STEM Curriculum Planning Guide

This instructional design guide serves as the template for the design and development of STEM units of instruction at the Dayton Regional STEM Center in Dayton, Ohio. The guide is anchored to the *STEM Education Quality Framework* also developed at the Dayton Regional STEM Center.

STEM Unit Title	**Revamping Recycling**
Economic Cluster	Environmental Engineering
Targeted Grades	K-1
STEM Disciplines	Science, Technology, Engineering, Math
Non-STEM Disciplines	English Language Arts, Social Studies

Section I: STEM Unit Overview

Unit Overview

Our schools throw away so much trash each day and some of it can be easily recycled. Exploring the subject of recycling is a necessary responsibility of our community and by having students delve into the subject, they will begin to become more cognizant of their own responsibility to recycling. The students will research the topic extensively to inform themselves of the importance and reasons why we recycle. They will then interview staff and students to gather data and ideas on how they can improve the recycling program already in place at their school. Finally, the students will be challenged to use the data to determine strategies they can implement to increase the amount of recyclables being collected at their school.

Essential Question

How can we increase the amount of recycling in our school?

Enduring Understanding

Recycling is essential to help, protect and save our environment. Recycling helps save energy and reduce waste in landfills. Recycling also allows for the creation of new products from old products. There are three main components, which consist of: reduce, reuse, and recycle. Reducing refers to making a smart choice. Ponder if you really need this product and if it's determined that you don't, then don't get it. Reuse allows you to use products again in a new way, and recycling, the focus of this unit, consists of placing appropriate materials that can be recycled by professionals, in a designated bin.

Data collection coincides with recycling to determine how successful and effective a recycling program is at a certain location. This helps deduce any trends over a specified period of time. After collecting data, showing the results in a graph allows for increased analysis, discussion and a visual representation of the overall growth that has been tracked over time. Bar graphs, picture graphs and tally charts are appropriate for this age group.

Engineering Design Challenge

Have you ever wondered how much recycling is produced at your school? We will be exploring this concept and seeking an answer to this question by collecting data using various methods. The gathering of data will be done through means of questioning/interviewing staff and students, journaling our observations and findings, graphing, (bar graphs and picture graphs) and measuring usage and placement of recycling containers, as well as tracking growth along the way. We will then use our data to formulate a plan for finding more efficient ways to increase recycling in the school system.

Time and Activity Overview

Day	Time Allotment	Actvities
1	50 minutes	PreTest and Unit Introduction
2	50 minutes	Why Do We Recycle?
3	60 minutes	What Things Can Be Recycled?
4	40 minutes	What is the Difference Between a Question and a Statement?
5	45 minutes	Interview Day
6	50 minutes	How Do We Collect Data and Communicate Information?
7	50 minutes	Day 6 continued

8	50 minutes	How Do Maps Represent Places? (optional)
9	45 minutes	What Are Goods and Services? How Do They Relate To Recycling? (optional)
10	50 minutes	Design Challenge: Ideation
11	60 minutes	Design Challenge: Implementation of (idea chosen in Day 10)
12	50 minutes	Redesign
13	50 minutes	Presentations
14	30 minutes	Post test

Academic Content Standards

Pre-requisite Knowledge & Skill

Prior to doing this lesson, students should know:
Children have likely had prior experiences with numbers 1-100, as numbers to 120 is a first grade standard. This rote knowledge of number sense is essential for success in this challenge, as students are expected to understand and interpret their collected data and create an array of graphs, ranging from bar graphs to picture graphs. Children also need to understand comparative vocabulary such as greatest and least/fewer and most. Additionally, children need to have prior experiences with how things can be grouped together, or sorted.

In regards to recycling, children should understand that they are able to take part in helping to save the Earth. Some children may understand the differences between trash and recyclable items, however students will discuss these in greater detail within the lesson. Finally, teachers should expose students to the new vocabulary prior to starting each lesson.

Add Standard	**Mathematics**	
Grade/Conceptual Category	Kindergarten	
Domain	Counting and Cardinality	
Cluster	Know number names and the count sequence.	
Standards	K.CC. 3. Write numbers from 0 to 20. Represent a number of objects with a written numeral 0-20 (with 0 representing a count of no objects).	

Add Standard	**Mathematics**	
Grade/Conceptual Category	Kindergarten	
Domain	Counting and Cardinality	
Cluster	Count to tell the number of objects.	
Standards	K.CC. 4. Understand the relationship between numbers and quantities; connect counting to cardinality. a) When counting objects, say the number names in the standard order, pairing each object with one and only one number name and each number name with one and only one object. b) Understand that the last number name said tells the number of objects counted. The number of objects is the same regardless of their arrangement or the order in which they were counted.	

Add Standard	**Mathematics**	
Grade/Conceptual Category	Kindergarten	
Domain	Counting and Cardinality	
Cluster	Compare numbers.	
Standards	K.CC. 6. Identify whether the number of objects in one group is greater than, less than, or equal to the number of objects in another group, e.g., by using matching and counting strategies. (Includes groups with up to 10 objects)	

Add Standard	**Mathematics**	
Grade/Conceptual Category	Kindergarten	
Domain	Measurement and Data	
Cluster	Classify objects and count the number of objects in each category.	
Standards	K.MD. 3. Classify objects into given categories; count the numbers of objects in each category and sort the categories by count. (Limit category counts to be less than or equal to 10).	

Add Standard	**Mathematics**	
Grade/Conceptual Category	First Grade	
Domain	Measurement and Data	
Cluster	Represent and interpret data.	
Standards	1.MD.4. Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.	

Add Standard	**English Language Arts**	
Grade	Kindergarten	
Strand	Reading Literature	
Topic	Key Ideas and Details	
Standard	K.RL.1. With prompting and support, ask and answer questions about key details in a text.	

Add Standard	English Language Arts	
Grade	Kindergarten	
Strand	Reading Informational Text	
Topic	Key Ideas and Details	
Standard	K.RI.1. With prompting and support, ask and answer questions about key details in a text.	

Add Standard	English Language Arts	
Grade	Kindergarten	
Strand	Reading Literature	
Topic	Craft and Structure	
Standard	K.RL.4. Ask and answer questions about unknown words in a text.	

Add Standard	English Language Arts	
Grade	Kindergarten	
Strand	Reading Informational Text	
Topic	Craft and Structure	
Standard	K.RI.4. Ask and answer questions about unknown words in text.	

Add Standard	English Language Arts	
Grade	Kindergarten	
Strand	Writing	
Topic	Text Type and Purposes	
Standard	K.W.2. Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.	

Add Standard	English Language Arts	
Grade	Kindergarten	
Strand	Writing	
Topic	Research to Build and Present Knowledge	
Standard	K.W.7. Participate in shared research and writing projects (ex. “how-to” books on a given topic and use them to write a sequence of instructions).	

Add Standard	English Language Arts	
Grade	Kindergarten	
Strand	Speaking and Listening	
Topic	Comprehension and Collaboration	
Standard	K.SL.1. Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups. a) Follow agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion). b) Continue a conversation through multiple exchanges. K.SL.2. Confirm understanding of a text read aloud or information presented orally or through other media by asking and answering questions about key details and requesting clarification if something is not understood. K.SL.3. Ask and answer questions in order to seek help, get information, or clarify something that is not understood.	

Add Standard	English Language Arts	
Grade	Kindergarten	
Strand	Language	
Topic	Conventions of Standard English	
Standard	K.L.1. Demonstrate command of the conventions of standard English grammar and d) Understand and use question words (interrogatives) (e.g., who, what, where, when, why, how). e) Use the most frequently occurring prepositions (e.g., to, from, in, out, on, off, for, of, by, with).	

Add Standard	English Language Arts	
Grade	Kindergarten	
Strand	Language	
Topic	Conventions of Standard English	
Standard	K.L.2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. a) Capitalize the first word in a sentence and the pronoun I. b) Recognize and name end punctuation. c) Write a letter or letters for most consonant and short-vowel sounds (phonemes). d) Spell simple words phonetically, drawing on knowledge of sound-letter relationships.	

Add Standard	English Language Arts	
Grade	Kindergarten	
Strand	Language	
Topic	Vocabulary Acquisition and Use	
Standard	K.L.6. Use words and phrases acquired through conversations, reading and being read to, and responding to texts.	

Add Standard	English Language Arts	
Grade	First Grade	
Strand	Reading Literature	
Topic	Key Ideas and Details	
Standard	1.RL.1. Ask and answer questions about key details in a text.	

Add Standard	English Language Arts	
Grade	First Grade	
Strand	Writing	
Topic	Text Types and Purposes	
Standard	1.W.2. Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure.	

Add Standard	English Language Arts	
Grade	First Grade	
Strand	Writing	
Topic	Research to Build and Present Knowledge	
Standard	1.W.7. Participate in shared research and writing projects (ex. “how-to” books on a given topic and use them to write a sequence of instructions).	

Add Standard	English Language Arts	
Grade	First Grade	
Strand	Speaking and Listening	
Topic	Comprehension and Collaboration	
Standard	1.SL.1. Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups. a) Follow agreed-upon rules for discussions. b) Build on others' talk in conversations by responding to the comments of others through multiple exchanges.	

Add Standard	English Language Arts	
Grade	First Grade	
Strand	Speaking and Listening	
Topic	Presentation of Knowledge and Ideas	
Standard	1.SL.6. Produce complete sentences when appropriate to task and situation.	

Add Standard	English Language Arts	
Grade	First Grade	
Strand	Language	
Topic	Conventions of Standard English	
Standard	1.L.1j. Produce and expand complete simple and compound declarative, interrogative, imperative, and exclamatory sentences in response to prompts. 1.L.2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.	

Add Standard	Social Studies	Ohio
Grade	Kindergarten	
Theme	A Child's Place in Time and Space	
Strand (pk-8 only)	Geography	
Topic	Spatial Thinking and Skills	
Content Standard	K.GEO.5. Terms related to direction and distance, as well as symbols and landmarks, can be used to talk about the relative location of familiar places. K.GEO. 6: Models and maps represent places.	

Add Standard	Social Studies	Ohio
Grade	Kindergarten	
Theme	A Child's Place in Time and Space	
Strand (pk-8 only)	Government	
Topic	Civic Participation and Skills	
Content Standard	K.GOV.9: Individuals have shared responsibilities toward the achievement of common goals in homes, schools and communities.	

Add Standard	Social Studies	Ohio
Grade	First Grade	
Theme	Families Now and Long Ago, Near and Far	
Strand (pk-8 only)	Geography	
Topic	Spatial Thinking and Skills	
Content Standard	1.GEO.4. Maps can be used to locate and identify places.	

Add Standard	Social Studies	Ohio
Grade	Kindergarten	
Theme	A Child's Place in Time and Space	
Strand (pk-8 only)	Economics	
Topic	Scarcity	
Content Standard	K.ECO.11. People have many wants and make decisions to satisfy those wants. These decisions impact others.	

Add Standard	Social Studies	Ohio
Grade	Kindergarten	
Theme	A Child's Place in Time and Space	
Strand (pk-8 only)	Economics	
Topic	Production and Consumption	
Content Standard	K.ECO.12. Goods are objects that can satisfy people's wants. Services are actions that can satisfy people's wants.	

Add Standard	Social Studies	Ohio
Grade	First Grade	
Theme	Families Now and Long Ago, Near and Far	
Strand (pk-8 only)	Economics	
Topic	Scarcity	
Content Standard	1.ECO.11. Wants are unlimited and resources are limited. Therefore, people make choices because they cannot have everything they want.	

Add Standard	Social Studies	Ohio
Grade	First Grade	
Theme	Families Now and Long Ago, Near and Far	
Strand (pk-8 only)	Economics	
Topic	Production and Consumption	
Content Standard	1.ECO.12. People produce and consume goods and services in the community.	

Add Standard	Social Studies	Ohio
Grade	First Grade	
Theme	Families Now and Long Ago, Near and Far	
Strand (pk-8 only)	Economics	
Topic	Markets	
Content Standard	1.ECO.13. People trade to obtain goods and services they want.	

Add Standard	Science	Ohio
Grade	K-4	
Theme	SCIENCE INQUIRY AND APPLICATION	
Topic		
Content Standard	During the years of PreK-4, all students must become proficient in the use of the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content areas: • Observe and ask questions about the natural environment; • Plan and conduct simple investigations; • Employ simple equipment and tools to gather data and extend the senses; • Use appropriate mathematics with data to construct reasonable explanations; • Communicate about observations, investigations and explanations; and • Review and ask questions about the observations and explanations of others.	

Add Standard	Science	Ohio
Strand		
Course Content		
Content Elaboration		

Add Standard	Fine Arts	Ohio
Enduring Understanding		
Progress Points		
Grade Level		
Content Statement		

Assessment Plan

What evidence will show that students have acquired the enduring understandings for this STEM unit?

Performance Task, Projects	Engineering Design Challenge Engineering Design Challenge Rubric (Appendix Q)
Quizzes, Tests, Academic Prompts	Pre/Post Tests (Appendices B,C,D, and E) Day 6 Individual Assessment (Appendix L) Goods and Services Assessment (Appendix N)
Other Evidence (e.g. observations, work samples, student artifacts, etc.)	What Can Be Recycled? Sorting Page (Appendix G) What Can Be Recycled? Rubric (Appendix H) Question Sorting Sheet (Appendix I) Presentation Rubric (Appendix S) Informal Observations
Student Self- Assessment	Self-Assessment and Group Assessment (Appendix R)

Technology Integration

ADISC Technology Integration Model*

	Type of Integration	Application(s) in this STEM Unit
A	Technology tools and resources that support students and teachers in ***adjusting, adapting, or augmenting*** teaching and learning to meet the needs of individual learners or groups of learners.	"I Recycle: A Song for Kids" https://www.youtube.com/watch?v=vPP4705pFdc (1:17) ABC Nightline - IDEO Shopping Cart https://youtu.be/M66ZU2PCIcM (8:12) Audio to QR code with iPad and Vocaroo https://youtu.be/cgrqK6Gicnk?list=WL (3:57) Ryan's Recycling http://abc7ny.com/society/boy-7-starts-recycling-business-saves-$10k-for-college-/1744945/ (2:04) My Map Movie Digital Story https://youtu.be/aNcF53AEPeQ (4:25) Little Sammy (Sally) Saucer Song https://www.youtube.com/watch?v=3psPT9e00yU (2:33) What's a graph? K2 Math Education Kids educational Video https://www.youtube.com/watch?v=Xp8eFxyZvak (1:04) Brain Pop Jr. Tally Charts and Bar Graphs https://jr.brainpop.com/math/data/tallychartsandbargraphs/ (4:18) Math Monsters Data Collection https://youtu.be/tK1zRkPSqq4 (14:38) The Great Graph Contest https://youtu.be/Oy_rJ4FjOt4 (6:39)
D	Technology tools and resources that support students and teachers in ***dealing effectively with data***, including data management, manipulation, and display.	iPad Digital Camera Graphs QR codes Scale Audio Recorder Computer Projector
I	Technology tools and resources that support students and teachers in conducting ***inquiry***, including the effective use of Internet research methods.	Scale Audio Recorder Computer Projector

S	Technology tools and resources that support students and teachers in ***simulating*** real world phenomena including the modeling of physical, social, economic, and mathematical relationships.	Maps Youtube Videos (see above)
C	Technology tools and resources that support students and teachers in ***communicating and collaborating*** including the effective use of multimedia tools and online collaboration.	Computers iPads Vocarro.com QR codes
	**The ADISC Model was developed by James Rowley PhD, Executive Director of the Institute for Technology-Enhanced Learning at the University of Dayton*	

Career Connections

Career Description

Atmospheric scientists study weather, climate and the relationships between atmospheric activity and human activity. They use computer models and simulations to represent weather data, which can include graphs of information such as temperatures, precipitation or other meteorological data.

Like statisticians, actuaries use mathematics and statistics in their daily work. An actuary's focus, however, is to calculate and mitigate risk. Actuaries are an essential part of the insurance industry, where their graphs are used to demonstrate probabilities, costs and other statistical data related to risk. They might specialize in health, property, casualty or life insurance. (http://www.ehow.com/info_8617528_jobs-use-graphing.html)

Cartographers / Geospatial Analysts use geographic information from photographs and satellite data. They research, study, and prepare maps and other spatial data in digital or graphic form for many purposes. Cartographers may work with Geographic Information Systems (GIS), using data structures GIS and mapping systems.

Civil Engineers plan, design, and oversee construction and maintenance of building structures, and facilities, such as roads, railroads, airports, bridges, harbors, channels, dams, irrigation projects, pipelines, power plants, and water and sewage systems.

Environmental Engineers prevent, control, and remediate environmental hazards. They may work in waste treatment or pollution control technology. They must have a good understanding of chemistry, engineering, and statistics. Environmental engineers include sanitation engineers and water/wastewater engineers.

Engineers make things, but Industrial Engineers make things better! Industrial engineers, or IEs, apply science, mathematics, and engineering methods to improve systems. They need to have knowledge and skills in a wide variety of disciplines, the ability to work well with people, and a "big picture" perspective. They work to eliminate wastes of time, money, materials, man-hours, machine time, energy and other resources that do not generate value. They have a philosophy of continuous improvement, with the goal of devising efficient systems that integrate workers, machines, materials, information, and energy to make a product or provide a service. In order to complete this effectively, they analyze and design facilities (buildings, rooms, equipment, infrastructures, etc.), material handling systems, manufacturing and production systems, information systems, and individual and group workplaces (including hospitals, offices, warehouses, etc.). In operations management IEs analyze, design, and manage manufacturing and service processes, production planning and control, resource allocation and scheduling, personnel assignment and scheduling, quality assurance, inventory control and system and personnel safety.

Materials Engineers evaluate materials (like glass, plastic, paper, or metals) to develop products that meet specialized performance specifications. They find new uses for materials as well as develop machinery and processes used with certain materials. Specialized materials engineers include metallurgists, ceramic engineers and welding engineers.

Operations Researchers apply analytical methods to help make better decisions. These decisions occur in a wide variety of contexts including supply chain management, network optimization, floor planning, the environment and scheduling, and are often associated with maximizing (profit, performance) or minimizing (risk, cost) a quantity. Their analysis almost always involves modeling a situation mathematically.

A Researcher in Medical Science will often use graphs to communicate the results of clinical trials, population-based studies on disease or connections between life habits and diseases such as diabetes or cancer. Medical informaticists are particularly likely to use large data sets and statistical analysis. Medical scientists typically specialize in a field such as cancer research, gerontology, pharmacology, immunology or neuroscience.

Sanitation Engineers are environmental engineers. They work in waste treatment, site remediation, or pollution control technology. Sanitation engineers may also include Water or Wastewater Engineers who monitor the supply of safe potable water.

Statisticians develop or apply statistical theory to collect, organize and summarize data. They are often even called in to help design experiments so that the experimental design yields useful data. They can consult in a wide variety of fields including biology, chemistry, engineering, marketing and politics. Once data is collected, statisticians analyze data to identify trends or relationships among variables. This can involve computing numbers or statistics associated to the data or finding an appropriate way to display the data so the these trends become apparent.

Career One Stop website: https://www.careerinfonet.org/occ_rep.asp?next=occ_rep&Level=&optstatus=111111111&jobfam=15&id=1&nodeid=2&soccode=152031&menuMode=&stfips=48&x=60&y=9

Section II: STEM Lesson Plan

Title of Lesson

Day 1: PreTest and Unit Introduction

Time Required

50 minutes

Materials

WHOLE CLASS:

Computer with projection capabilities
Book – "Recycle!: A handbook for kids" by Gail Gibbons
Video – Ryan's Recycling: http://abc7ny.com/society/boy-7-starts-recycling-business-saves-$10k-for-college-/1744945/ (2:04)

PER STUDENT:

Recycling Pre/Post-test and Answer Key(Appendices B and C)
Optional: Recycling Pre/Posttest (Tactile Version) (Appendix D) or Recycling Pre/Post-test (Advanced Version) (Appendix E)

Objectives

Students will be able to define recycling.
Students will be able to define reasons why we recycle and its importance.

Instructional Process

1. Students will take the Recycling Pre-Test. There are 3 different levels of differentiated Pre-tests from which teachers may choose.

2. Once the students have completed and handed in the PreTest, begin viewing the video clip, Ryan's Recycling http://abc7ny.com/society/boy-7-starts-recycling-business-saves-$10k-for-college-/1744945/ (2:04).

3. Discuss with the students: What are things that Ryan did? Who supported him? What are his goals? Why do you think he has such an interest in recycling?

4. Have students gather for reading the book, "Recycle!: A handbook for kids" by Gail Gibbons. After reading, discuss with the students: What new information did you learn? What can you do to recycle? This could also be turned into an exit slip for students to answer on an index card, scrap paper, or a science notebook page.

5. Inform students that you will be spending time learning about recyclables and graphing.

Differentiation

Visual learners will benefit from the graphics of the book and the video.

There are 3 different levels of differentiated Pre tests from which to choose.

Assessments

Informal observation with questions like: Are students able to define recycling? Can students define reasons why we recycle and why recycling is important? This could also be turned into an exit slip for students to answer on an index card, scrap paper, or a science notebook page.

Section II: STEM Lesson Plan

Title of Lesson

Day 2: Why Do We Recycle?

Time Required

50 minutes

Materials

WHOLE CLASS

Book - “Where Does the Garbage Go” by Paul Showers
“Learn to Recycle” Activity Boxes (http://www.orientaltrading.com/learn-to-recycle-activity-boxes-a2-62_9516.fltr) You may also create your own.
Save the Earth Song-Mister C - https://www.youtube.com/watch?v=4-8f7OR4Dhk (4:00)
Harry Kindergarten Song Going Green - https://www.youtube.com/watch?v=8DJ45Yc3urg (2:40)
Jack Johnson 3R Song - https://www.youtube.com/watch?v=uSM2riAEX4U (3:26)

Objectives

Students will be able to verbally state benefits of recycling.
Students will be able to define the importance of recycling.
Students will participate in question and answer sessions during the read-aloud.
Students will create their own rap/jingle to demonstrate the importance of recycling.

Instructional Process

1. Begin the lesson by posing questions to the student. “Why is recycling important?” or “Does anyone at home recycle? Why?” (gather prior knowledge)

2. Read the book “Where Does the Garbage Go?” (Feel free to substitute if you have another story regarding the importance of recycling) Generate a lot of discussion during the story. (pose questions related to what is happening in the story, why recycling is important, how it is helpful to the characters in the story or people/animals/plants/Earth---perhaps do some “turn and talk” throughout, summarize discussion at the end and “think-pair-share”)

3. Show song/video clip as a movement/dance/brain-break (links listed in materials section above)

4. Give each student one or two items for the recycling boxes. Have them bring the items up and place them in the appropriate boxes ("Learn to Recycle" Activity Boxes -http://www.orientaltrading.com/learn-to-recycle-activity-boxes-a2-62_9516.fltr).

5. Finish with the students creating their own jingle/rap about the importance of recycling.

6. If time, have each group share/perform their jingle/rap.

Differentiation

There is a lot of partnering discussion and group work embedded in the lesson, which will be of great benefit to the interpersonal learners.

The lesson will also be great for the bodily kinesthetic, musical and artistic personalities because of the movement breaks, song/dance and form of assessment, as well as the sorting activity because of the manipulatives. (rap/song creation/development)

The story will also help the verbal/auditory learners, and the visual learners will benefit from the pictures/story as well.

Assessments	Informal observation---participation and answering during read-aloud, turn-and-talk and think-pair-share, sorting activity. Creation of product from the rap/jingle (higher-order thinking and critical thinking components on Bloom's Taxonomy).

Section II: STEM Lesson Plan

Title of Lesson

Day 3: What Things Can Be Recycled?

Time Required

60 minutes

*Prior to beginning the lesson, teachers need to weigh/count the amount of recycled materials in their classroom, which is essential for Day 4's lesson. Note the duration (days or weeks) you collected materials. You will need to use the same duration for the implementation day.

*NOTE: Teacher should begin collecting "trash" a week or two before this lesson, as students will be placed in small groups and need to sort the trash into categories of recycled materials and explain why. Teacher will create a graph of materials collected. This graph can be seen in Appendix F.

Materials

WHOLE CLASS:
- Computer
- Chart paper
- Markers
- Book - "Recycle That!" by Fay Robinson
- Video: "I Recycle: A Song for Kids: https://www.youtube.com/watch?v=vPP4705pFdc (1:17)

PER SMALL GROUP:
- Materials for sorting activity (some suggested examples): milk jugs, pop bottles, pop cans, plastic laundry/ soap containers, vegetable or fruit cans, varying kinds of papers, glass bottles, shredded paper, newspaper, cardboard, etc.

PER STUDENT:
- What Things Can Be Recycled? Sorting Page (Appendix G)
- What Things Can Be Recycled? Rubric (Appendix H)

Objectives

Students will be able to identify objects that can be recycled and objects that cannot be recycled.
Students will be able to sort recyclable objects into categories.

Instructional Process

PRIOR TO THE LESSON: The teacher needs to create two anchor charts for today. One chart (chart #1) should be titled, "What can be recycled?" The second chart (chart #2) needs to have the same title, but should include a table with the following categories: paper, plastic, metals, and glass. Chart 2 will be used towards the end of the lesson. The teacher could also choose to omit chart one and just discuss the responses with the class if time is of concern.

1. Briefly review yesterday's lesson on the purpose of recycling. Allow time for the students to recall the value of recycling.

2. Introduce and show students today's anchor chart (chart #1). Since they now know the importance of recycling, ask them what types of things can be recycled to recall prior knowledge. Begin by asking the class what things can be recycled. Write their responses down on the large chart paper. Record all responses, even if they are incorrect. At this point, just get the students brainstorming different materials, regardless if it can be recycled.

3. Hold up different materials that can be recycled (suggestions: milk jug, water bottle, paper, cardboard, glass bottle, etc.). Ask students what they know about the materials. Have them feel the different textures. See if students can describe the material, before you tell them what it's made out of.

4. Read the story, "Recycle That!" by Fay Robinson. As you read, ask questions about the materials they see in the pictures. Continue to read, but stop on page 18 and page 21 to reread the last line that talks about how each

material goes into its own bin. At the conclusion of the story, discuss what they saw. What were some of the materials? How were they grouped?

5. Visit YouTube to watch the “I Recycle A Song for Kids” that further explains what things can be recycled. Ask the students what they saw in the video. What types of materials did they see that could be recycled? The link to the video can be found here: https://www.youtube.com/watch?v=vPP4705pFdc (1:17).

6. Explain the group sorting activity next. Place students into groups of about 4-5. Give each team some “trash,” but be sure to give them the same types of materials (plastics, cans, papers, glass). Be aware of sharp edges and points when handling the metals and the fragility of glass (preface this to the students before they begin). Tell them that they’ll need to have an explanation as to why they grouped certain materials together. As described above in the beginning of the lesson, the teacher will need to have started collecting materials a few weeks before this lesson. Give them about 5-10 minutes to sort the materials. When the time is up, have each group present to the class how and why they grouped/sorted the materials they did. Ask the other groups if they notice anything wrong with their groupings? Was paper combined with metals, etc.?

7. Bring the class back together and ask students to consider their own classroom and school and discuss how they participate in recycling. What/where are the current bins in their school? Does the classroom have a recycle bin for paper? Does the cafeteria have a recycling station for plastic bottles and metals? Discuss what their school does for recycling and the things we can recycle at school.

8. Use anchor chart #2 and have the students provide some examples in the correct category of things that can be recycled. Hang up chart #2 for future reference.

9. Then have the students complete the recycling sorting page (Appendix G) to check for understanding. Give each student a copy and have them sort into the correct category. Grade with the corresponding rubric (Appendix H).

Differentiation

Adjust and scaffold questions to allow for student success.

When assigning student groups, consider heterogeneous grouping.

Provide language to help students identify and understand the differences between paper, plastic, metals and glass.

Provide visuals to help students sort recycled materials.

Allow students to touch the sample materials and feel the different textures.

Kindergarten students may have trouble with the short answer on the sorting page. This may be omitted, however the rubric will need to be revised to suit.

Auditory and visual learners will benefit from the song.

Kinesthetic learners will benefit from the sorting objects activity.

Students can provide several other materials that cannot be recycled, as well as explain to the class why they cannot be recycled.

Assessments

Teacher observes students while they’re sorting the objects in groups.

Teacher observes first then formally assesses each student’s sorting page.

Students can be informally assessed during the whole group discussions through observations or teacher-created checklists.

Section II: STEM Lesson Plan

Title of Lesson

Day 4: What is a Question?

Time Required

40 minutes

Materials

WHOLE CLASS
- Chart paper
- Markers
- Book - “Are You My Mother?” by P.D. Eastman
- Sentence Strips

PER SMALL GROUP:
- Paper
- Pencils

PER STUDENT:
- Question Sorting Sheet (Appendix I)
- Scissors
- Glue

Objectives

Students will be able to identify the difference between a question and a statement.
Students will produce questions for interviews.

Instructional Process

PRIOR TO THE LESSON: Create a chart with two columns: “question” and “not a question”. Write the following quotes on sentence strips: 1. I must get something for my baby bird to eat! 2. Where is my mother? 3. I will go and look for her. 4. Are you my mother? 5. I am not your mother. 6. How could I be your mother?

1. Open the lesson by asking the students , “What is a question?” Briefly discuss their answers and work together to form a definition.

2. Write your definition on chart paper. Suggested definition: A question is something you are wondering and do not know the answer. A question is something you ask another person so they can tell you the answer.

3. Read the story, “Are You My Mother?” by P.D. Eastman.

4. Discuss the baby bird’s adventure to find his mother and refer to the prepared quotes on sentence strips. As a group, sort the quotes between “question” or “not a question”.

5. Explain the sorting activity. Students will work individually to sort the questions and statements (Appendix I). If needed students can work in pairs or groups.

6. At the conclusion of the sorting activity, come back together as a group and discuss what was placed in each column.

7. Refer to yesterday’s lesson about recycling. Explain tomorrow’s activity (For example, interviewing people from the school to determine where to place recycling bins). They will need to ask three questions. As a class, work together to determine one required question to ask. Question suggestions: Where do we need a recycling bin? What do you throw away most?

8. Divide the children into groups of 2-3 to formulate two additional interview questions. The student or teacher records the questions on chart paper.
Regroup as a class to share the questions.

Differentiation

When grouping students, consider heterogeneous grouping to encourage success.

Consider pairing or grouping students to complete the paper sorting activity.

Adjust and scaffold questions to allow for student success.

Students may create additional interview questions.

Assessments

Teacher observes first then formally assesses each student's sorting page.

Students can be informally assessed during the whole group discussions/sorting through observations or teacher-created checklists.

Students can be informally assessed during question creation and discussion through observations or teacher-created checklists.

Section II: STEM Lesson Plan

Title of Lesson

Day 5: Interview Day

Time Required

45 minutes

Materials

WHOLE CLASS:
- Chart paper
- Markers

PER SMALL GROUP:
- Interview questions from previous lesson
- OPTIONAL: iPads or audio recorders to record interviews

PER STUDENT:
- Paper
- Pencils
- Interview Day Question Template (Appendix J)

Objectives

Students will conduct interviews to gather and record data.

Instructional Process

PRIOR TO THE LESSON: The teacher should have secured people for the children to interview. This could be staff members or older students. The teacher may also choose to use the Interview Day Question Template (Appendix J) to have questions ready for students to use in interviews.

1. Refer to yesterday's lesson and review questions.

2. Explain today's activity: Interviewing people from the school to gather data about recycling. Remind the students of the group-created question.

3. Regroup students to remind themselves of their group-created questions. Give them paper and pencils to record the answers. The teacher can write the questions in Appendix J and make copies for each group to take to the interviews.

4. Bring in the interviewees and conduct interviews.

5. At the conclusion, regroup as a class to discuss gathered answers. Record answers on chart paper.

Differentiation

If necessary, prepare interviewees ahead of time by telling them the questions so they can prepare an answer and possibly prompt students.

For students with poor writing/fine motor, consider typing their questions before the interviews (Appendix J).

Assessments

Students can be informally assessed during interviews and discussion through observations or teacher-created checklists.

Section II: STEM Lesson Plan

Title of Lesson

Days 6-7: How Do We Collect Data and Communicate Information?

Time Required

50 minutes each day

Materials

WHOLE CLASS
- Computer
- Chart paper
- Markers
- Book - “The Great Graph Contest” by Loreen Leedy
- Online version of “The Great Graph Contest” by Loreen Leedy https://youtu.be/Oy_rJ4FjOt4 (6:39)
- Video: K2 Math Education "What is a Graph?" https://www.youtube.com/watch?v=Xp8eFxyZvak (1:04)
- Video: "Tally Charts and Bar Graphs" https://jr.brainpop.com/math/data/tallychartsandbargraphs/ (4:18)
- Farm Animals video clip 11:38-13:07 https://youtu.be/tK1zRkPSqq4

PER SMALL GROUP: Students will work in small groups to graph given data.
- Appendix K:
  - Weather Graph (sunny, rainy, cloudy, snowy)
  - Fast Food Graph (Taco Bell, Pizza Hut, McDonald’s, Arby’s)
  - Hair Graph (blonde, brown, black, red)
  - Candy Graph (gum, chocolate, hard, chewy)
  - Bedtime Graph (7:00, 7:30, 8:00, 8:30)
  - Garden Graph (flowers, herbs, veggies, trees)

PER STUDENT:
- Graphing Practice Worksheet (Appendix L)

Objectives

Students will be able to organize, represent, and interpret data with up to three categories.
Students will be able to make a tally chart.
Students will be able to show data in a bar graph.
Students will be able to interpret data in a bar graph.
Students will be able to ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.

Instructional Process

*NOTE: Teacher can use the “trash” that they have been collecting all week as the data they graph OR the teacher can use some of the examples provided in Appendix K.

1. Say: Today we are going to learn how to collect data and share information. You can collect data on just about anything. (Tie in career connections here -Who collects data? What do they use it for? See statisticians, atmospheric scientists, researcher in medical science, statisticians, and actuaries in the Career Connections Section of this unit). Watch the "What is a Graph?" https://www.youtube.com/watch?v=Xp8eFxyZvak (1:04) Ask: What data was being collected in the video we just watched? One way to collect data is to take a survey and make a tally chart.

2. Say: Now let’s watch to see how Anna collects data. Kids are deciding where to go on their next field trip. Anna will then use that data to make a bar graph. https://jr.brainpop.com/math/data/tallychartsandbargraphs/ (4:18)

3. Say: Let’s look at the data we collected from the list of interview questions we came up with yesterday. Make a tally chart to record the data on a piece of chart paper. Use the data from the tally chart to make a human bar graph. Also make a bar graph on chart paper for them to see when you ask the following questions. Have a discussion with the students on how they would label the axes and where the title would go.

How many people picked _____?
What was the most popular choice?
What was the least popular choice?
How many more people picked ____ than ____?
How many less people picked _____ than ____?

4. Career Application...Watch Farm Animals video clip 11:38-13:07 (https://youtu.be/tK1zRkPSqq4) What other jobs can you think of that would make tally charts? When can you use tally charts?

5. Have the students break up into groups to create tally charts and bar graphs with the data that is supplied for them (Appendix K). Students will collect data and graph the results independently to see if they understood today's lesson (Appendix L). This will get turned into the teacher.

6. Read the story, "The Great Graph Contest" by Loreen Leedy. An online version of the book can also be found here: https://youtu.be/Oy_rJ4FjOt4 (6:13).

7. How can you use a tally chart to collect data and share the information for our Engineering Design Challenge? Record ideas on chart paper.

Differentiation

Adjust and scaffold questions to allow for student success.

When assigning student groups, consider heterogeneous grouping.

Put up key vocabulary in the room for students to reference that include words and pictures (for visual learners).

Auditory and visual learners will benefit from the videos.

Kinesthetic learners will benefit from the hands-on sorting activity.

Assessments

Students can be informally assessed during the whole group discussions through observations or teacher-created checklists

Student will complete a graphing worksheet (Appendix L) that can be assessed.

Section II: STEM Lesson Plan

Title of Lesson

Day 8: How Do Maps Represent Places? (optional lesson)

Time Required

50 minutes

Materials

WHOLE CLASS:
- Paper
- Pencils
- Crayons
- Markers
- Glue Sticks
- Teacher-made Map of the Classroom (Appendix M)
- Plastic gold coins
- Chocolate gold coins
- Small toys or candy
- Pre-cut shapes of teacher's choice (Ellison Press)
- Shape templates (pattern blocks)
- Video: "My Map Movie Digital Story" https://youtu.be/aNcF53AEPeQ (4:25)
- Books: "Mapping Penny's World" by Loreen Leedy or "Me on a Map" by Joan Sweeney
- Little Sammy (Sally) Saucer Song: https://www.youtube.com/watch?v=3psPT9e00yU (2:33)
- Map examples: https://www.pinterest.com/pin/283656476511306599/

PER STUDENT OR SMALL GROUP:
- Teacher-made Map of the Classroom (Appendix M)

Objectives

Students will be able to describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as above, below, beside, in front of, behind, and next to.

Students will become familiar with terms related to direction and distance, as well as symbols and landmarks, and use these terms to talk about the relative location of familiar places.

Students will understand that models and maps represent places.

Students will understand that maps can be used to locate and identify places.

Instructional Process

PRIOR TO THE LESSON:
Label each wall of the classroom with North, South, East and West.

Make several treasure maps of your classroom (Appendix M). You will need one map to demonstrate the activity with students and one map for each group of students. (See https://www.pinterest.com/pin/283656476511306599/)

Choose coins, candy, small toys, etc. to hide around the room to be the "treasures" that students will search for using the maps you create. Hide as many treasures as needed around the room.

NOTE: This lesson is adapted from"First Map Skills- Teaching Kids How to Read Maps" https://www.pinterest.com/pin/283656476511306599/. Please see examples of these simple maps and the treasure map activity before making your own classroom maps.

1. Begin the lesson by stating that the students will learn about maps today to familiarize them with basic map concepts. State that students will learn to use maps and make maps by the end of the lesson.

2. Read: “Mapping Penny's World,” “Me on a Map,” or watch a short video “My Map Movie Digital Story” https://youtu.be/aNcF53AEPeQ (4:25).

3. Listen to the song: The Learning Station’s Rock-n-Roll Songs That Teach CD-Little Sammy (Sally) Saucer-https://www.youtube.com/watch?v=3psPT9e00yU (2:33). Students dance and practice identifying the North, East, South, West signs on the walls of the classroom.

4. Show students a map of the classroom (This should be created by the teacher before the lesson. See Appendix M). Review the basic parts of the map.

5. Practice using the map as a whole class to find the hidden treasure.

6. Give different maps of the classroom to groups of students (These should be created by the teacher before the lesson. See Appendix M). Have the students read the map symbols and work together to find the “treasure.”

7. If time remains, students can make their own maps of the classroom using pre-cut shapes or pattern blocks to represent objects in the classroom, hide a treasure, and have a partner read the map to find the treasure or see the extension activity below.

Extension:
Add map-making materials (pre-cut shapes, pattern blocks to the art or social studies center for students to continue to explore making and using maps.

This lesson could be modified to include a wing or area of the building, entire building, etc. when you do your design challenge.

Differentiation

Visual learners-video, books, making maps

Verbal learners-describing the directions to get to find the hidden treasure

Kinesthetic and Auditory learners-song “Little Sammy (Sally) Saucer”, following a map to find the treasure

Interpersonal-working as a group to use the map

Intrapersonal-allow this person to follow the directions on the demonstration map to find the hidden treasure

Mathematical-using positional words to describe the location of the hidden treasure or to describe how to place the objects on the map

Assessments

Observation-Can students correctly read the symbols of the map and follow the directions to find their hidden treasures? Can students use symbols, a compass rose to construct a simple map that will lead another student to the hidden treasure?

Work Samples- Collect the students’ maps they created. Did students use the basic elements of the map correctly?

Section II: STEM Lesson Plan

Title of Lesson

Day 9: What are Goods and Services? How Do they Relate to Recycling?

Time Required

45 minutes

Materials

WHOLE CLASS:
- "A New Coat for Anna" by Harriet Ziefert
- "A New Coat for Anna" Pictures for sorting (Appendix N), cut out and laminated
- Chart paper
- Optional Video (need BrainPopJr. account): "Goods and Services" https://jr.brainpop.com/socialstudies/economics/goodsandservices/ (4:20)
- Optional Song: "Goods and Services" http://www.kidseconposters.com/singalongs/goods-and-services/

PER STUDENT:
- Goods and Services Assessment (Appendix O)

Objectives

Students will be able to identify goods (objects that can satisfy people's wants) and services (actions that can satisfy people's wants).

Students will be able to identify goods and services involved in the recycling process.

Instructional Process

PRIOR TO THE LESSON: Print, laminate, and cut out "A New Coat for Anna" Pictures for sorting (Appendix N). Make copies of the Goods and Services Assessment for each student (Appendix O).

1. Read aloud "A New Coat For Anna" by Harriet Ziefert. Ask students: What did Anna want? (She wanted a new coat) What did Anna and her mother do to get a new coat? (They traded items to get the things they wanted).

2. Show students pictures from the story (Appendix N). Ask students to do an open sort with the pictures and then describe the attributes they used for sorting. This may be done in small groups or as a whole class.

3. Next, introduce the terms goods (objects that can satisfy people's wants) and services (actions that can satisfy people's wants). Sort the pictures again into these categories. Goods: wool, yarn, cloth, coat, gold watch, lamp, cherries, lingonberries, necklace, teapot. Services: farmer raising & shearing sheep, woman spinning wool into yarn, weaver making cloth, tailor sewing the coat.

4. To tie this lesson into the unit, remind students that they also use goods and services. Have students think about the data they have collected. What items from their data would be classified as goods? (notebook paper, handouts, magazines, newspapers, soda, water, gatorade, etc) What information from their data might be considered services? (waste collection, recycling, custodial services, advertising, etc). Record students' ideas on chart paper.

5. To assess student's knowledge of goods and services, have students draw a picture of one good and one service from their daily life. Students should label their picture and write a 1-2 sentence caption (Appendix O).

Differentiation

Allow students to work in heterogeneous groups for the sorting activity.

Consider providing real goods (wool, yarn, cloth, etc.) for kinesthetic learners.

Provide sentence stems/frames for students who need scaffolding.

For auditory and visual learners the following video is an option. It does require an account. https://jr.brainpop.

com/socialstudies/economics/goodsandservices/

The following free song could also help students distinguish between goods and services: http://www.kidseconposters.com/singalongs/goods-and-services/

Assessments

Goods and Services Assessment (Appendix O): Students draw a picture of one good and one service. Students write 1-2 sentences to describe their pictures.

Section II: STEM Lesson Plan

Title of Lesson

Day 10: Ideation

Time Required

50 minutes

Materials

WHOLE CLASS
- Data from previous day in the form of a graph
- Sticky Notes
- White Board
- Dry Erase Markers
- Engineering Design Process Graphic (Appendix P)

TEACHER RESOURCE: https://youtu.be/M66ZU2PCIcM (8:12)

Objectives

Students will use the engineering design process to brainstorm ideas for improving recycling in the classroom and/or at their school.

Students will create a plan to improve recycling in the classroom and/or at their school.

Instructional Process

PRIOR TO THE LESSON, teachers should have baseline data and will provide the data to the students in the form of a graph. * Refer to video to see how to conduct an ideation phase. https://youtu.be/M66ZU2PCIcM (8:12).

1. Review the design process using Engineering Design Process graphic (Appendix P). Display the graphic on a projector or print a large poster. Discuss with students where we are in the process. Tell them that we will be moving from the “question” stage to the “think” stage today.

2. Inform students that they will use the data collected from days 6-7 to brainstorm ideas for improving recycling at school.

3. Explain to students how to conduct an ideation session. Refer to Ideation session video. https://youtu.be/M66ZU2PCIcM (8:12).

4. Inform students that they are going to be environmental engineers and create new ideas to improve recycling. Allow students 10-15 minutes to generate as many ideas as possible for improving recycling. The teacher (or students) should record student ideas. Ideas could be recorded using sticky notes, chart paper, a whiteboard, etc.

5. Once the students have submitted as many ideas as possible, as a class, sort the ideas based on similarities.

6. Group students and assign them a category to focus on for creating an idea to improve recycling.

7. Groups generate an idea to improve recycling in their classroom and/or school and draw a plan for that idea.

Possible Ideas:

Change the placement of recycling bin in the school/classroom,
Redesign or decorate recycling bins to make them more appealing,
Create announcements to encourage increased recycling,
Create a recycling song, jingle or commercial,
Bring in outside presenter,
Start recycling club or committee,

Create a recycling rewards program to encourage student recycling,
Have a recycling contest between classrooms.
Use “trash” or recyclables to advocate recycling such as buttons, sculptures or posters,
Create a slideshow to present to administration,
Make a mural using recycled materials.

8. Bring groups back together to share ideas. Have the engineers vote on their favorite idea. Choose ONE idea to focus on and change for Day 11. You can guide students towards an idea that fits your classroom needs. Remember to keep it simple! Only change one aspect of the current recycling plan to make data collection more reliable.

9. Do not move on to Day 11 until you have collected materials needed for the design.

Differentiation

Students will work in heterogeneous groups during the ideation sessions.

Students can be paired with a peer for assistance within their group if needed.

Assessments

Students will be informally assessed by the teacher through observation of group work.

Section II: STEM Lesson Plan

Title of Lesson

Day 11: Implementation of Recycling Plan (idea chosen in Day 10)

Time Required

60 minutes

Materials

WHOLE CLASS:

*Will vary based on design idea chosen in Day 10

*Remember before beginning Day 10 be sure you have collected materials needed for the design.

PER STUDENT:

Engineering Design Graphic (Appendix P)
Engineering Design Challenge Rubric (Appendix Q)
Self and Group Evaluation Rubric (Appendix R)

Objectives

Students will use the chosen idea from Day 10 to design a plan to increase recycling.

Instructional Process

1. Inform students that they are moving to the "design" portion of the Engineering Design Process. Refer to the Engineering Design Graphic (Appendix P).

2. Review the Engineering Design Challenge Rubric (Appendix Q) with students so they are aware of expectations for the design.

3. This day can look very different depending on the idea chosen by the class. You can guide students towards an idea that fits your classroom needs.

Possible Ideas:

Change the placement of recycling bin in the school/classroom,
Redesign or decorate recycling bins to make them more appealing,
Create announcements to encourage increased recycling,
Create a recycling song, jingle or commercial,
Bring in outside presenter,
Start recycling club or committee,
Create a recycling rewards program to encourage student recycling,
Have a recycling contest between classrooms.
Use "trash" or recyclables to advocate recycling such as buttons, sculptures or posters,
Create a slideshow to present to administration,
Make a mural using recycled materials.

4. Implement the recycling change created and collect data for the same time period as initial data was collected in Day 3.

5. Collect post-data. The teacher collects recycled material over the same period as the initial data was collected in Day 3 (baseline data) i.e., if the teacher collected recycling for one day for the baseline data, recycling needs to be collected for one day for the post-data; if the teacher collected recycling for one week for the baseline data, recycling needs to be collected for one week for the post-data. The students and teacher should sort the material collected into categories of recycled materials and remove material that is not recyclable. The class records how much recycled material was collected by weighing it or by other means. Then the class will create a graph to visualize this data.

6. Allow students time to complete the Self and Group Evaluation (Appendix R).

Differentiation

Students will work in heterogeneous groups.

Provide support and scaffolding for groups as needed.

Assessments

Students will assess their participation in the group with a Self and Group Evaluation Rubric (Appendix R)

Recycling plans will be assessed using the Engineering Design Challenge Rubric (Appendix Q).

Informal observation of group participation will be conducted by the teacher.

Section II: STEM Lesson Plan

Title of Lesson

Day 12: Redesign

Time Required

50 minutes

Materials

WHOLE CLASS:
- *Will vary based on design idea chosen in Day 10
- *Remember before beginning Day 10 be sure you have collected materials needed for the design.
- Markers
- Chart paper

PER STUDENT:
- Engineering Design Graphic (Appendix P)
- Engineering Design Challenge Rubric (Appendix Q)
- Self and Group Evaluation Rubric (Appendix R)

Objectives

Students will use the implemented idea from Day 11 to redesign their plan to increase recycling.

Instructional Process

1. Inform students that they are moving to the “redesign” portion of the Engineering Design Process.

2. Students will analyze the data they collected after implementing their design plan. Ask students: Did our recycling increase? What are some ways we can improve our design to include even more recycling to occur.

3. Make a list of ideas for redesign on chart paper. Students choose one way to improve their design.

4. Implement design change and collect data for the same time period as initial data was collected in Days 3 and 10.

5. Collect post-data. The teacher collects recycled material over the same period as the initial data was collected in Day 3 (baseline data) i.e., if the teacher collected recycling for one day for the baseline data, recycling needs to be collected for one day for the post-data; if the teacher collected recycling for one week for the baseline data, recycling needs to be collected for one week for the post-data. The students and teacher should sort the material collected into categories of recycled materials and remove material that is not recyclable. The class records how much recycled material was collected by weighing it or by other means. Then the class will create a graph to visualize this data.

Differentiation

Students will work in heterogeneous groups.

Provide support/scaffolding for groups as needed.

Assessments

Students will assess their participation in the group with a Self and Group Evaluation Rubric (Appendix R).

Recycling plans will be assessed using the Engineering Design Challenge Rubric (Appendix Q)

Informal observation of group participation will be conducted by the teacher.

Section II: STEM Lesson Plan

Title of Lesson

Day 13: How Can I Present My Results to Others?

Time Required

50 minutes

Materials

*Prior to the lesson teachers will need to download an MP3 recorder to an iPad, or other device

WHOLE CLASS:
- iPad, or other device with a microphone
- Access to vocarro.com
- See instructional video on making QR codes using an iPad and vocarro.com: https://youtu.be/cgrqK6Gicnk?list=WL (3:57)

PER STUDENT:
- Poster board
- Markers
- Crayons
- Construction Paper
- Scissors
- Glue
- Glitter (optional)
- Presentation Rubric (Appendix S)

Objectives

Students will be able to present information gained through the engineering design process.

Students will illustrate posters and record tips encouraging staff and students to recycle.

Instructional Process

1. Inform students they will be using the knowledge gained through the engineering design process to create posters and list recycling facts persuading students and staff to recycle in school.

2. Assign teams of 2-6 students to present information.

3. Students will work together to create a poster encouraging students and staff to recycle and/or informing them how to recycle in school. The information will be displayed throughout the school. (You may choose to split the groups in half and have some students work on the poster and others work on the voice recording for the QR code.)

4. Model for students how to use an MP3 recorder to create voice recordings.

5. Students will generate 1-2 recycling facts to record on an MP3 player or iPad. They may write these in their science journals before recording.

6. The teacher will transfer voice recordings to a QR code using vocarro.com or other QR code generating app.

7. Print QR codes and attach to posters. Display the posters throughout the school.
Encourage students and staff to look for the posters around the school and scan the codes for more information on recycling.

Differentiation	Students will work in heterogeneous groups. Students can be paired based on abilities (writing, speaking and language) to work on specific parts of the presentation.
Assessments	Final projects will be assessed using a Presentation Rubric (Appendix S).

Section II: STEM Lesson Plan

Title of Lesson	**Day 14: Post Test**
Time Required	30 minutes
Materials	PER STUDENT Recycling Pre/Post-test and Answer Key(Appendices B and C) Optional: Recycling Pre/Posttest (Tactile Version) (Appendix D) or Recycling Pre/Post-test (Advanced Version) (Appendix E)
Objectives	Students will be able to demonstrate their knowledge of graphing and recycling concepts.
Instructional Process	1. Administer the Recycling Pre/Post-test.
Differentiation	There are three different levels of differentiated Post-tests.
Assessments	Recycling Pre/Post-test and Answer Key(Appendices B and C) Optional: Recycling Pre/Post-test (Tactile Version) (Appendix D) or Recycling Pre/Post-test (Advanced Version) (Appendix E)

Section III: Unit Resources

Materials and Resource Master List

PRINTABLES-

- Recycling Pre/Posttest and Answer Key(Appendices B and C)
- Optional: Recycling Pre/Posttest (Tactile Version) (Appendix D) or Recycling Pre/Posttest (Advanced Version) (Appendix E)
- Teacher-created Graph Sample (Appendix F)
- What things can be recycled? Sorting Page (Appendix G)
- Rubric for sorting page (Appendix H)
- Question sorting sheet (Appendix I)
- Interview Day Question Template (Appendix J)
- How Do We Collect Data? Graph Sorts: Weather Graph (sunny, rainy, cloudy, snowy), Fast Food Graph (Taco Bell, Pizza Hut, McDonald's, (Arby's), Hair Graph (blonde, brown, black, red), Candy Graph (gum, chocolate, hard, chewy), Bedtime Graph (7:00, 7:30, 8:00, 8:30), Garden Graph (flowers, herbs, veggies, trees) (Appendix K)
- Day 6 Individual Assessment : Graphing Practice Worksheet (Appendix L)
- Teacher-made Map of Classroom (Appendix M)
- "A New Coat for Anna" Pictures (Appendix N)
- Goods and Services Assessment (Appendix O)
- Engineering Design Process Graphic (Appendix P)
- Engineering Design Challenge Rubric (Appendix Q)
- Self and Group Evaluation Rubric (Appendix R)
- Presentation Rubric (Appendix S)

INVESTIGATION / EXPLORATION

- Computer with projection capabilities
- Chart paper
- Markers
- Materials for sorting activity (some suggested examples): milk jugs, pop bottles, pop cans, plastic laundry/ soap containers, vegetable or fruit cans, varying kinds of papers, glass bottles, shredded paper, newspaper, cardboard, etc.
- Sentence Strips
- Paper
- Pencils
- Scissors
- Glue
- iPads or audio recorders to record interviews (optional)
- Crayons
- Glue sticks
- Pre-made treasure maps/maps of the classroom
- Plastic gold coins
- Chocolate gold coins
- Small toys or candy
- Pre-cut shapes
- Shape templates
- Data from previous day in the form of a graph
- Sticky Notes
- White Board
- Dry Erase Markers
- Poster board
- Crayons
- Construction Paper
- Glitter (optional)
- "Learn to Recycle" Activity Boxes (http://www.orientaltrading.com/learn-to-recycle-activity-boxes-a2-62_9516.fltr) (optional)

DIGITAL RESOURCES

- Video – Ryan's Recycling (http://abc7ny.com/society/boy-7-starts-recycling-business-saves-$10k-for-college-/1744945/) (2:04)
- Save the Earth Song-Mister C (https://www.youtube.com/watch?v=4-8f7OR4Dhk)(4:00)

Harry Kindergarten Song Going Green (https://www.youtube.com/watch?v=8DJ45Yc3urg)(2:39)
Jack Johnson 3R Song (https://www.youtube.com/watch?v=uSM2riAEX4U) (3:27)
Video: “I Recycle: A Song for Kids (https://www.youtube.com/watch?v=vPP4705pFdc) (1:17)
Online version of “The Great Graph Contest” by Loreen Leedy (https://www.youtube.com/watch?v=Oy_rJ4FjOt4) (6:39)
Brain Pop Tally Charts and Bar Graphs video (https://jr.brainpop.com/math/data/tallychartsandbargraphs/) (4:18)
Farm Animals video clip 11:38-13:07 (https://www.youtube.com/watch?v=tK1zRkPSqq4)
Video-What's a graph? (https://www.youtube.com/watch?v=Xp8eFxyZvak) (1:04)
Video: “My Map Movie Digital Story” (https://www.youtube.com/watch?v=aNcF53AEPeQ) (4:25)
Little Sammy (Sally) Saucer Song (https://www.youtube.com/watch?v=3psPT9e00yU) (2:33)
Instructional video on making QR codes using an ipad and Vocarro.com (https://www.youtube.com/watch?v=cgrqK6Gicnk) (3:57)

BOOK RESOURCES
“Recycle!: A Handbook for Kids” by Gail Gibbons
“Where Does the Garbage Go?” by Paul Showers
“Recycle That!” by Fay Robinson
“Are You My Mother?” by P.D. Eastman
“The Great Graph Contest” by Loreen Leedy
“Mapping Penny's World” by Loreen Leedy or “Me on a Map” by Joan Sweeney
“A New Coat for Anna” by Harriet Ziefert

Key Vocabulary

Bar Graph- a bar graph used the length of bars and a scale to show data

Cardinal directions- the directions of north, south, east, west

Compass Rose- a symbol on a map that shows directions (north, south, east, west)

Data- data is information that has numbers. Data can be shown in charts, tables and graphs

Design- an outline, sketch, or plan

Fewer- of a smaller number (i.e. two hearts are one fewer than three hearts)

Fewest- the smallest number in a group

Glass- a hard, brittle transparent substance used for windows and bottles

Goods- objects that can satisfy people’s wants

Graph- a diagram representing a system of connections or interrelations among two or more things by a number of distinctive dots, lines, bars, etc.

Ideation- the process of forming ideas or images

Improve- to make more useful

Interview- a meeting in which one or more persons questions another person

Map key- the part of a map that gives the meaning of symbols and colors

Map- a representation, usually on a flat surface, of the features of an area

Metal- a substance (as gold, tin, copper, or bronze) that has a more or less shiny appearance, is a good conductor of electricity and heat, and usually can be made into a wire or hammered into a thin sheet

More- in greater quantity, amount, measure, degree, or number (three hearts are one more than two hearts)

Most- in the greatest number in a group

Needs- goods or services that are required

Paper- a substance made from wood pulp, rags, straw, or other fibrous material

Picture Graph- a picture graph uses pictures or symbols to show data

Plastic- a group of materials, either synthetic or naturally occurring, that may be shaped when soft and then hardened to retain the given shape

Question- a sentence in an interrogative form, addressed to someone in order to get information in reply

Recycle- to convert (waste) into reusable material

Recycling- to treat or process (used or waste materials) so as to make suitable for reuse

Reuse- to use material again in a different way

Services- actions that can satisfy people's wants

Statement- something stated: such as a single declaration or remark or a report of facts or opinions

Survey- to question (someone) in order to collect data for the analysis of some aspect of a group or area

Symbol- something used for representing something else

Tally Chart- a tally chart shows all the data collected using tally marks

Tally Mark- a tally mark is used to record each piece of data. Five tally marks are shown like this ////, //// // stands for 7.

Wants- desires that can be satisfied by consuming a good

Technical Brief

According to an EPA report, the United States produced 258 million tons of personal waste in 2014, that comes to 4.4 pounds of waste per person per day. To dispose of this waste in a landfill costs on average $50.59 per ton according to the same report. Furthermore, materials such as metals and plastics (which are made from oil) use resources that are limited and are not easily recoverable once placed in a landfill. Thus there is a strong financial incentive to reduce the amount of waste we send to landfills. The methods to decrease the amount of waste that we dispose of in landfills can be conveniently described by four R's: reduce, reuse, recycle and reclaim.

Reduce: the goal is to minimize the amount of waste we produce. We can do this by buying products with less packaging or borrowing (instead of buying) products that we only use rarely.

Reuse: the goal is to find new uses for products that we do not need anymore. For example donating clothes that no longer fit instead of throwing them away.

Recycle: the goal is to take products we use and extract the materials from them to make new products. For example, old paper can be processed and made into new paper.

Reclaim: To take waste and convert it into energy, typically by burning it to produce steam to run an electric generator.

This lesson focuses mainly on Recycling.

In the 2014 EPA report, the EPA estimated that 34% of all waste material was recycled (or composted), 13% was reclaimed as energy and 53% was committed to a landfill. Paper and paperboard made up almost 50% of the weight all products recycled, the next most common by weight were metals, plastics than glass. Many

industries use recycled materials. According to the EPA, 37% of fiber used to make new paper products came from recycled sources in 2011 and according to the American Iron and Steel Institute 2/3 of all new steel comes from recycled sources. Recycling also reduces the energy required to make new products: according to the Recycling union of Utah it takes 95% less energy to make new aluminum products from recycled aluminum than from raw materials. Moreover, the EPA estimates that recycling in 2014 saved over 1.1 billion BTUs of energy. However, we can do better job of recycling. Overall, 65% of paper products were recycled, whereas 34% of metals were recycled, 26% of glass was recycled and only about 10% of plastics were recycled.

This lesson aims to increase recycling in our schools. To help us make decisions on how to increase recycling we will collect and organize data. It is important that we establish a baseline recycling information, so prior to the lesson the teacher should collect data on how much the school recycles. This will allow students to decide if their ideas worked to increase recycling.

The data collected will depend on what aspects of recycling the teacher wants to focus on: if you are only looking at amount of paper recycled in the classroom per week, the teacher should find an average amount of recycling in that classroom for several weeks prior to the lesson.

Data comes in two different forms: categorical and quantitative.

Categorical data is data that is divided into categories and measures how much of it falls in a particular category. Example: colors of shirts students are wearing today, the categories are colors and the amount in each category is the number of students wearing a particular colored shirt.

Quantitative data is data that records measurements or amounts of something. Example: heights of students in class, you record the height in inches of each student in class.

The data in this lesson will most likely be categorical. The most important of these categories is the amount of recycling before and after we made changes to our recycling program (the amount in each category here could be weight). Other categories may include types of recycled materials or specific changes we were thinking of making to the recycling program and how many respondents would think it would help, some changes might be location of recycling bins, how big the bins are, design of the bins (color, shape, etc), existence of an awareness campaign (contest, posters, etc). All of these provide different categories for data.

To summarize data it is extremely useful to visualize it using a graph. For categorical data there are two commonly used types: bar graphs and pie graphs.

Bar graphs display the data by showing the counts for each category next to each other. Each count is represented as a height of a bar. The order of the categories here does not matter, and space should be provided between the bars of each category to show that they are distinct. The area of the bar for each category should be proportional to the amount so as not to mislead the reader as the eye often sees area instead of height.

Pie graphs show the whole group of cases as a circle and slice the circle into pieces whose size is proportional to the fraction of the whole in each category. In particular, if using percents the sum of the percents in all categories should be 100%.

Safety and Disposal

When preparing recycling items for student use, make sure objects are clean and free of sharp edges. Use caution when handling metal or glass objects. Students should be supervised when handling any "trash" or recycled material.

When handling recycled materials, students may wear protective gloves (work gloves, latex gloves, etc)

Dispose of all trash and recyclables in the appropriate containers.

Check for any student food allergies before using candy in the Day 8 lesson.

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Section IV: Appendices