ANSWER KEY.

ZornScience
zornscience.org

One Species, Six Vegetables

Biology | ANSWER KEY

Sample answers and data. Accept answers that match the group's own data and reasoning.

Draft lab. This lab has not been tested in a classroom yet. Your teacher may change some steps, times or amounts.

The Puzzle

Broccoli, cauliflower, cabbage, Brussels sprouts, kale, and kohlrabi look like six different plants. They are all one species, *Brassica oleracea*, the same species as wild cabbage, a scraggly plant from the coasts of Europe. Over thousands of years, farmers saved seed from the plants they liked best. Each crop is a different plant part that farmers made bigger.

Question

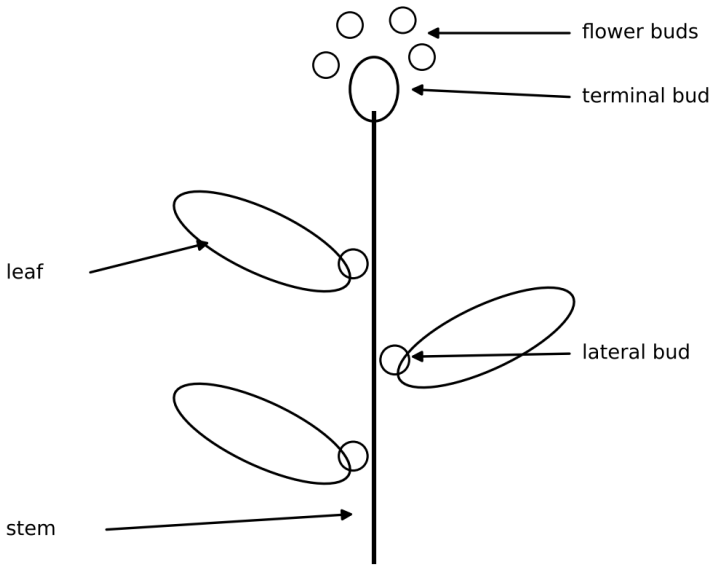
Which part of the wild plant did farmers select to enlarge in each crop, and what evidence shows it?

Safety

- Do not eat anything in the lab.
- Only your teacher uses the knife. Handle cut vegetables with care.

Materials

- Six stations: broccoli, cauliflower, cabbage (whole and cut in half top to bottom), Brussels sprouts (whole and cut in half), kale, kohlrabi
- Ruler, hand lens, paper towels



The parts of a wild Brassica plant.

CC BY-NC-SA 4.0 | zornscience.org

Procedure

1. At each station, look closely at the vegetable with the hand lens. Compare it with the plant parts in the diagram.
2. Decide which plant part is enlarged: terminal bud, lateral buds, leaves, stem, or flower buds.
3. Write the clues you used. Look for veins, leaf scars, buds at the base of leaves, a central stem, or tiny flower buds.
4. Measure the enlarged part: its widest diameter or its length, in cm.
5. Move to the next station when your teacher signals (about 5 minutes each).

Data

Table 1. Selection map

Crop	Enlarged plant part	Evidence (clues you saw)	Size (cm)
Broccoli	**Flower buds and flower stalks**	**Clusters of tiny green buds; a few may show yellow petals**	**about 12**
Cauliflower	**Flower buds (undeveloped)**	**Tightly packed, branched white clusters on thick stalks**	**about 14**
Cabbage	**Terminal (top) bud**	**Cut view: short stem core with leaves wrapped tightly around it**	**about 15**
Brussels sprouts	**Lateral (side) buds**	**Cut view looks like a tiny cabbage; scar where it joined the stem**	**about 3**
Kale	**Leaves**	**Flat blade, branching veins, leaf stalk; no buds**	**about 30 long**
Kohlrabi	**Stem**	**Leaf stalks or leaf scars grow out from the sides of the round bulb**	**about 8**

Analysis

1. What does it mean that all six crops are the same species?

   They can interbreed and produce fertile offspring. They share one gene pool, even though they look very different.

2. Describe how farmers could have produced kale from wild cabbage. Use the words **variation**, **select**, and **generations**.

   Wild plants showed variation in leaf size. Each year farmers selected the plants with the biggest leaves and planted only their seeds. Over many generations, the population's leaves became much larger.

3. Cabbage is an enlarged terminal bud and Brussels sprouts are enlarged lateral buds. Use the cut halves to explain how they are alike.

   Both cut views show a short stem core with many small leaves tightly wrapped around it. A Brussels sprout is a small side bud with the same structure as the top bud of a cabbage.

CC BY-NC-SA 4.0 | zornscience.org

4. Farmers did not create any new plant parts. Explain why selection can enlarge a part but cannot make a part from nothing.

Selection only chooses among variation that already exists. Each crop came from plants that already had buds, leaves, stems and flowers of slightly different sizes.

5. How is artificial selection like natural selection? How is it different?

Alike: both act on heritable variation, and the individuals that reproduce more pass their traits on, so the population changes. Different: in artificial selection, humans decide which plants reproduce; in natural selection, the environment does.

6. Claim, evidence, reasoning: Can selection produce large changes in a population?

Claim

Yes. Selection over many generations can greatly change how a species looks.

Evidence

Six crops with very different enlarged parts (buds, leaves, stem, flowers) all belong to one species descended from wild cabbage.

Reasoning

Farmers repeatedly chose plants with larger versions of one part. Because the traits were heritable, each generation shifted further, and different choices led to different crops.

CC BY-NC-SA 4.0 | zornscience.org