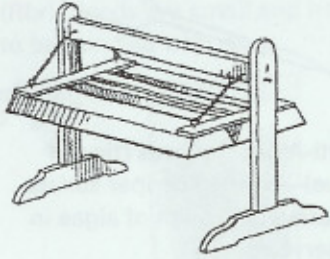


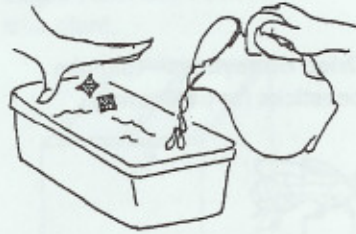
# Illustrated Growing Instructions

## Getting Ready

1. Set up your lighting system

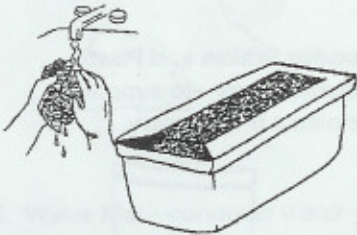


2. Fill reservoirs with water and drop in blue algae-control squares. Snap on lid.



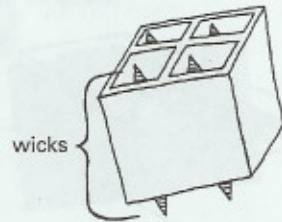
3. Saturate water mat and lay it on reservoir lid with end of mat extending into water.

**Note: Be sure mat is thoroughly wet.**

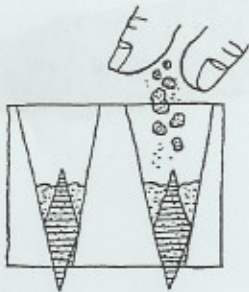


## Planting: Day 1

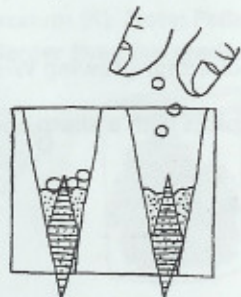
4. Drop one wick into each cell so that the tip extends halfway out of the hole in the bottom (about 2 cm).



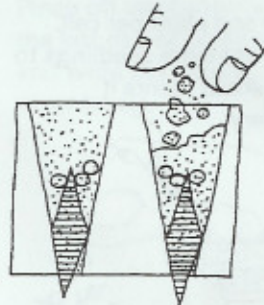
5. Moisten soil *slightly*. Fill each quad cell halfway with soil.



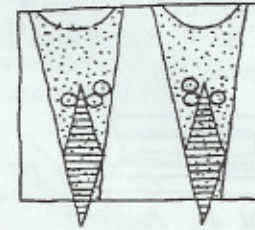
6. Add 2-3 fertilizer pellets to each quad cell.



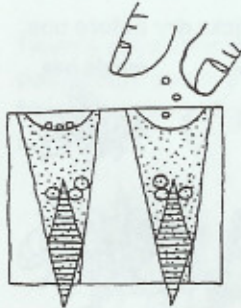
7. Fill each cell to the top with moistened soil.



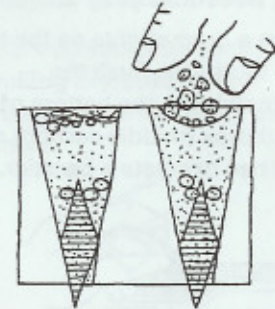
8. Make shallow depressions on top of each cell. Do not press hard and compact soil.



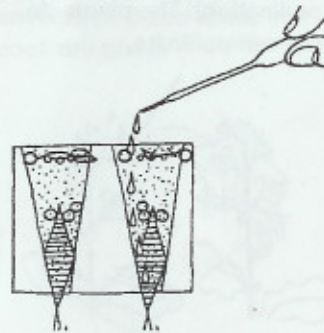
9. Drop 2-3 seeds in each depression.



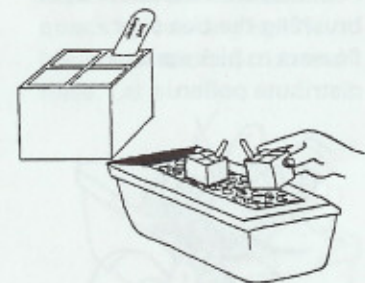
10. Sprinkle enough potting mix to cover seeds in each cell.



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

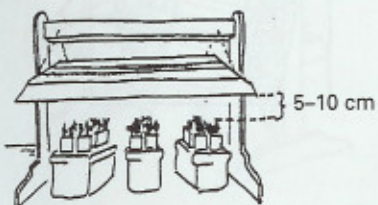


12. Label each quad with date and student's name. Place quads on water mat.



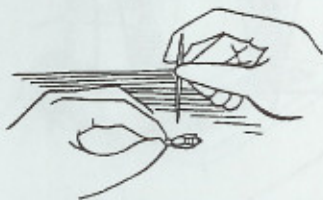
## Illustrated Growing Instructions (continued)

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.



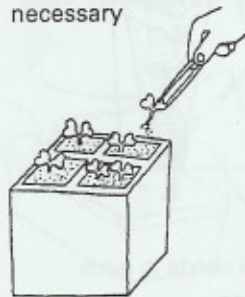
### Pollinating: Days 13 to 16

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

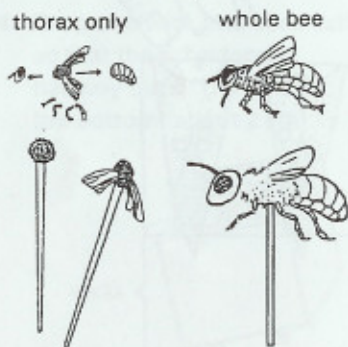


### Thinning Plants: Day 4 or 5

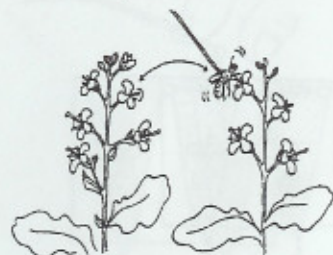
14. Thin to one plant per cell. Transplant extra seedlings to cells without plants if necessary



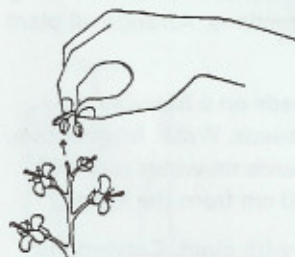
16. Let beesticks dry before use.



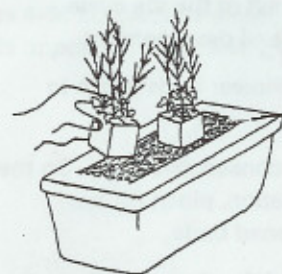
18. Pollen must be transferred back and forth among different plants (cross-pollination). The plants do not self-pollinate.



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.



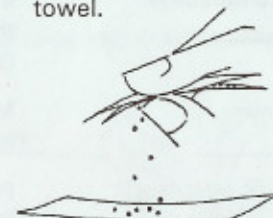
### Observing Seed Pod Development: Days 17 to 35

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.



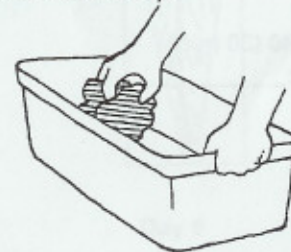
### Harvesting: Day 40

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)

#### Preparation (1.5 hours)

Date: \_\_\_\_\_

### Activities

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.

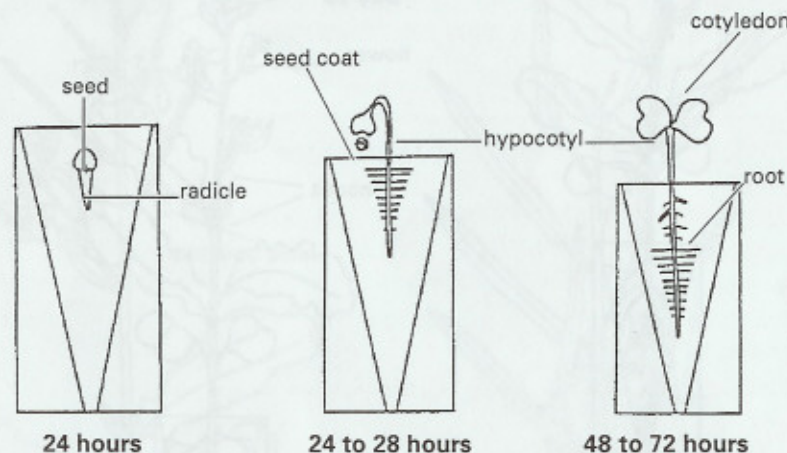
#### Day 40 (30 min)

Date: \_\_\_\_\_

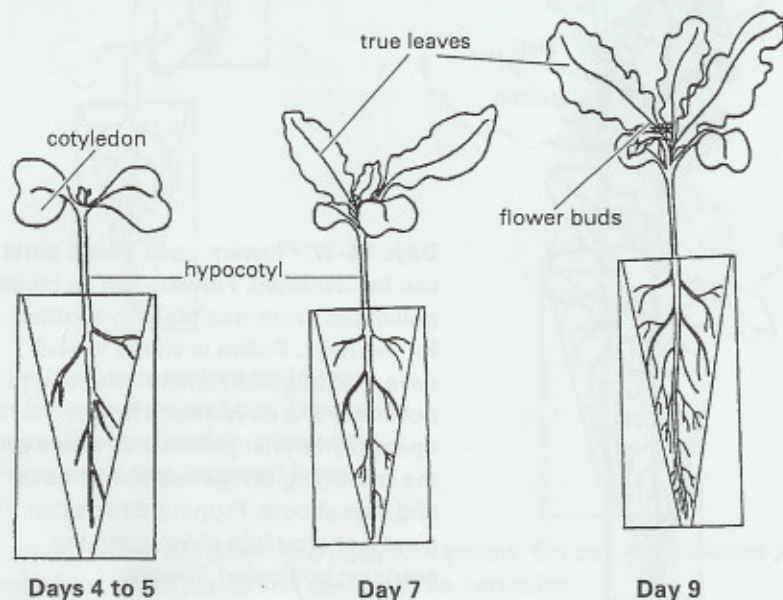
Harvest seeds from dry pods. Clean up all equipment. Plant your own seeds or store them appropriately.

## 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.



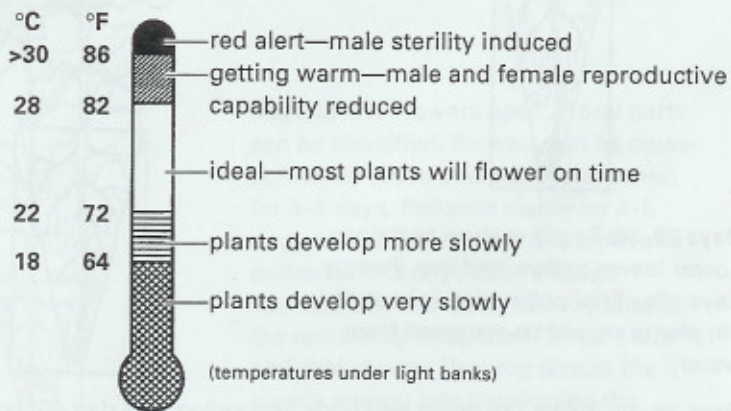
## Growing Tips and Suggestions

- 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](http://www.fastplants.org)

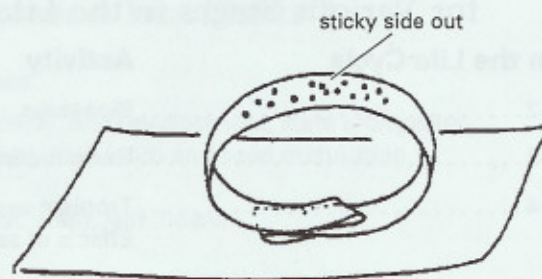
### Lighting Formula for Successful Growth

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.

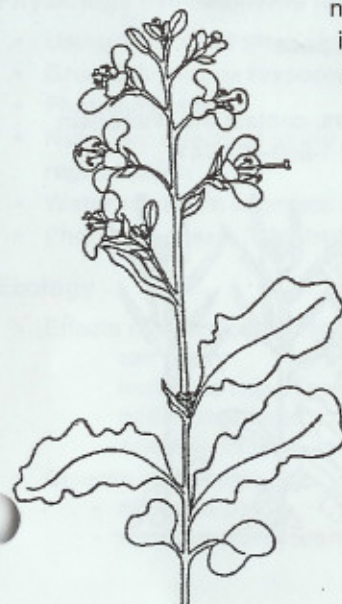
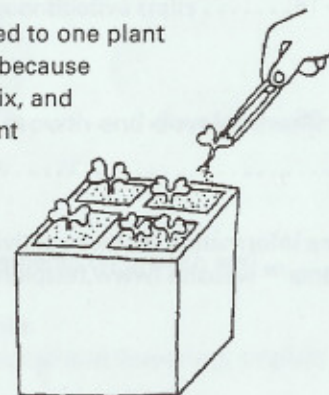


- Fertilizer pellets are larger than Wisconsin Fast Plants™ seeds.
- For easier seed handling, sprinkle a few seeds on a piece of clear tape. Make a loop of the tape (sticky side out) and attach to a paper card. Each student can pick seeds off the seed tape when planting.



- 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.

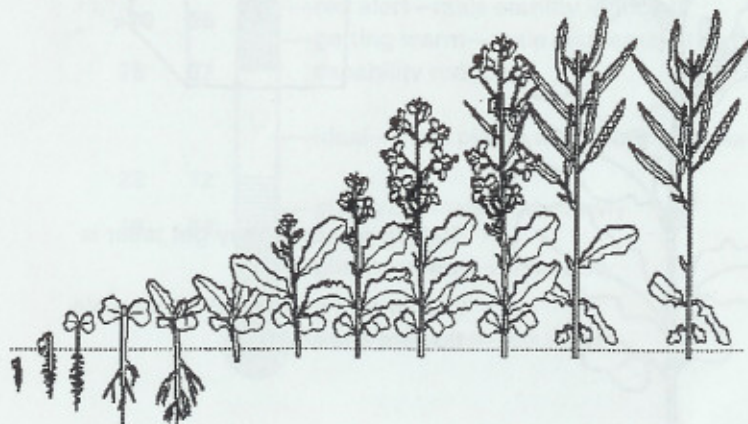


- Staking plants as they get taller is optional.
- Wisconsin Fast Plants™ are edible, flowers and all.

## 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](http://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, quantitative traits
- Selection
- Evolution

### Physiology (mechanisms for underlying growth and development)

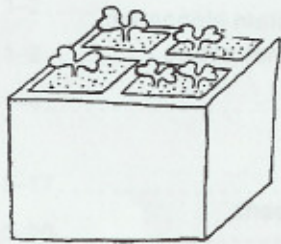
- Using numerous physiological mutants
- Growth hormone responses
- Photosynthesis
- Nutrition: effects of major and minor elements on growth and reproduction
- Water relations: excesses and deficiencies
- Photoresponses: light intensity, photoperiod and flowering, tropism

### 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)

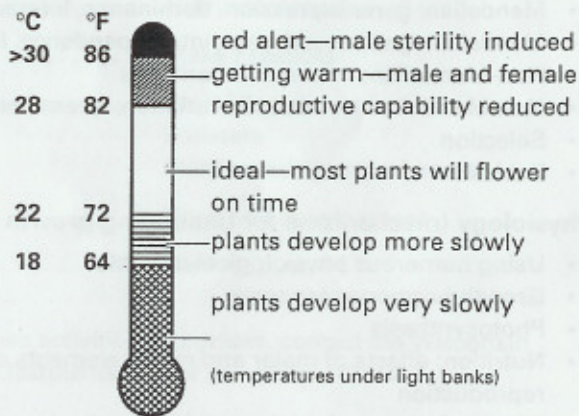


- Seeds planted too deep in quad
- Potting mix compacted, or too wet when dropped into planting container
- Quad not watered carefully from the top for the first 3 days
- Seeds washed out of quad
- Room temperature below 60°F (15.5°C)
- Fertilizer pellets were planted instead of seeds

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

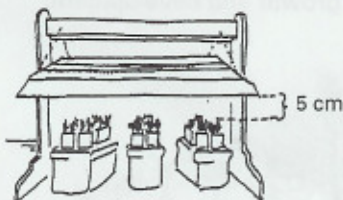
### Slow Growth

- 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

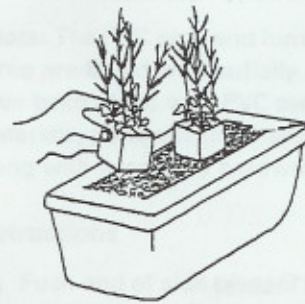


### Spindly Plants

- 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



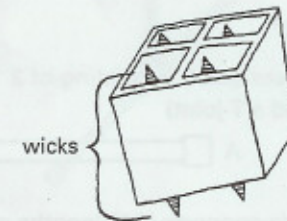
### Plants Wilt



- 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.

