

Waste Reduction Innovation

Sustainability

Introduction

Humans generate a significant amounts of waste. According to the United Nations, people around the world dispose of about 11.2 billion tons of solid waste each year. In the United States, the average amount of waste per person is about 4.9 pounds per day, or nearly 1,800 pounds every year. There is a collaborative effort to encourage everyone to reduce waste and to reuse items for other purposes rather than dispose of them. Students can help by reducing food waste, conserving water during daily activities such as brushing their teeth, washing dishes, bathing efficiently, and much more. They can explore innovative ways to reduce the 35 million tons of food that is wasted each year in the U.S. which is, according to the Upcycled Food Association, about 40% of the country's food.



LEARNING OBJECTIVES

Students will:

- form teams to research sources of and innovative ways to reduce waste
- collaboratively design a learning-based board game with strategic thinking, rule setting, and game components
- use players' feedback to refine their learning-based board game

Vocabulary

waste reduction	environment	distribution
reduce	impact	objectives
reuse	energy	rule setting
recycle	plastic	navigation
resources	packaging	collaboration

SUPPLIES

- firm paper or index cards
- markers, crayons, and colored pencils
- scissors, glue, and tape
- blank game boards (sturdy cardboard or poster board)
- small, recycled items or modeling material such as Model Magic®

PREPARE

The most prevalent types of waste in schools and homes include water, food, energy/electricity, paper, plastics, and ordering new items rather than reusing or repurposing materials. Before students create learning games, have them research examples of waste reduction. In addition, discuss how games can be learning resources. Familiarize yourself with the aspects of game play from setting and following rules to how components move players forward. Encourage students to think out of the box as they design their games.

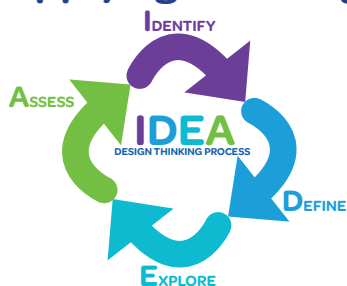
Essential Questions

- What impact does waste have on the environment, people, and animals in local communities, around the nation and worldwide?
- Why is it important to reduce waste? How can people reduce waste at school and home?
- What innovations could be developed to reduce water, food, and energy waste?
- How do innovations in product design, packaging, and distribution help to reduce waste?

Guiding Questions

- How can the Design Thinking process encourage innovative thinking?
- What decisions do game makers need to make and what information do they need before they create a game about Waste Reduction Innovation?
- How does creating an original game help the designers learn content and think strategically?
- How do objectives help shape rules, game play, and components (board design, playing cards, game pieces, etc.)?

Applying the Design Thinking process to this project:



- **IDENTIFY** learning objectives.
- **DEFINE** the game's content, mechanics, and components.
- **EXPLORE** the game's objectives and how players will move through the steps to achieve their goals.
- **ASSESS** how the game contributed to students learning about waste and innovation solutions.

Crayola and Waste Reduction

Setting science-based targets and implementing waste reduction programs are two major priorities for Crayola. The improvement goals adopted by the company help bring innovation to every aspect of the manufacturing and distribution process, from sourcing raw components, to designing for the least amount of waste during manufacturing, and to efficiently distributing children's art supplies.

Crayola sources many materials locally and manufactures many crayons and markers close to where they are used, instead of having these items travel across oceans to get to children. Crayola has redesigned Broad Line Markers over the past 10 years to reduce the amount of plastic used in them by an estimated 2 million pounds.

Packaging innovation is another way to reduce waste. Starting in 2023 Crayola Classpacks packaging, as well as inner-pack crayon sleeves have been made using 100% recycled cardboard instead of bleached cardboard, which reduces CO2e emissions by an estimated 100 metric tonnes per year, and also reduces waste. Delivering crayons to schools as Classpacks without individual packaging further reduces packaging waste.

Sustainability



- Have students observe and research many types of waste, such as water, food, plastic, energy, and over-purchasing.
- Have students pick one waste-related issue that interests them. Divide the class into small game-making groups based on similar interests.



- o Some teams may explore innovative ways of managing waste instead of sending it to landfills.
- o Other teams may look at how refillable or concentrated products might reduce packaging waste.
- o Other groups might explore innovative ways to reduce agricultural waste by upcycling rather than discarding leftover components. For example, chocolate production results in leftover cacao pulp which can be used as



livestock feed. Leftover whey from yogurt-making can be mixed into new ice cream flavors. Imperfectly formed vegetables are perfect for pizza toppings.

- o Other teams may explore waste that gets into the water supply, such as fertilizer, pharmaceuticals, and other trash that enters streams, rivers, and lakes, then flows into bays and oceans. They could explore how composting organic waste reduces the need for chemical fertilizers.
- Have students explore a problem, its impact, and innovative solutions as they dive into a specific area that will be the theme of their game.



Have each group create a board game that will teach players about the waste topic that team has selected. Have students plan their game-making process (objectives, rules, board navigation, challenges, players' pieces, etc.) using knowledge of other games and the topic they researched.

Each team will:

- Brainstorm the game's learning objectives and player goals (i.e., move to various destinations, generate innovative solutions in response to challenge cards, help other players resolve the problems they face, etc.).
- Consider many types of game mechanics and components before deciding which to use. For example, they could challenge the competitive nature of most games and rethink the ways collaboration could earn players points or help them "win." Other decisions each team will make include:
 - o How could a board be used to help players navigate



challenges, demonstrate their knowledge, and achieve goals? What ways might the board be organized? What graphic elements will represent key ideas in the aspect of waste that their team has selected?

o How might game pieces help players move around the board to the destinations? What symbols or characters might the pieces represent?

o What other components help players move through the game? For example, will students make dice or a spinner? Will they create challenge cards with problems to solve, actions to take, or questions to answer?

As each team decides on their game design, they will draft preliminary rules that they and others test. The rules should outline how players will start, move, take actions, and end the game. They should also design a scoring system, if one will be included in the game.



- Have each group play another group's game and share feedback on the draft rules and components and have them suggest revisions if anything seems incomplete or confusing.
- The game designers should ask players what new information they learned about waste reduction innovation by playing the game.
- Each team will modify and refine their game to incorporate player feedback.



- Help students connect their game to the learning objectives and the waste reduction solutions applicable to their communities and elsewhere.
- Compare the structure of their student-designed learning games to board games they have played. What engaging aspects of other games could they incorporate into their revised designs? The process of continuous improvement applies to game making, too.
- Review the IDEA Design Thinking process with students and discuss how this approach could be applied to other sustainability topics or areas of the curriculum.

Sustainability

For Younger Students

Young children can explore the differences between what is a “want” (something desired but not needed) vs. a “need” (something necessary). They can design simple versions of “Want or Need” games, where teams decide whether they want or need various foods/snacks, toys, clothes, or other items.

Some favorite games preferred by young children are card games and simple board games that allow them to learn the game mechanics while matching, finding opposites, or moving characters around very clearly delineated pathways on a board. These and other simple game mechanics such as sorting, sequencing, pattern replication, and trading or exchange, can help them focus on age-appropriate learning goals. For emergent readers, creating games with dice and cards that have a few words supported by drawn images will help them with literacy learning goals, as well as sustainability concepts.

For Older Students

Have older students articulate and assess their game’s learning goals, revising the game rules and components as needed, to ensure that their game achieves the learning objectives of deepening understanding of the topic and inspiring innovative thinking. They should gain collaboration skills that are enriched by the co-design process, which respects each person’s ideas and uses an agreed-upon assessment process. Help students embrace the Design Thinking process by identifying the appropriate time for divergent thinking, coming up with as many ideas as possible, and knowing when that discussion needs to shift to convergent thinking and collaborative decision making.



Object: get to the fish barge with 30 tokens.
Rules:
- oldest player starts the game and game play continues clockwise.
- each person starts with an "option" card and moves the number of spaces specified and earn tokens.
- land on a yellow space, read a fact card and earn tokens.



Student Reflections

- Why is waste reduction important? How can innovative solutions help improve conditions in the community, nation, and world?
- What opportunities are there to become involved in waste reduction on a personal, school, family, and community level?
- Why is working as a team important in exploring sustainability topics and designing learning games?

Teacher Reflections

- Which waste reduction issues and innovative solutions were most interesting to students?
- What prior experience did students have in collaboratively designing team projects that involved research and group decision making? How did designing a sustainability game deepen those skills?
- How does the IDEA Design Thinking process help students work collaboratively to develop new ideas and how does that align with your teaching goals?
- How can students further develop their strategic planning and collaboration skills?

Sustainability



Standards and Skill Development

Standards provide a guide to what students should know and be able to do. They help connect everyday learning experiences to the curriculum. This **sustainability** project addresses the following educational standards:

SCIENCE (NGSS)

- Obtain information from books and other reliable media about how a given human activity (e.g., in agriculture, industry, everyday life) affects the Earth's resources and environments.
- Use scientific information and principles to generate a design solution.
- Communicate information about solutions that reduce the negative effects of humans on the local environment.

LANGUAGE ARTS

- Use information gained from illustrations (e.g., maps, photographs) and text to demonstrate understanding (e.g., where, when, why, and how key events occur).
- Produce writing, with guidance and support from adults, in which the development and organization are appropriate to task and purpose.
- Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade-appropriate topics, building on others' ideas, and expressing their own clearly.
- Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

VISUAL ARTS

- Collaboratively brainstorm multiple approaches to an art or design problem.
- Organize and develop artistic ideas and work.
- Elaborate on imaginative ideas and use the Design Thinking process to bring those ideas into tangible form.
- Convey meaning through the presentation of artistic work.
- Analyze components in visual imagery that convey messages.
- Relate artistic ideas and work to personal meaning and external context.

MATHEMATICS

- Reason abstractly and quantitatively.
- Recognize area as an attribute of plane figures and understand concepts of area measurement.
- Reason with shapes and their attributes.

SOCIAL AND EMOTIONAL COMPETENCIES

Help children understand how emotions, behaviors, and attitudes impact achievement in school, career, and life by building skills in:

- Self-awareness—developing interests and a sense of purpose.
- Self-Management—using planning and organizational skills.
- Responsible Decision Making—demonstrating curiosity and open-mindedness.
- Relationship building—practicing teamwork and collaborative problem solving.
- Social Awareness—setting personal and collective goals.

