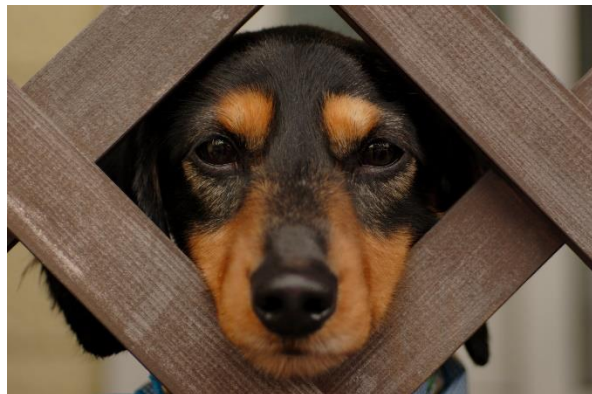


ARKANSAS NGSS INTEGRATED BIOLOGY
STANDARDS SUGGESTIONS:

BI-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

Bi-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.



Science and Engineering Practices: Developing and Using Models (BI-LS2-5), Constructing Explanations and designing solutions. (BI-LS2-3). Using Mathematics and Computational Thinking. (BI-LS2-4)

Disciplinary Core Ideas: Organization for Matter and Energy Flow in Organisms (LS1.C) Cycles of Matter and Energy Transfer in Ecosystems. (LS2.B)

Crosscutting Concepts: Energy and Matter; (BI-LS2-4, BI-LS2-3), Systems and System Models. (BI-LS2-5)

Connections to the Arkansas Disciplinary Literacy Standards: RST.9-10.8, WHST.9-12.2

Connections to the Arkansas Mathematics Standards: MP.2, MP.4, HSN.Q.A.1,2,3

NOTE: THIS IS A MULTI-DAY LESSON!

Objective: Students will be able to determine if soybeans grow better or worse when there is a fresh 'body' underneath them. Students will surmise that plants need nutrients available to roots to grow and an undecomposed body will not immediately release the nutrients available to help plants grow.

Assessment: Students will be asked to write in their own words a research paper of the experiment and add a reflection section about what they learned in this project.

Key Points: plant roots, plant growth and nutrition, cycling of nutrients in the soil



Materials:

- plastic containers (can be margarine tubs, yogurt tubs, cut 2L soda bottles etc.), at least four per group of four students.
- soybean seeds
- soil from the school yard
- chicken meat with skin from a grocery store (any meat part will do)
- Rulers
- notebook for data collection
- scissors for cutting chicken and spoon for the soil
- *OPTIONAL*: Allow students to take daily photos of the soybean plants with their phone cameras for comparison at the end of the project. This will throw a 'technology and expanded data collection' aspect into the lesson.

Preparation: Seeds can be obtained through the SSC on-line seed store (www.uaex.uada.edu/soywhatsup). Seeds are shipped out within a week of ordering. Soybean seeds take about eight to ten days to germinate and emerge from the soil. You can either plant the seeds and introduce the seedlings at the beginning of the project or have the students do the planting/watering in anticipation of the lesson.

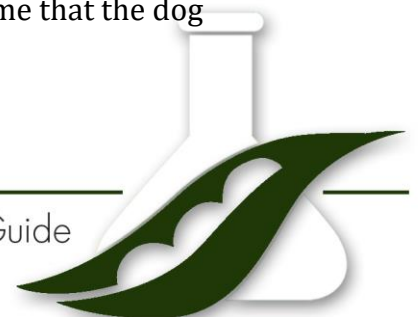
Time Duration: From planting to writing the paper anticipate about three to four weeks although the daily time amount for measuring/photographing will be minimal, maybe 10 minutes each day.

Elicit (Access prior knowledge):

Ask students what happens after an animal dies on the surface of soil. Make a KWL graphic organizer about what we know about decomposition, then ask how plants are affected by decomposition of organic matter. Ask questions such as 'What do plants eat?' and 'How do plants get the nutrients they need from the soil?'. Now ask the questions 'What happens to organic matter (dead animal) after it is buried?' and 'What will happen to a plant if it is planted over a newly buried dead animal versus an animal that is decomposing?'

Engage (Get the students' minds focused on the topic):

Now tell the hypothetical story of how soybean farmer Mr. Edamame's dog Fido went missing from his yard two days ago. Now this dog was known for causing issues with Mr. Lamb's sheep on one side of the soybean farm and raising havoc with Ms. Bird's poultry on the other side of the soybean farm. Needless to say, the only person who missed Fido was Mr. Edamame! After some sleuthing, it was very apparent to Mr. Edamame that the dog hadn't run away nor was it stolen, but where was Fido?



Before Mr. Edamame can decide who, the culprit is, he needs to find out where his dog went.

The clues:

There was blood splattered around the dog kennel and run with the door chain having been cut by wire cutters.

It looked like something had been dragged from the dog kennel to the soybean field where the drag marks ended.

Explore (Common experience):

Ask the students for hypotheses here; what could have happened to Fido based on the clues so far? Have students write down the question being asked and what they think the hypothesis is.

Usually someone will write that the dog got buried in the soybean field. Ask your students 'How could we go about proving this?' 'What do we know about the early decomposition of bodies and their impact on plants?' 'What could we do to research this?'

Assign the students to teams and then ask them what they think should be researched to answer these questions. Ideas such as soybean nutrition, soil dynamics, newly buried bodies and their impact on growing plants etc. should come up in the brainstorming session. Give the students as many days as you want for research.

Website Options:

<http://www.thecorpseproject.net/decompositionscience/>

<https://www.sciencenewsforstudents.org/article/recycling-dead>

Explain (Teach the concept):

When the students have completed their research, have each group tell what they learned by writing it on a white board or easel, so each group contributes their knowledge. Discuss the information with the class and add information where needed; elaborate on plant nutrition and how roots obtain the water and minerals needed for growth. Talk about what nutrients plants need to grow, and how those essential ingredients are cycled between plant, animals, and the soil. Focus on the different cycles like the carbon or nitrogen cycle and how essential these cycles are to plant growth. You can add or extend any additional information you want here.

Elaborate (Students apply information learned in the **Explain** section):

Students should have discovered by now that newly buried bodies make for poor nutrition for plants so...how can we prove this statement and how can it help us find Fido? Ask the students to

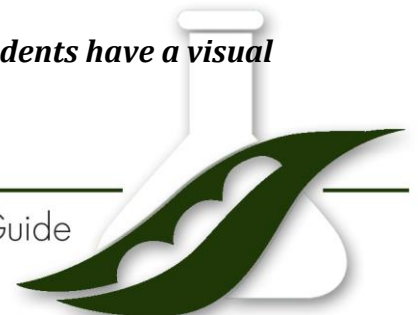


come up with a way to prove that newly buried Fido isn't good for soybeans. Students should figure out the most obvious way is to plant something (most likely fresh meat) under soybeans and see what happens.

The experiment:



- Assign a minimum four pots of soybeans to a group. Ask the students why at least four? (needed for controls and verification).
- Have the students cut up two thinner pieces of chicken that are about two thirds the size of the diameter of one container. The students need to carefully dig up the soybean seedlings with roots from the designated 'chicken' pot and place one piece of chicken in the hole. The seedlings are then placed carefully on top of the one piece of chicken and the second piece is gently placed over and around the roots of the plants, covered with dirt and watered. *NOTE: the roots must be completely covered by the chicken so cutting the second piece halfway up will help surround the roots!*
- Students then need to carefully dig up the pots of control plant seedlings and replant them in the soil, then water. Ask the students why it is necessary to dig up the control plants (for consistency in the experiment, eliminating the variable of digging up the roots as a cause for growth differences).
- Students will need to do an initial (base) measurement of height of all plants, number of leaves, overall color etc. Base pictures and daily pictures are recommended!
- Students will do a height measurement, count the number of leaves and leaf color/health, and check daily for two weeks or until plant death. Plants should be watered at least every other day and noted in a logbook with the data collected.
- After two weeks, students will do a comparison of the control plants vs the chicken plants.
- **Teacher Hint: plant two soybean pots that are left 'as is' so students have a visual of what soybeans look like undisturbed.**



- **NOTE: if the experiment is grown outside, consider putting them in some type of protective area away from furry critters wanting to dig up the chicken.**
- **FYI: Previous experimentation showed soybean seedlings died a week after being transplanted over chicken. Mature plants would take longer to be affected.**

The results:

- Students will need to put together a data table that has the height of plants and number of leaves of plants. Students should also do a color chart comparison of leaf color. Data point graphs should also be done to show differences in the plants over time. *

*If students do not know how to do a point graph, refer them to <https://nces.ed.gov/nceskids/graphing/Classic/> and have them follow the prompts for making a graph.

Evaluate (How will you know the students have learned the concept?):

Students should now have everything needed to write a paper on what happened to Fido. The following should be included: a stated research question, hypothesis, how they conducted the experiment, a created data table and graph, and what their conclusion was based on their data.

If everything goes according to plan, the chicken plants should not have grown as well as the controls and this should come out in the conclusion of the experiment. *Students will add a reflection paragraph about what they learned regarding the cycling of materials in the soil and their impact on plant nutrition and growth.*

Extend (Deepen conceptual understanding through use in new context):

Discuss the results of the experiment with the class. Students now know what happens to soybeans when a fresh body is buried underneath them so ask them to use this information to help the farmer find out if Fido is buried in his soybean field.

- Have students break into groups and come up with a plausible way to figure out if Fido is really pushing up soybeans.
- The students should determine the best places to look for a possible Fido eternal resting place are in small areas where the soybeans are not growing as well as the plants around them.



- Ask the students the following questions:
 1. what would be the next best step to determining if they are correct?
 2. Tie in the data from the experiment...could the data be like what you would find in the field?
 3. Could it be used there? Why or why not?
 4. If Fido is found, what steps could be taken scientifically to figure out who did it?

End the lesson with how decomposition is important to plants and the cycling of matter as it breaks down organic material into minerals and ions the plant can absorb and use. These nutrients are in turn used in both photosynthesis and cellular respiration by the plants. Plants are eaten by animals and the cycle begins again. So, decomposition is not only important to the cycle of matter, but it also can help solve a crime!

