Green LEAF & Lessons, Activities Opportunities

Decomposing Pumpkins

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Overview: Students document and discuss what they observe, make predictions, and reflect about what they think will happen as pumpkins decompose in an inside and outside location. This investigation can take up to several months.

Targeted Grade: 2 **Additional Connections: 3, 4, 5, MS, HS**

NGSS Standard(s)	CT Social Studies Standards
2-LS4-1 Diversity of Life in Different Habitats **2-LS2-2** Modeling Seed Dispersion by Animals	**HIST 2.2** Past and Present **GEO 2.6** Cultural & Environmental Characteristics
Common Core Math Standard(s)	**Common Core ELA Standard(s)**
2.MD.1-4 Measurements **2MD.9** Generating Data **2.MD.10.D** Graphing	**W.2.7** Shared research **W.2.2-3** Writing explanatory texts/narratives

The standards presented here are suggestions only; you may identify others! Please refer to your grade level at Next Generation Science Standards (http://www.nextgenscience.org/search-standards) and Common Core State Standards (http://www.corestandards.org/).

This lesson has been designed to scaffold student learning using the following to connect students' understanding of science:

Scientific and Engineering Practices of NGSS	NGSS Crosscutting Concepts
Asking questions and defining problems *Developing and using models* *Planning and carrying out investigations* *Analyzing and interpreting data* *Using mathematics and computational thinking* *Constructing explanations* *Engaging in argument from evidence* *Obtaining, evaluating, and communicating information*	*Patterns* *Cause and effect* *Systems and system models* *Energy and matter: Flows, cycles and conservation* *Structure and function* *Stability and change*

Materials needed:

5 gallon clear bin with lid or 10-gallon glass terrarium
soil
2 Pumpkins (other hard-skinned fruits, such as watermelons, may be substituted)
An area to place pumpkin—could be in sunny/shady area, protected/unprotected—you choose!
Large clear plastic bag
Hardware Cloth [tight mesh fencing] (to keep larger critters away)
Tent stakes to hold the hardware cloth box down
Check with your library or other source about identification books about insects

Check with your local grocery store for pumpkin donations!

Have students develop questions about what they think will happen to the pumpkin(s) over time. Plan your investigation—based on the questions raised and the students' predictions. Set intervals to observe the pumpkins (these may be adjusted according to what students are observing.)

Suggested Procedure

For decomposing a pumpkin inside the classroom:

1. Cover the bottom of a 5-gallon clear bin or 10 gallon aquarium with an inch or two of soil.
2. Cut a wedge (1/4 of the pumpkin) out of the pumpkin to provide a "window" to see in.
3. Place the pumpkin in the bin and cover.
4. Place the bin in a clear plastic bag secured with rubber band (fruit fly containment!)
5. Set the bin in the room in an out-of-the-way location.

For comparison pumpkin placed outside:

1. Choose an accessible location that is out of the way.
2. Plan to post a sign "Do not disturb, Science Is Happening Here!"
3. Clear part of the ground where the pumpkin will be placed.
4. Scoop some of the soil in this location for use in step one above.
5. Cut a wedge from Pumpkin (like step 2 above)
6. Place pumpkin on ground.
7. Make a 3 sided box of the hardware cloth to cover the pumpkin to protect from larger scavengers
8. Stake down the hardware cloth box to secure.

Consider these questions (or those that student develop) and use your observations to create more questions. Be sure to make observations, measurements, and photograph your pumpkins before you start!

What do we see going on with each pumpkin?

Do the changes match our predictions? If so how?
Are there differences with the inside pumpkin and the outside pumpkin? (The inside pumpkin might be carried outside—but left in its bin—for side-by-side comparisons)

Are there similarities and/or difference on the skin vs insides of each pumpkin?
Are there organisms present in either site? Can we identify them?
Can we make measurements of our observations?

Repeat observations and collect data at determined intervals. Photojournal and record your results. The intervals might be changed according to what your students are observing.

Standards-Based Curricular Connections: **Decomposing Pumpkins** can support your curricular goals in many ways including, but not limited to, the example below.

- **Life Sciences**: **2-LS4-1** Make observations of plants and animals to compare the diversity of life in different habitats.
    - Students could conduct an experiment analyzing the differences in which the inside and outside pumpkins decompose.
        - Students should observe and collect data regarding the presence/absence of decomposers, distribution of fungi, etc. (2.MD.1-4) (2.MD.9-10)
        - Students might create a storyboard or narrative as the project progresses that explains what they have observed (W.2.2-3)

- **Life Sciences: 2-LS2-2** Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.
    - Students could create a model showing how animals such as squirrels or chipmunks might collect seeds from the outside pumpkin and, for example, drop a seed while returning to their burrow, thereby contributing to seed dispersal. Students might create a storyboard or narrative about their model (W.2.2-3)
    - Students could compare this method of seed dispersal to that of the inside pumpkin which is not visited by animals. This discussion could be used to foreshadow 3rd-grade standards regarding variation of ecosystem resources (3-LS4-3; 3-LS3-2).

Other Potential Connections: The following list provides a general overview of other possible uses for **Decomposing Pumpkins**. Check your NGSS and CCSS standards documents (links provided on page one) to explore how these suggestions may assist in achieving your grade-specific curricular goals.

Science –Decomposing pumpkins can set up many discussion topics, including: Living (Biotic) vs. non-living (Abiotic); plant life cycle; solids, liquids, gases; plant needs: water/sunlight; the role of different organisms in the ecosystem.

Math – This investigation allows for many form of data collection, graphing and analysis. Students can weight and measure the pumpkins, count insects in the outdoor site, etc.

ELA – students can collect information over time about the growth cycle of a plant. Students can use vocabulary words, such as: predicting, decomposition, growth, life cycles--front loaded to enhance their understanding. Students can read nonfiction texts about decomposition, pumpkins, insect identification, etc. Students can create a partner slide show of their research using laptops.

Social Studies- Students can look at the history of the use of pumpkins, where they are grown, and what countries they originated from. (HIST 2.2) (GEO 2.6)

International Studies: Students can do further research to learn how other countries use pumpkins. Family recipes for pumpkins might be collected and used to create a book for sharing.

Art – Students can illustrate their observations, create pumpkin prints, and use pumpkin seeds to create artwork.

Engagement and Community Involvement Some of the most meaningful learning activities are ones that allow for community and parental involvement. **Decomposing Pumpkins** may be used to promote community engagement in the following ways:

- Visit a local farm
- Roast pumpkin seeds and sell to parents during Parent-Pickup time, or at the school store.
- Share photos of decomposition process and student findings on school screens, for parents to see upon entering school building
- Ask someone from the produce department or local farm to come in and speak to class

Additional Connections: Grades, Topics, and DCIs

This investigation was written on a 2nd-grade level. You could also apply this investigation in other grades, to support your curricular goals. The Disciplinary Core Ideas "LS2" and "LS4" appear in other grades, allowing similar investigations to be conducted either above, or below, the 2nd-grade level that is described above. You may also use this concept to connect your lesson with other LS2 & LS4 grade-specific standards. Some additional examples to consider are presented here:

NGSS Standard(s)	CT Social Studies Standards
3-LS4-3 Habitats **3-LS4-4** Biodiversity **3-ESS2-1** Weather Data	**HIST 3.11.** Cause and effects of events
Common Core Math Standard(s)	**Common Core ELA Standard(s)**
3.MD.1,3,4,5,8 Measurement and data, concepts of area	**W.3.2-3** Writing explanatory texts and narratives **W.3.7** Conduct research projects

- **Life Sciences: 3-LS4-3** Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
    - Students could investigate how changes in a system affect the ability of organisms to survive, thrive, or perish.
        - Beginning with a bin filled only with soil, or the site before the pumpkin is place there, students should make observations regarding the visible presence (or absence) of organisms, such as worms, insects, or fungi
        - Students should collect periodic data, including observations of the system's temperature, and presence of decomposers.
        - Students could plot the investigation area in square inches (3.MD.3-4-5-6) and calculate are and perimeter.(3.MD.8)
- **Life Sciences 3-LS4-4** Make a claim about the merit of a solution to a problem cause when environment changes and the types of plants and animals that live there may change (biodiversity)
        - Students' observations about the changing flora and fauna in the investigation sites will lead to questions about biodiversity, cause and effect.
            - Students could explore the cause and effects of different environmental events from the past and currently. They could connect this to what could happen in the future with changes in climate. (HIST 3.11)
        - Students can conduct research including non-fiction texts (critter identification, etc.), and write explanatory texts about their findings and procedures, and narratives about the results (W.3.2-3) (W.3.7)
- **Earth' Systems 3-ESS2-1** Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
        - Students might collect data about the weather during this investigation. That data can help establish the patterns of typical weather in that location.

NGSS Standard(s)	Common Core Math Standard(s)	Common Core ELA Standard(s)
4-LS1-1 Internal/External Structures	**4.MD.1** Systems of measure **4.MD.6-7** Circles **4.G.1** Angles	**W.4.2** Writing Explanatory Texts **W.4.9** Draw evidence from texts to support analysis and research

- **Life Sciences: 4-LS1-1** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
    - Students could compare the rates of decomposition between a whole pumpkin, and one whose top has been removed, allowing quicker microbial access to the inside
        - Questions to consider: What is the function of the parts of the pumpkin and how are those parts affected by decomposition? Is decomposition "normal" or not to the pumpkin? How does this affect or support the life cycle of the pumpkin?
        - Students should collect data on rates of decomposition, which may then be graphed. Practice measures in metric (4.MD.1)
        - Collect data at the site based on fractions of the circle by plotting the site in sections of a circle, discussing rays, angles(4.MD.5) Diagram findings on paper plots to practice angles.(4.MD.6-7) (4.G.1)
        - Students should consider the role of the pumpkin rind in mitigating decomposition (survival during growth and development) vs breaking down (allowing for seed disbursal and supporting new plant growth)
        - Students should consider the role of the pumpkin seeds in reproduction
        - Student reflections could include explanatory texts (W.4.2) and discussions of evidence that supports their analysis (W.4.9)

NGSS Standard(s)	Common Core Math Standard(s)	Common Core ELA Standard(s)
5-LS2-1 Movement of Matter **5-PS3-1** Sun's Energy	**5.MD.1** Conversion of units **5.MD.2** Represent and interpret data **5.MD.5** Calculating volume	**RI.5.9** Integrating Information from Texts **W.5.7** Short research projects **W.5.9** Use evidence from reading to support research

- **Life Sciences: 5-LS2-1** Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
    - Students could model the life cycle of the pumpkin, from seed to mature pumpkin to food for other animals, and then to decomposition and the return of nutrients back to the soil (5-LS2-1; 5-PS3-1)
        - Students should consider sources of nutrients and energy that support growth
    - Students should integrate relevant textual information into their model (RI.5.9)(W.5.9)
    - Students could calculate the volume of the contain proposed for the experiment (5.MD.5)

Middle School Connections

NGSS Standard(s)	CT Social Studies Standards
MS-LS1-6 Photosynthesis **MS-LS2-3** Model matter and energy flow **MS-LS2-4** Ecosystems changes **MS-LS2-1** Ecosystems resources **MS-LS2-2** Interrelationships **MS-LS 2-5** Competing design solutions **MS-LS-1-7** Chemical reactions	**GEO 8.2.** Characteristics that make places similar and different
Common Core Math Standard(s)	**Common Core ELA Standard(s)**
6.EE.9.C Variables in real-world problems **6.RP.3.A** Reasoning using ratios/rates **8.F.3.A** Linear equations (y = mx + b)	**RST.6-8.3** Multi-step procedures **RST.6-8.7** Integrating visual data w/ text **RST.6-8.9** Supporting Research w/ Informational texts **SL.8.5** Multimedia presentations **WHST.6-8.2** Writing explanatory/informative text **WHST.6-8.1** Evidence-based arguments

- By utilizing a systems-model approach, this activity may be conducted as a bridge between multiple standards across multiple Science, Math, and ELA disciplines

    - Students could begin the unit with a lesson on photosynthesis, with particular emphasis on tracing the flow of energy and matter.(MS-LS1-6 and MS-LS 2-3) This should be related to the growth of the pumpkin, from seed to harvest.
        - Students could create posters that explain how CO_2 and H_2O are converted to sugars that allow the plant to grow (MS-LS1-6; MS-LS1-7; RST.6-8.7)
    - Ask students to consider the indoor covered terrarium as a closed ecosystem, and the outdoor uncovered terrarium as an open ecosystem. This is an excellent opportunity to reinforce relevant terms and concepts such as system boundaries.
        - Examining the decomposer populations in the two systems allow for comparison of the living and non-living parts of these systems (MS-LS2-3) and the change in those populations over the course of decomposition builds on the concepts of MS-LS2-4
        - Students could produce bi-folds comparing the characteristics of open/closed systems. (WHST.6-8.2)
        - The closed ecosystem could be intentionally populated with your choice of organisms. These may include, for example, worms, pill bugs, or fruit flies.
    - Ask students to consider that ecosystems can change. In this case, a dead pumpkin will be introduced to each system.(MS-LS2-4)
        - Additionally, two otherwise identical terrariums may be used, with one receiving an intact pumpkin, and the other featuring one that has had a “window” cut into it or the pumpkin cut into small pieces. Students could measure changes based on size of the pieces, or other factors.(MS-LS2-5)

- Students should make observations to track worm/fly populations, mass of pumpkin or entire system, presence of fungi (decomposers), soil moisture content, pH, etc.
    - Students may be grouped, and assigned a particular organism or other measurable in the system for tracking. Groups could make periodic presentations of their data to the class (SL.8.5; 6.EE.C.9)
    - Soil testing of the soil under the pumpkin could be performed initially, and at intervals by students, using a home-garden soil testing kit. Alternatively, local agricultural facilities may be able to provide before and after professional-grade testing. Consider: "How does the chemical composition change, where do those changing constituents come from, and what does this tell us?" (MS-LS1-7)
    - Students could practice using ratio/rate/proportion reasoning while collecting data. (6.RP.3.A) For example:
        - If I started with 500cm^3 of soil, and I count how many worms are in a 10cm^3 sample, how many worms are in the entire bin?
        - I remove a chunk of pumpkin (the window), and determine its mass to be 6.7% of the whole. As I re-measure the mass of the chunk periodically, can I determine the current mass of the whole pumpkin?
            - This data can then be graphed and used to calculate a rate of decomposition, as a function of time (6.EE.C.9)
            - For upper-middle grades, an equation for line-of-best-fit may be derived. (8.F.A.3)
        - Students could then use their calculations to predict the amount of time required for pumpkins of various sizes to decompose, the future population of worms/flies, etc.
    - Students could create a photo-journal, to be integrated with other quantitative data in their final reports. (RST.6-8.7)
- Ask students to comprehensively analyze their data, and consider:
    - What happened to the worms/flies? Did they help or hinder decomposition? Did their populations increase/decrease? Was there any variation in the rates-of-change, at different times?(MS-LS2-2)
    - Students should consider where the decomposers came from, if they were not visible prior to introduction of the pumpkin. What does this mean in terms of availability of resources?(MS-LS2-1)
    - What differences were observed between the indoor closed ecosystem, and the outdoor open ecosystem? Why? Which of these systems was the most successful at enhancing decomposition? (MS-LS2-5)
        - Using this concept and the idea of terrariums students could explore what characteristics make these places similar and different from other places in the world. Where may they find these environments throughout the world? (GEO 8.2)
- Using data obtained throughout the investigation, ask students to create a detailed model of energy and matter flows in both the open and closed systems.
    - Students should integrate textual information with their own data, to explain what happened to their group's organism (MS-LS1-7; MS-LS2-1; MS-LS2-3; MS-LS2-4; RST.6-8.9; RST 6-8.7; WHST.6-8.1; SL.8.5; 6.EE.C.9; MP.2)

- **For students needing a greater challenge, or for teachers looking to complete an engineering investigation:**
    - Students could either describe or complete an assignment that answers a question such as: “Based on your observations, what factors might promote or inhibit decomposition? Design [and test/refine] a controlled experiment to explore your theory” (MS-LS2-5)
        - As a class-wide experiment, this could be framed as a “competition” for maximizing organic decomposition, such as in a compost pile or bioreactor, or for minimizing food spoilage as the pumpkin is transported from harvest site to market. (MS-LS2-5) (MS-ETS1-2; MS-ETS1-3)

High School Connections

NGSS Standard(s)	CT Social Studies Standards
HS-LS1-5 Photosynthesis **HS-LS1-6** Matter/energy **HS-LS1-7** Cellular respiration **HS-LS2-3** Aerobic/anaerobic conditions **HS-LS2-5** Carbon cycle **HS-LS2-6** Ecosystems	**Modern World History: GEO 9-12.7.** Changes in characteristics and influence on trade and land use
Common Core Math Standard(s)	**Common Core ELA Standard(s)**
HSN-Q.A.2 Defining appropriate quantities **HSN-Q.A.3** Choosing levels of accuracy **HSS-ID.A.1** Representing data **HSS-IC.A.1** Inferences from statistics (samples & populations)	**WHST.9-12.2** Explanatory/ informative texts **WHST.9-12.5** Strengthening writing through revision **WHST.9-12.9** Supporting research w/ textual Information **SL.11-12.5** Digital media

- **Life Sciences: HS-LS1-5** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy
    - Similar to the middle-grades introductory lesson described above, students could model the growth of the pumpkin, but with greater detail to the transfer of energy as the creation or breaking of chemical bonds
    - As the pumpkin decomposes, students could take their investigation deeper by considering other interactions within the ecosystem, through a focus on chemical bonds:
        - Students could model the process of decomposition, on a molecular scale, by detailing the steps of [aerobic] cellular respiration using textual information and digital media supports (HS-LS1-7; HS-LS2-3; WHST.9-12.9; SL.11-12.5)
        - Students could write a detailed description of how decomposers digest the sugars present in the pumpkin, which in combination with other available nutrients supports their growth (HS-LS1-6)

    - Students at this level could also use the ecosystem model-approach described previously, to investigate how changes in characteristics of an ecosystem affect populations (HS-LS2-6; MP.4; HSN-Q.A.2; HSS-IC.A.1; Modern World History: GEO9-12.7)
    - Following these steps, students could integrate their knowledge by creating a model that relates the flow of matter and energy into Earth's 4 main "spheres":
        - Example: During pumpkin growth, CO_2 is absorbed from the atmosphere and incorporated into the fruit (biosphere) as a component of sugar. Other animals then consume some of these sugars, while others are returned to the soil (geosphere) as by-products of decomposition (HS-LS2-5)
- The solutions-engineering concept described in the "middle-school" section may also be applicable at a higher level, after adapting it to reflect your grade-level standards and curricular goals.

*These suggestions are examples only, and may require adaptation. Check your grade-specific standards to determine whether or not the suggestions provided meet your individual curricular needs***.**

For more information, contact ctgreenleaf@ctgreenschools.org

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