exercises on germination, seedling development, and tropism.
- *Investigating Plant Physiology.* Exercises on plant responses to growth hormones and to varying amounts of fertilizer.
- *Investigating Mendelian Genetics.* Exercises on monohybrid and dihybrid genetics.
- *Investigating Non-Mendelian Genetics.* Exercises on cytoplasmic (maternal) inheritance.
- *Investigating Ecology.* Exercises on salt pollution, acid rain, ionizing radiation, and other ecological conditions.

(Chapters are also sold separately as activity booklets)
Carolina catalog number: 15-8950.

STC™ (Science and Technology for Children) Curriculum Units

Plant Growth and Development. Developed for Grade 3.

	Carolina catalog number
Teacher's Guide	97-1902
Student Activity Book	97-1903
Complete Unit (with materials)	97-1901

Experiments with Plants. Developed for Grade 6.

	Carolina catalog number
Teacher's Guide	97-3102
Student Activity Book	97-3103
Complete Unit (with materials)	97-3101

Video

	Carolina catalog number
Wisconsin Fast Plants™—The Basics	49-5229

The Wisconsin Fast Plants™ Program (WFP) and Carolina Biological Supply Company

Since 1986, the Wisconsin Fast Plants™ Program has developed innovative educational and research materials for teachers, scientists, and students around the world. Funding has allowed WFP to develop an integrated network of teachers, scientists, and students dedicated to improving science education (six previous grants from the National Science Foundation, the Kellog Foundation, and NASA). The Wisconsin Fast Plants™ Program is a unique educational development program. Rather than adhering to a proscribed curriculum, teachers and school systems are encouraged to develop their own particular emphasis and approaches to hands-on, investigative science by using Fast Plants as a learning tool.

The success of rapid-cycling *Brassica rapa* as a model organism is partly due to the cooperation between the Wisconsin Fast Plants™ Program, Carolina Biological Supply Company, and educators. As developers, distributors, and users, all contribute toward bringing new ideas and materials to teachers in all grade levels.

Carolina and the Wisconsin Fast Plants™ Program conduct workshops using Fast Plants throughout the year. For more information on the next workshop, please contact the Wisconsin Fast Plants™ Program at the University of Wisconsin in Madison:

website: www.fastplants.org
email: wfp@fastplants.cals.wisc.edu
telephone: 1-800-462-7417

Carolina strives to provide exceptional service and quality products. If you have any questions regarding the Wisconsin Fast Plants™ products, please contact Carolina Biological Supply Company:

website: www.carolina.com
email: cbsstaff@carolina.com
telephone: 1-800-227-1150

For ordering Wisconsin Fast Plants™ kits and seed call 1-800-334-5551, or order on-line at www.carolina.com.

To order call:
1-800-334-5551 (US and Canada)
336-584-0381 (International)

For technical help call:
1-800-227-1150

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