Exploring Nature-Based Solutions: Recycling and Upcycling for a Sustainable Future

RESET AN AEOP EFFORT aeop

180 minutes

Authors

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SUBJECT/GRADE LEVEL

Subject Area: Science

Grade Level: K-5

Materials

- Potted plants
- Recyclable materials (e.g., paper, plastic bottles, fabric scraps, etc.)
- Rulers or measuring tapes
- Clean-up supplies (gloves, trash bags)
- Posters and art supplies–markers, glue, cardboard, etc.
- Four blue recycling bins for sorting paper, plastic, glass, aluminum
- Large sheets of white butcher paper
- Multiple bottle caps of different sizes and color
- Research materials on nature-based solutions, recycling, and upcycling
- Projector to show videos

STANDARDS

Next Generation Science Standards

- K-ESS3-3: Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.
- 3-LS4-4: Make a claim about the merit of a solution to a problem caused when the environment changes.
- 5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Mathematics Standards | Common Core State Standards

- CCSS.MATH.CONTENT.K.MD.A.1: Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.
- CCSS.MATH.CONTENT.3.MD.A.2: Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l).
- CCSS.MATH.CONTENT.5.MD.A.1: Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems.

English Language Arts Standards | Common Core State

- CCSS.ELA-LITERACY.RI.K.1: With prompting and support, ask and answer questions about key details in a text.
- CCSS.ELA-LITERACY.RI.3.1: Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
- CCSS.ELA-LITERACY.RI.5.2: Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.

LESSON OBJECTIVE(S)

Students will identify nature-based solutions, recycling, and upcycling.
Students will describe how they can implement nature-based solutions, recycling, and upcycling to contribute to a sustainable future.

CAREER CONNECTION(S)

Mentor Background: S. Kyle McKay is a research civil engineer with the U.S. Army Engineer Research and Development Center (ERDC) Environmental Laboratory (EL). He is stationed in New York City to facilitate cooperative research between the ERDC, local U.S. Army Corps of Engineers offices, the City University of New York, and other local partners. His research focuses broadly on examining ecological effects of water resources infrastructure with applications related to urban ecosystem restoration, ecological models, dam operations and decommissioning, and flood risk management. Integrated water resource management is "a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems" (Global Water Partnership). Our team generally works on the science, techniques, and tools to realize the vision of integrated water resource management.
STEM Careers: Environmental Scientist, Ecologist, Civil Engineer, Environmental Engineer, Sustainable Product Designer, Urban Planner, Materials Scientist, Renewable Energy Engineer, Waste Management Specialist, Green Building Architect, Conservation Biologist, Environmental Educator, Water Resource Engineer, and Climate Scientist.

ENGAGEMENT

Brief Description: These engaging questions will stimulate interest, curiosity, and discussion among students. They will help reinforce the concepts of nature-based solutions, recycling, and upcycling, and encourage students to explore creative and sustainable ways to address environmental challenges.

Procedures:

Warm-up Activity (15 minutes):
Students will be introduced to the impact of their trash on the earth and its inhabitants. While incorporating the "3 Rs" which are recycle, reduce, and reuse, they will engage in both a recycle and reuse hands on activity.

Begin the lesson by engaging students in a discussion about waste and its impact on the environment. Ask questions like:

Suggested K-3 Questions:

- Why do we need clean air?
- Why do we need clean water?
- What happens to the things we throw away?
- Have you ever heard of recycling? If so, what does it mean?
- How can we reduce waste and help the environment?

Suggested 4-5 Questions:

- What are some examples of recyclable materials you use at home, and how do you think they can be creatively upcycled into something new and useful?
- Imagine you're a nature-based solution superhero! What eco-friendly powers would you possess to save the planet and promote sustainability?
- How can we apply the concept of 'reduce, reuse, and recycle' in our everyday lives to make a positive impact on the environment?
- Why is it essential to protect our local habitats and ecosystems? Can you think of ways recycling and upcycling can contribute to their preservation?
- How can we transform a waste item into a functional piece of art? Share your ideas and discuss the benefits of creating art through upcycling."

Show a video which is an overview of the 3 Rs so students understand and have an overview of each one before delving deeper into what each means to the environment. (This video needs to be paused at exactly eight minutes because it shows an activity for reusing newspapers at the end of the video.)

https://www.generationgenius.com/videolessons/reducing-our-impact-on-earth-video-for-kids/

In order to confirm students understood the video ask after the video ask some questions such as:

- Why should we recycle or reuse items?
- What happens to trash that is not recycled?
- How is the earth impacted by all of our trash?
- If we do not reduce pollution how will that affect the earth?

EXPLORATION

Brief Description:

Students will be exposed to the concept of nature-based solutions and how it aligns with recycling and upcycling, then it will be followed by the next activity below. (10-15 minutes)

Recycling Exploration (20 minutes): Students will be shown how to identify and sort material that is recyclable. They will demonstrate mastery of their ability to sort recyclable materials by completing a hands-on activity.

Procedures:

- Show students how to identify if an item is recyclable by locating the recycle emblem on the product.
- Use digital resources to showcase real-life recycling facilities or videos on how different materials are recycled. https://youtu.be/3Lzsu8SXaWY
- Show visual examples of recyclable materials (paper, plastic, glass, metal) and discuss their properties and potential for recycling
- Explain the recycling process: collection, sorting, processing, and manufacturing of new products made from recycled products.

Introduction to Nature-Based Solutions

Suggested description for K-5 teachers:

Nature-based solutions are like superhero powers that help our planet stay healthy and happy! Just like how trees give us fresh air to breathe, nature-based solutions use the power of nature to solve problems and make the Earth a better place.

Imagine you have a magical forest that can help us with different challenges. One superpower is "**Green Infrastructure.**" It's like putting a magical shield on the ground to protect us from heavy rains and floods. Green roofs, rain gardens, and special roads that let water soak in are part of this superhero team.

Then we have "**Reforestation and Afforestation**." This power is all about planting lots and lots of trees! Trees are like superheroes because they clean the air, give homes to animals, and even fight climate change by taking carbon dioxide from the air.

Next up is "**Wetland Restoration.**" Wetlands are like sponges that soak up extra water during storms and keep our rivers clean. With this superpower, we can make sure these special places stay healthy and do their job to protect us.

And don't forget "**Natural Coastal Protection**"! It's like having big, strong guardians along the seashore. Mangroves and salt marshes are nature's superheroes. They shield us from big waves and storms, keeping our coasts safe.

These nature-based solutions are not just cool but also good for our planet. They make our communities stronger, help wildlife thrive, and make sure we have clean water to drink and play in.

Additional resource: Untangled: Nature-Based Solutions

How some principles of Nature-Based Solutions are aligned with Recycling and Upcycling

Academic Description
Emulating Ecosystems:

- Recycling Alignment: Recycling aligns with the principle of emulating ecosystems by reintroducing materials back into the production cycle, mimicking the natural process of nutrient cycling. Just as nutrients from decomposed organic matter nourish new plant growth in ecosystems, recycling converts waste materials into new products, reducing the need for extracting virgin resources.

- Upcycling Alignment: Upcycling also aligns with emulating ecosystems as it creatively transforms discarded materials into new, higher-value products, similar to how nature repurposes waste materials in ecosystems. Upcycling extends the useful life of materials, reducing the overall waste generation and minimizing the environmental impact associated with producing new items.

Suggested description for K-5 teachers:

Let's talk about something really cool called "Emulating Ecosystems." Imagine that we can learn from nature and do things the way nature does them!

First, we have something called "Recycling Alignment." It's like when we take old things, like paper, plastic, or glass, and instead of throwing them away, we make them into something new! Just like in nature, where plants and animals create nutrients that help other plants grow, recycling turns old stuff into new things. This way, we don't have to take as many new resources from the Earth, and it's kind of like giving our planet a big hug!

Next, we have "Upcycling Alignment." This is when we take things that we might think are no longer useful, like an old jar or a broken toy, and use our creativity to turn them into something even better! Nature does this too when it finds a new purpose for things in the environment. By upcycling, we can make things last longer, and that means we create less waste, which is great for our planet!

So, emulating ecosystems means we try to copy how nature handles things like recycling and upcycling. By doing that, we can take better care of our Earth and make sure it stays healthy and happy for a long, long time!

Academic Description
Enhancing Resilience:

- Recycling Alignment: Recycling contributes to enhancing resilience by reducing the strain on natural resources and ecosystems. By diverting materials from landfills and reducing the demand for virgin resources, recycling helps preserve natural habitats and biodiversity, supporting the resilience of ecosystems.

- Upcycling Alignment: Upcycling enhances resilience by promoting resource efficiency and reducing waste generation. By transforming discarded materials into valuable products, upcycling reduces the need for additional resource extraction, lessening the environmental impact and contributing to a more resilient circular economy.

Suggested description for K-5 teachers:

Enhancing resilience is like having a superpower that makes us strong and able to bounce back from challenges. Let me explain what it means and how it connects to recycling and upcycling.

Imagine you have a special shield that protects you from all kinds of problems. It keeps you safe and helps you stay strong, just like how superheroes are always ready to face tough situations. That's what "enhancing resilience" is all about!

Now, let's see how it's connected to recycling and upcycling. When we recycle things, like paper or plastic, we give them a chance to be reborn into something new and useful. By doing this, we reduce waste and protect our environment. It's like giving our Earth a superpower to handle all the stuff we use and make sure it stays clean and healthy!

And with upcycling, we use our creativity to turn old or unused things into something amazing. Instead of throwing them away, we give them a new purpose and make them even more valuable. It's like giving things a second chance to be awesome and useful again!

You see, by enhancing resilience through recycling and upcycling, we help our planet stay strong and ready to face challenges like pollution and waste. We become Earth's superheroes by taking care of it and making sure it stays happy and healthy for all living creatures.

So, next time you see a plastic bottle or an old toy, think like a superhero and ask yourself, "How can I help this thing be strong again? How can I make it useful and awesome?"

Academic Description
Multi-functionality:

- Recycling Alignment: Recycling offers multi-functionality by simultaneously addressing environmental challenges such as waste reduction, resource conservation, and energy savings. Recycling helps conserve resources, reduce pollution, and minimize greenhouse gas emissions, showcasing its ability to provide multiple benefits to society and the environment.

- Upcycling Alignment: Upcycling exemplifies multi-functionality by combining waste reduction with creative innovation. It not only diverts materials from landfills but also fosters artistic expression and showcases sustainable design practices. The upcycled products can serve as functional items and serve as a visual reminder of the value of waste reduction.

In conclusion, both recycling and upcycling align well with the main principles of Nature-based solutions. They embrace the circular economy concept, contribute to resource conservation, and promote environmental resilience, making them essential components in building a more sustainable and harmonious relationship between human activities and the natural world.

Suggested description for K-5 teachers:
Multi-functionality is like having a magic wand that can turn one thing into many useful things! Let me explain how it works and how it's connected to recycling and upcycling.

Imagine you have a special toy that can do more than one fun thing. For example, it's a car, but with a twist, it can also turn into a cool robot or a helicopter! That's multi-functionality in action! It means one thing can have different purposes and be used in many creative ways.

Now, let's see how it's related to recycling and upcycling. When we recycle something, like a plastic

bottle or old paper, we give it a new life! Instead of throwing it away, we use special magic to turn it into something useful again, like a new bottle or even a cool backpack made from old juice pouches.

But wait, there's more! With upcycling, we take things that might seem old or not needed anymore and transform them into something super awesome! For example, we can turn an empty jar into a beautiful candle holder or make colorful art from old magazines.

You see, by using multi-functionality, we help reduce waste and take care of our planet. We give things new purposes and save resources, like energy and materials. It's like being a superhero for the Earth!

So, remember, the next time you see something that might be thrown away, think like a magician and ask yourself, "How can I give this thing a new life? How can I make it useful and cool again?"

EXPLANATION

Brief Description: Sorting (60 minutes) - Students will be given a variety of recyclable products and will work in small groups to sort items appropriately and then create line graphs to show the number of items in each category.

Procedures:

Students will be divided into small groups and be given recyclable trash. Each group will be given a bag of random trash to be sorted that contains paper, plastic, glass, and aluminum. Each group will also be given four blue recycling bins for sorted items of paper, plastic, glass, and aluminum. A demonstration will be given on how to sort items. Students will then work with their group to sort the trash into the appropriate bins. After the sorting process, a discussion will occur with students about the activity. Some items to discuss with students could include the following questions:

- What was the most difficult thing about sorting the trash?
- How did you decide where to put certain items that contained both plastic and paper?
- Why do you think more people don't recycle more?
- What is something you could do to encourage recycling at school, home or in their community?

In order to incorporate quantitative data, student groups will use large butcher paper to create line graphs. The students will use data collected by counting the number of items in each of the categories, paper, plastic, glass, and aluminum to create a graph. Percentages could also be calculated if desired for an enrichment activity. The graphs will be displayed around the room and discussed. Each group will appoint their speaker to explain to the class what they learned. Some suggestions on what groups should explain are how many items did they sort and which category had the most items. However if the teacher or other classmate asks them a question, any member of the group may respond. Some items to discuss with students could include the following questions:

- Did each group have the same number of items?
- Was there a trend students could identify of a category that was typically the largest?
- Was there a trend students could identify of a category that was typically the smallest?

ELABORATION

Brief Description: Recycle (60 min) Students will demonstrate their understanding of reusing items to create something new by creating a bottle cap mural.

Procedures:

Before this lesson, bottle caps will need to be collected, washed, and brought in by students over a period of time. They may be from a variety of items such as soft drinks, lotion, ketchup, and water. When caps are brought in they should be sorted by color.

Students should be shown the video https://youtu.be/YhjKkF6cAa0 to show how bottle caps could make a beautiful picture to be displayed in a school. Instruct students to create their own upcycled artwork or functional items using the materials provided. Encourage students to think creatively and apply STEM principles to their designs.Students will be divided into small groups and each will use bottle caps to create a type of animal. Students decide what animal they'd like to create based on the color of bottle caps available, and then sketch out the animal on a piece of cardboard. Students will then lay out the bottle caps to create the design. There are several ways to attach the bottle caps. In this example students will glue them on the cardboard using gorilla glue. This allows students to have a variety of jobs based on their interest and abilities. While some students are really artistic others may be better with spatial relations in laying their animals out or gluing the caps neatly. After the activity, discuss the benefits of upcycling, such as reducing waste, saving resources, and promoting creativity.

EVALUATION

Brief Description: Students will be given a summative assessment to determine if they understand the basic components of the 3 Rs.

Procedures:

Students will be asked to complete the following kahoot https://play.kahoot.it/v2/?quizId=84772020-722d-43f1-83c7-1b3d7fb83875. It could also be in worksheet form if students do not have computers available. The link for the paper form is https://drive.google.com/file/d/1czmCuWpvOfNrs8U2GKb3KB5P-l4806rH/view?usp=drive_link

REFERENCES

https://youtu.be/jP49Vt7aP3k 5th graders why we have to do more than recycle (10.5 min)
https://youtu.be/1TDC-Zud_uM 5th graders reduce (approximately 13 min)
https://youtu.be/ZT0uqEPzbd0 5th graders reduce (3.5 minutes)
https://youtu.be/XvYRrSaIpvs 5th graders upcycle (8 minutes)
http://art-actually.blogspot.com/2012/03/bottle-cap-mural.html
https://mericherry.com/2014/02/07/school-wide-bottle-cap-mural-project/
https://youtu.be/YhjKkF6cAa0