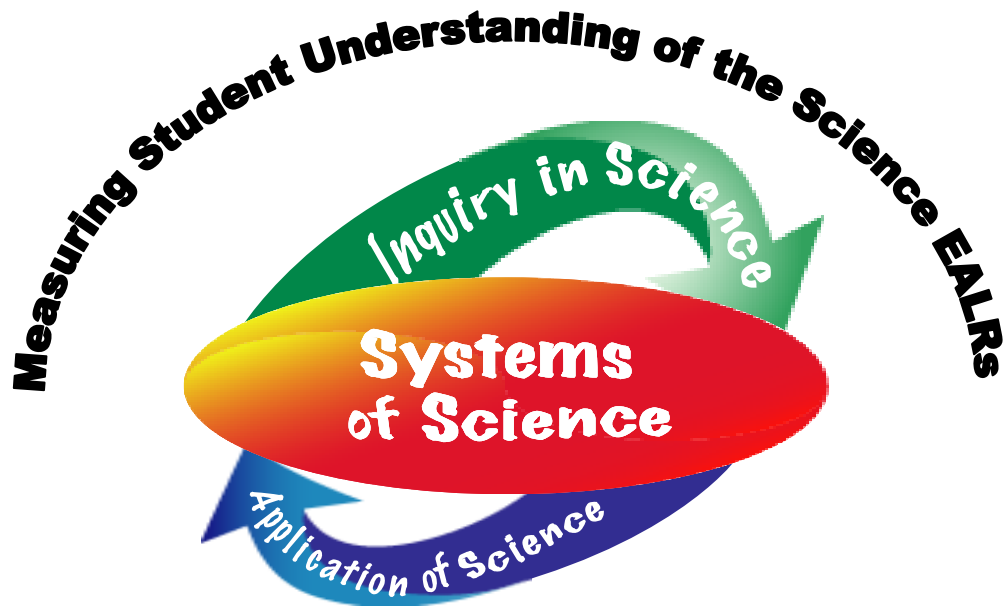


Bean Machine

Middle School
Inquiry
Powerful Classroom Assessment (PCA)



Published by the Science Learning Team of the Washington Office of the Superintendent of Public Instruction on January 2, 2009.

Copyright © 2008 by Washington Office of the Superintendent of Public Instruction (OSPI)

All rights reserved. Educational institutions within the State of Washington have permission to reproduce this document. All other individuals wishing to reproduce this document must contact OSPI.



Bean Machine

Directions: Use the following information to answer questions 1 through 11.

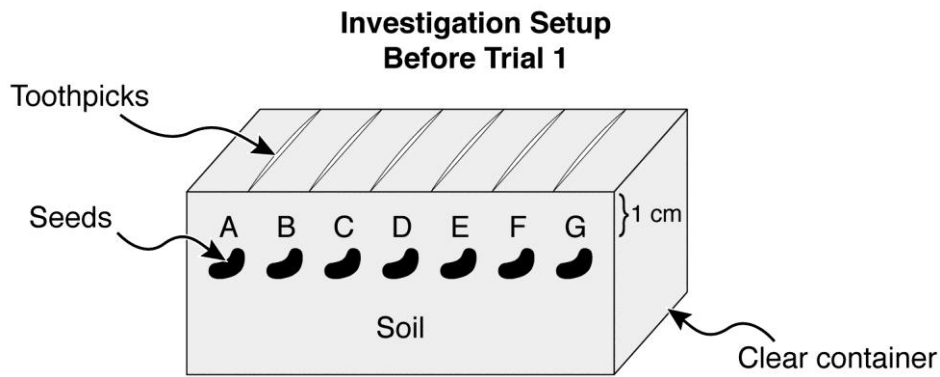
Sharon knew that water was necessary for seeds to germinate and develop roots. She wondered how water affects seed roots so she did the following investigation.

Question: How does the volume of water given to bean seeds affect the direction of root growth?

Hypothesis (prediction): Bean seeds given 3 milliliter (mL) or more of water daily will develop roots that grow straight down because that will be enough water for the seed to perform its life functions.

Materials:

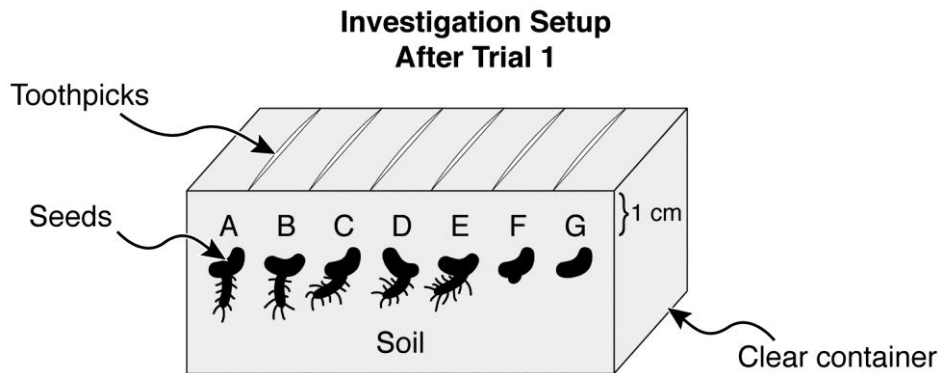
- clear plastic container
- soil
- bean seeds (all the same)
- toothpicks
- water
- graduated cylinder



Bean Machine, a Middle School Inquiry PCA

Procedure:

1. Put the materials together as shown in the Investigation Setup Before Trial 1 diagram.
2. Water Seed A with 6 mL, Seed B with 5 mL, Seed C with 4 mL, Seed D with 3 mL, Seed E with 2 mL, and Seed F with 1 mL of water. Add the water every day directly to the soil that covers each seed. Do not water Seed G.
3. Record observations of the root development of each seed after 8 days.
4. Repeat steps 1-3 for a second trial.



Data:

Water vs. Direction of Sprouted Root

Seed	Water (mL)	Direction of Sprouted Root	
		Trial 1	Trial 2
A	6	straight down	straight down
B	5	straight down	straight down
C	4	down and toward B	down and toward B
D	3	toward C	toward C
E	2	toward D	no root
F	1	root bud	root bud
G	0	no root	no root

Bean Machine, a Middle School Inquiry PCA

- 1** In Sharon's investigation, which variable was the responding (dependent) variable?
- A. Amount of water added to each seed
 - B. Direction of root growth
 - C. Length of root growth
 - D. Type of seeds grown
- 2** Which variable was the controlled (kept the same) variable in this investigation?
- A. Length of root sprouted by each seed
 - B. Volume of water added to each seed
 - C. Direction the root growth
 - D. Type of seed planted
- 3** Sharon noticed that Seed E in Trial 2 sprouted differently than Seed E in Trial 1. Which of the following actions should Sharon take regarding this difference in her data?
- A. Report all the results of the investigation
 - B. Ignore Trial 2 because Trial 1 was correct.
 - C. Change Trial 2 results to match Trial 1.
 - D. Look up the answer on the Internet.



Bean Machine, a Middle School Inquiry PCA

- 5** As bean plants grow, matter is added to their structure. Which of the following factors provides energy for this growth process?
- A. Sugar
 - B. Oxygen
 - C. Sunlight
 - D. Nitrogen
- 6** Which statement describes why bean plants are classified as producers?
- A. Bean plants produce their own food using sunlight.
 - B. Bean plants produce carbon dioxide using sugar.
 - C. Bean plants produce food for humans.
 - D. Bean plants produce seeds.
- 7** Which modification to Sharon’s original investigation format would increase the reliability of the investigation?
- A. Use different seed types in each section of the container
 - B. Use different soil types in each section of the container
 - C. Post the results of the investigation on a website
 - D. Repeat the entire investigation the same way



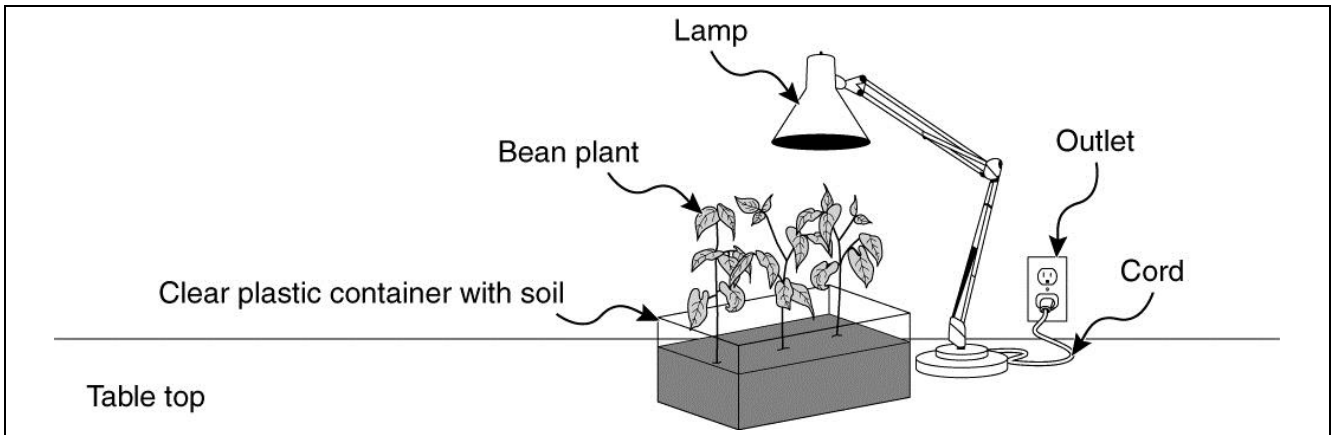
Bean Machine, a Middle School Inquiry PCA

- 8 Sharon let some of the bean seeds continue to grow into bean plants using the system diagrammed in the box. Describe **two** energy transfers that happen in the system shown in the diagram.

In your description, be sure to:

- Identify the forms of energy **before** and **after** each transfer.
- Describe **where** each energy transfer happened.

You may use words, labeled pictures, and/or labeled diagrams on the diagram below.



One transfer:

Another transfer:



Bean Machine, a Middle School Inquiry PCA

9 As a bean plant develops, which part of the plant captures the energy needed for growth?

- The seed
- The roots
- The leaves
- The flowers

10 Which human body system serves the same function as the stem of a bean plant?

- Reproductive
- Circulatory
- Immune
- Nervous



