



Fast Plants Life Cycle

Seed to Seed in 35 Days

The growing of Fast Plants, rapid cycling *Brassica rapa*, through a life cycle from seed to seed can provide the basis for learning many aspects of biology that are relevant to the students' understanding of themselves as individual organisms among the many others inhabiting the Earth. What are Fast Plants? Fast Plants are a special form of the species *Brassica rapa* (Wisconsin Fast Plants), a member of the mustard or cabbage family Cruciferae. Crucifers are distinguished by characteristic flowers with four petals in the form of a cross or crucifix. Other forms of *Brassica rapa* include turnips, Chinese cabbage, pak choi and canola.

Life Cycle Concepts and Questions

Beginning the Life Cycle: Growth, Development and Flowering

Germination is the awakening of a seed (embryo) from a resting state. It involves the harnessing of energy stored within the seed and is activated by components in the environment. Growth represents increase in size, number and complexity of plant cells and organs. Environment and genetics play fundamental roles in regulating growth. The energy for growth comes from photosynthesis.

Flowering is the initiation of sexual reproduction. The generation of male and female gametes (sperm and eggs) is one of the primary functions in flowering. The plant prepares for pollination by producing flowers. Each part of the flower has a specific role to play in sexual reproduction. The flower dictates the mating strategy of the species.

- What are the main components of the environment necessary for germination?
- How does the seedling orient itself?
- What enables the emerging plant to shift its dependency from stored energy to the energy from light?
- What is the role of the environment in regulating plant growth?
- How do plants grow?
- How does a plant know when to produce leaves and when to produce flowers?
- Why does a plant have flowers?

Pollination

Pollination is the process of mating in plants. In flowers, pollen is delivered to the stigma through a wide range of mechanisms that insure an appropriate balance in the genetic makeup of the species. In brassicas, pollen is distributed by bees and other insects. The flower is the device by which the plant recruits the bee. Bees and brassicas have evolved an interdependent relationship.

- How do flower parts function to influence mating behavior?
- How does the flower recruit the bee?
- How does pollination occur?
- How does the flower discriminate between self and nonself in the mix of pollen?

Double Fertilization and Post-Fertilization Events

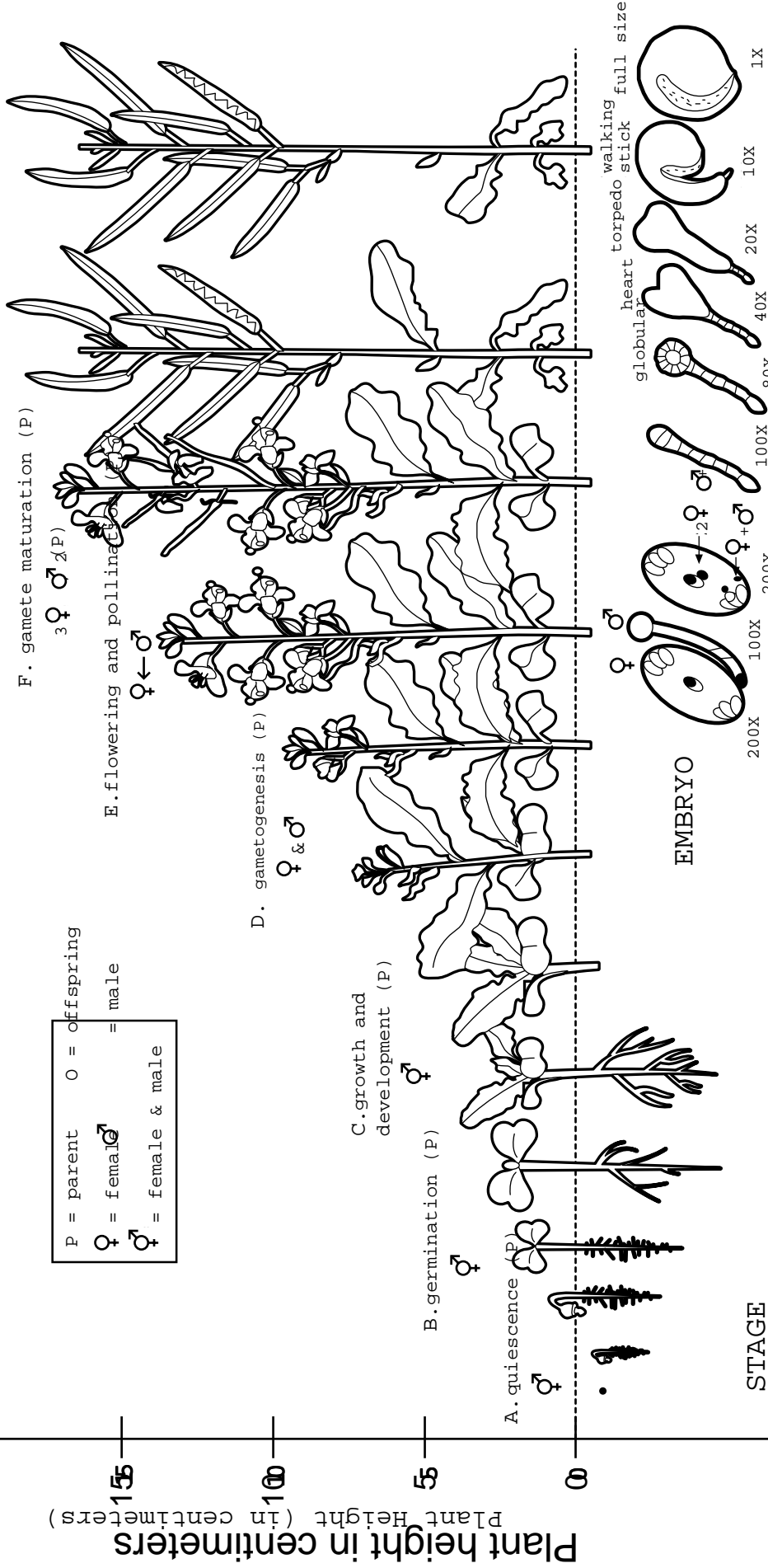
Fertilization is the final event in sexual reproduction. In higher plants, two sperm from the pollen grain are involved in fertilization. One fertilizes the egg to produce the zygote and begin the new generation. The other sperm combines with the fusion nucleus to produce the special tissue (endosperm) that nourishes the developing embryo. In some plants endosperm nourishes the germinating seedling. Fertilization also stimulates the growth of the maternal tissue (seed pod or fruit) supporting the developing seed.

- What is unique about fertilization in flowering plants?
- What is endosperm and what is its relationship to the embryo?
- How does an embryo develop into a seed?
- How does the maternal parent contribute to the developing embryo?

Growth of Fast Plants

H. fruiting (P) and embryogenesis (O)
 I. senescence (P) and seed ripening (O)
 G. double fertilization
 ♀ + ♂ → ♀ embryo
 2♀ + ♂ → endosperm (P)

P = parent
 ♀ = female
 ♂ = male
 ♀♂ = female & male
 O = offspring



STAGE	A	B	C	D	E	F	G	H	I	J			
Days after Sowing	0	1	2	3	4	7	9	11	13	15	18	28-35	> 35

Stages in the Life Cycle of Fast Plants: Concepts of Dependency

Stage	State	Condition	Dependency
A. seed	¥ quiescence (dormant embryo)	¥ suspended growth of embryo	¥ independent of the parent and many components of the environment
B. germinating seed	¥ germination	¥ awakening of growth	¥ dependent on environment and health of the individual
C. vegetative growth	¥ growth and development	¥ roots, stems, leaves grow rapidly, plant is sexually immature	¥ dependent on environment
D. immature plant	¥ flower bud development	¥ gametogenesis Ñ reproductive [male (pollen) and female (egg)] cell production	¥ dependent on healthy vegetative plant
E. mature plant	¥ flowering ¥ mating	¥ pollination Ñ attracting or capturing pollen	¥ dependent on pollen carriers; bees and other insects
F. mature plant	¥ pollen growth	¥ gamete maturation ¥ germination and growth of pollen tube	¥ dependent on compatibility of pollen with stigma and style
G. mature plant	¥ double fertilization	¥ union of gametes ¥ union of sperm (n) and egg (n) to produce diploid zygote (2n) ¥ union of sperm (n) and fusion nucleus (2n) to produce endosperm (3n)	¥ dependent on compatibility and healthy plant
H. mature parent plant <i>plus</i> embryo	¥ developing fruit ¥ developing endosperm ¥ developing embryo	¥ embryogenesis Ñ growth and development of endosperm and embryo ¥ growth of supporting parental tissue of the fruit (pod)	¥ interdependency among developing embryo, endosperm, developing pod and supporting mature parental plant
I. aging parent plant <i>plus</i> maturing embryo	¥ senescence of parent ¥ maturation of fruit ¥ seed development	¥ withering of leaves of parent plant ¥ yellowing pods, drying embryo ¥ suspension of embryo growth, development of seed coat	¥ seed is becoming independent of the parent
J. dead parent plant <i>plus</i> seed	¥ death, desiccation ¥ seed quiescence	¥ drying of all plant parts, dry pods will disperse seeds	¥ seed (embryo) is independent of parent, but is dependent on the pod and the environment for dispersal