To Biodegrade or to Not Biodegrade

The things that we use and consume take many shapes and forms. We see this reflected in the waste we produce in our homes, schools and businesses as well as the litter we find here in southern Illinois. However, as waste continues to build up exponentially, it becomes important as responsible citizens to know how to reduce the amount of waste we produce and how to dispose of other items properly. Certain items can be composted, others are recycled and we can avoid purchasing items that use single use materials that would be otherwise destined for the landfill.

This lesson is designed to help students learn what is means for an object to be biodegradable versus non-biodegradable. It is also meant to help students build a foundation of knowledge for further investigation and discussion later in their academic careers.

Illinois Science Standards and Goals

Next Generation Science Standards

- **5-ESS3-1:** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
    - **Science and Engineering Practice:** Obtaining, Evaluating, and Communicating Information; Analyzing and Interpreting Data; Constructing Explanations; Carrying Out Investigations
    - **Disciplinary Core Ideas:** ESS3.C: Human Impacts on Earth Systems
    - **Crosscutting Concepts**: Systems and System Models
- **5-PS1-3:** Make observations and measurements to identify materials based on their properties.
    - **Disciplinary Core Ideas:** Structure and Properties of Matter

Common Core ELA

- **RI.5.1.:** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem.
- **W.5.8.:** Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work and provide a list of sources.

Objective

- Students will demonstrate their understanding of the important vocabulary, biodegradable and non-biodegradable, by constructing a display with one of the items used during the activities- this will include item descriptions, properties of the item, and whether it is bio or non-biodegradable.

Materials and Resources:

- Bag of trash
- Chromebook
- Writing utensil
- Notebook

- PowerPoint
- Exit Slip
- Vocabulary cards

Talk Moves
The curriculum writers suggest reviewing 9 Talk Moves to help aid in facilitating discussion between students as well as to elicit answers from individual students. The link can be found here.

Safety Concerns
- Trash that is placed in the classroom should be rinsed and dried before being placed in the classroom setting. It is also important that trash is appropriate for the school setting and does not have any sharp or pointed edges.

Note: Instructors should maintain facility, school, and district policies regarding safety a priority when planning classroom lesson plans.

Vocabulary
- **Environment:** The surroundings or conditions in which a person, animal, or plant lives or operates.
- **Biodegradable:** Able to be broken down by the action of living organisms.
- **Non- Biodegradable:** Kind of substance which cannot be broken down by natural organisms and acts as a source of pollution
- **Decompose:** To break down or be broken down into simpler parts or substances especially by the action of living things.

Misconceptions can include, but are not limited to:

- **All waste disappears eventually**; inorganic materials such as plastics and Styrofoam never truly go away. Even organic materials in landfills struggle to break down as there are adverse conditions preventing either aerobic or anaerobic breakdown.
- **All biodegradable materials are compostable**; organic materials such as oils, meats and cheeses are not meant to be composted because they attract wildlife and can become a breeding ground for dangerous diseases such as E. Coli and salmonella.
- **Plastic is naturally biodegradable**; plastic is a synthetic, inorganic material. While it does breakdown to a certain extent, the chemicals cannot be digested by animals and/or bacteria to make into an organic material. In other words, plastic gets smaller, but is always present at a molecular level.
- **Waste biodegrades in a landfill (or) landfills are giant compost piles**; landfills are not designed to break down waste, but to store it. Excavations of certain landfills have shown newspapers to still be legible after 40 years. Things simply do not break down conditions limiting air, water, and the lack of temperature control.
- **Biodegradable, compostable and recyclable are interchangeable terms**; biodegradable materials are materials that can change on a chemical level as they

break down. Non-biodegradable materials remain the same on a chemical level and continue to be present even as the material breaks into smaller and smaller parts.

- Note: Instructors should not try and correct misconceptions in the classroom, but rather take note of them for future lessons. Research shows that students need to correct misconceptions on their own.

Career Awareness

- In this lesson, there is the opportunity to introduce students to new careers that they may have been previously unaware of including, but not limited to:
    - Environmental Engineer
    - Environmental Lawyer
    - Environmental Scientist
    - Environmental Educator
    - City, County, and/or State Solid Waste Management and Divisions
    - Hazardous Waste Management
    - Recyling Coordinators
    - City Planners
    - EPA Regulators

Accommodations

- Vocabulary cards will be included in the resource section of this text this will help assist students that need visual or textual language. These cards will also be available in .pdf form for easy access on devices for the classroom or printing for the educator.
- The educator can make concessions for the students that have accommodations for presenting in front of others, as they will be in groups this student can give their group peer feedback.
- Recordings of the exit slip and other materials will be made available on the Clean SoIL website for ease of access for those students with accommodations for hearing or read aloud.
- Further accommodations and modifications will be made available on the Clean SoIL website or within the printed resource section for the curriculum.

Engagement: (5 minutes)

- To engage students, the instructor will begin the lesson by scattering trash all over the floor before the students enter the room. As students walk in, they will observe trash on the ground and be confused by it.
- The instructor will act as though there is no trash on the ground and instruct the class as if it were normal. Example: Asking students to sit down, get out notebooks and writing utensils. Only when students ask about the trash on the ground will the instructor address it. Ideally, this will happen quickly.
- The instructor will then ask:
    - Where do you think the trash came from?
    - What happens to our garbage over time?
    - Where have you seen trash like this before?

- How does it make you feel to see trash all over the classroom?
- What would happen if we just left it here?
- What if we didn't throw it away?
- What would break down?
- What wouldn't break down?
- What are your observations?
- What do we know about the trash we generate?
- Based on all our observations and wonderings, what do you think the focus question is?

Exploration (15 minutes)

- The instructor will ask students what it means for something to break down or for something to rot. It is important for the instructor to refrain from using the words biodegradable and non-biodegradable in the beginning portion of this lesson. Let students use words they are more familiar with such as rot, break down, etc.
- Questions to facilitate the discussion include, but are not limited to:
  - What does it mean if an object can break down?
  - What types of objects rot and break down?
  - What are objects that can break down made of?
  - Where do you find items that can break down?
  - What does it mean if an object can't break down?
  - What types of objects can't break down?
  - What are objects that can't break down made of?
  - What keeps them from breaking down?
  - Where do you see these items usually?
- The teacher will then group students together and ask them to sort through the trash and classify it based on whether they think it could break down or not. Students are expected to get objects wrong.
  - It is important that the instructor lets students make these mistakes.
- Students will also be asked to record why they think each object belongs in the pile they chose for it to be in.
- Students will record their findings that will help with their presentation.

Explanation (20 minutes)

- Groups will present and explain their thought process and reasoning for placing each object.
- After each group has presented, the instructor will have students fill out an exit slip.
  - This exit slip will ask them to list an item that breaks down and an item that doesn't break down. It will also include a space for students to list any questions they may have about the material.
  - The instructor will prepare for the elaboration phase of the lesson as students turn in their exit slips.

Elaboration (40 minutes)

- After students have presented, the instructor will present vocabulary words of biodegradable and non-biodegradable to give students the language used in place of "to break down" or "to not break down."
    - The instructor should be aware of any misconception's students may have. Possible misconceptions are listed above in the teacher information section.
- After the presentation of the definitions of vocabulary words, the instructor will then ask groups to apply what they've learned and apply the vocabulary words to the piles of items they have been working with.
- The instructor will prompt students and ask them whether they want to switch any of the objects in the piles they created based on new knowledge they have obtained during the presentation.
    - If students choose to make changes, the instructor will ask them to elaborate as to why they made that choice.
- Afterwards, the teacher will instruct the class on which items belonged in which pile. Students are self-assessed during this part of the lesson.
- If an object is placed incorrectly, the instructor will ask students why they think it is incorrect to allow students to express new knowledge or ask questions.
- The instructor can also ask:
    - What is the impact of biodegradable and non-biodegradable waste on the environment?
    - What are the different ways individuals, and the community are reducing the impact of trash to protect our community and the environment?

Evaluation (30 minutes)

- For grade 3, it is suggested that students stay in their groups and be asked to select one item of trash and do research on that one item (e.g., water bottle).
- For grade 4, it is suggested that students stay in their groups and select three items in a category (e.g., straws, plastic bags, and plastic bottles).
- For grade 5, it is suggested that students do research on a category of objects (e.g., plastics, food waste, paper products, etc.)
- Students should answer the questions:
    - Is this object(s) biodegradable or non-biodegradable?
    - What properties make it biodegradable?
    - What properties make it non-biodegradable?
    - What human need does this object meet?
    - How does this object fit into the larger ecosystem?
    - How should this item be disposed of to reduce the impact on the planet?
    - What ways are most effective at reducing biodegradable and non-biodegradable trash?
        - What is your evidence?
    - Where can this item be disposed of in our community?
    - How does this item fit into the bigger picture?
        - How does this item impact our ecosystem and habitat?
        - How will this item affect animals in southern Illinois? Waterways? Forests? Parks?

        - Example: A plastic water bottle meets the (perceived) human need of a cheap, effective way of carrying hydration. However, once the plastic bottle has served its purpose, the plastic bottle cannot be consumed and digested by any animals, plants, and/or decomposers. Meanwhile, a banana peel, once a human is done with it, can be broken down by other organisms.
    - What are the different ways individuals and communities are reducing the impact of trash to protect our community and the environment?
    - What are the properties of the object that made your group include it in a particular category?
- Students should combine multiple sources of information in their presentation.
    - If students have previously learned how to list and cite sources for their information, they should include this as well.
- Students will present their findings to the class on the instructor.
- Students will be instructed to take out notebook paper and make positive notes on the presentations given by their classmates.
- The teacher will grade the presentation based on the checklist available on the Clean SoIL website.
- The class will go over important vocabulary from the lesson and the instructor will ask for any ending comments or questions.

References

NGSS Lead States. 2013. *Next Generation Science Standards: For States, By State*s. Washington, DC: The National Academies Press.