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	**Humpty Dumpty: Stay on the Wall!**
Economic Cluster	Human Performance & Medicine
Targeted Grades	Pre-K and Kindergarten
STEM Disciplines	Science, Technology, Engineering, Mathematics
Non-STEM Disciplines	Language Arts

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Section I: STEM Unit Overview

Unit Overview

In this unit, students will conduct scientific investigations and use the engineering design process to solve a problem related to the nursery rhyme: "Humpty Dumpty". The scientific investigations will engage students in understanding weather patterns, recognizing signs of impending weather, sorting and describing materials, and building strong structures. The students will form generalizations using their prior knowledge about weather. Students will create and test a safety seat for Humpty Dumpty. Students will use the engineering design process to test a seat that will withstand specific elements of weather and analyze their results to improve their product. Students will engage in analyzing, collecting, and recording data throughout this collaborative inquiry based unit. This is a 9-lesson unit. Lessons 1-8 will build background knowledge for students that will inform their decisions during the engineering design challenge in Lesson 9.

Essential Question

What is weather?
How can we predict the weather?
How do people describe materials?
How do people use materials to build strong structures?

Enduring Understanding

Weather is what is happening in the air outside.
We can look at the clouds to predict what will happen with the weather.
People gather and use information to make good decisions.
People talk about materials using words that describe their properties.
People can build strong structures by putting different materials together.

Engineering Design Challenge

Students will study and test various common materials, then use their collected data to help design a structure that will keep Humpty Dumpty (simulated by a plastic egg) from falling off of a wall during both a simulated rain storm and a simulated wind storm. Students will then analyze their data and redesign the structure to improve the results. Students will use common classroom materials to build their structures.

Time and Activity Overview

Day	Time Allotment	Actvities
1	30-60 minutes	Pre-test and Introduction (Humpty Dumpty: "Stay on the Wall!")
2	30-45 minutes	Humpty Dumpty Sat on the Wall (Wall Construction)
3	30-60 minutes	Down Came the Rain (Precipitation)
4	30-60 minutes	I'll Huff and I'll Puff (Wind)
5	30-60 minutes	How I Wonder What You Are (Materials Exploration)
6	30-60 minutes	Eeny Meeny Miny Moe (Sorting Materials)

7	60-90 minutes (2 days)	What Jack Built (Constructing with Materials)
8	30-45 minutes	Rain Rain Go Away (Effects of Water and Wind)
9	90-120 minutes (2-3 days)	Humpty Dumpty "Stay on the Wall!" (Engineering design challenge)

Pre-requisite Knowledge & Skill	Students should be familiar with the nursery rhyme Humpty Dumpty. Students will need time to adapt to school routines and expectations.

Academic Content Standards

Add Standard	Mathematics	Ohio
Grade/Conceptual Category	Kindergarten	
Domain	Counting and Cardinality	
Cluster	Know number names and the count sequence.	
Standards	Count to 100 by ones and by tens.	

Add Standard	Mathematics	Ohio
Grade/Conceptual Category	Kindergarten	
Domain	Counting and Cardinality	
Cluster	Count to tell the number of objects.	
Standards	Understand the relationship between numbers and quantities; connect counting to cardinality.	

Add Standard	Mathematics	Ohio
Grade/Conceptual Category	Kindergarten	
Domain	Measurement and Data	
Cluster	Describe and compare measurable attributes.	
Standards	Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.	

Add Standard	**Mathematics**	Ohio
Grade/Conceptual Category	Kindergarten	
Domain	Measurement and Data	
Cluster	Classify objects and count the number of objects in each category.	
Standards	Classify objects into given categories; count the numbers of objects in each category and sort the categories by count.	

Add Standard	**Mathematics**	
Grade		
Standard		
Benchmark		
Indicator		

Add Standard	**English Language Arts**	Ohio
Grade	Kindergarten	
Strand	Literature	
Topic	Key Ideas and Details	
Standard	With prompting and support, identify characters, settings, and major events in a story.	

Add Standard	English Language Arts	Ohio
Grade	Kindergarten	
Strand	Writing	
Topic	Research to Build and Present Knowledge	
Standard	With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.	

Add Standard	English Language Arts	Ohio
Grade	Kindergarten	
Strand	Writing	
Topic	Text Types and Purposes	
Standard	Use a combination of drawing, dictating, and writing to narrate a single event or several loosely linked events, tell about the events in the order in which they occurred, and provide a reaction to what happened.	

Add Standard	English Language Arts	Ohio
Grade	Kindergarten	
Strand	Speaking and Listening	
Topic	Comprehension and Collaboration	
Standard	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).	

Add Standard	English Language Arts	Ohio
Grade	Kindergarten	
Strand	Language	
Topic	Vocabulary Acquisition and Use	
Standard	Identify real-life connections between words and their use (e.g., note places at school that are colorful).	

Add Standard	English Language Arts	
Grade		
Standard		
Benchmark		
Indicator		

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	Individuals have shared responsibilities toward the achievement of common goals in homes, schools, and communities.	

Add Standard	Social Studies	
Grade		
Standard		
Benchmark		
Indicator		

Add Standard	Science	Ohio
Grade	Pre-K	
Theme	Observations of the Environment	
Topic	Observations of Objects and Materials	
Content Standard	Objects and materials are described by their properties.	

Add Standard	Science	Ohio
Grade	Kindergarten	
Theme	Observations of the Environment	
Topic	Daily and Seasonal Changes	
Content Standard	Weather changes are long-term and short-term.	

Add Standard	Science	Ohio
Grade	Kindergarten	
Theme	Observations of the Environment	
Topic	Properties of Everyday Objects and Materials	
Content Standard	Objects and materials can be sorted and described by their properties.	

Add Standard	Science	Ohio
Strand		
Course Content		
Content Elaboration		

Add Standard	Science	
Grade		
Standard		
Benchmark		
Indicator		

Add Standard	**Fine Arts**
Grade	
Subject	
Standard	
Benchmark	
Indicator	

Add Standard	**Technology**
Grade	Kindergarten
Standard	Technology and Social Interaction
Benchmark	D: Collect information about products and discuss whether solutions create positive or negative results
Indicator	2. Describe how a product or system can be used the right way and the wrong way (e.g., using scissors as a knife, a screwdriver as a can opener)

Assessment Plan

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

Performance Task, Projects	Testing materials and artifacts Engineering design challenge
Quizzes, Tests, Academic Prompts	Pre-test/Post-test Journal prompts
Other Evidence (e.g. observations, work samples, student artifacts, etc.)	Lab journals Class journals
Student Self- Assessment	

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.	Duplos
D	Technology tools and resources that support students and teachers in ***dealing effectively with data***, including data management, manipulation, and display.	Chart paper Interactive white board
I	Technology tools and resources that support students and teachers in conducting ***inquiry***, including the effective use of Internet research methods.	http://education.nationalgeographic.com/education/encyclopedia/wind/?ar_a=1 http://education.nationalgeographic.com/education/encyclopedia/precipitation/?ar_a=1 Ruler/meterstick Measuring cup
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.	Fan Hairdryer Strainer Plastic pitcher Watering can Sieve
C	Technology tools and resources that support students and teachers in ***communicating and collaborating*** including the effective use of multimedia tools and online collaboration.	Interactive white board Digital camera and/or video camera
	**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

An auto safety engineer would be responsible for design and test of vehicle safety systems. One such system would be the design of infant/ child restraint systems. Many iterations evaluating designs and materials of construction would be conducted prior to releasing a design. This would be analogous to the design/build/test of our Humpty restraint system.

A construction engineer would oversee the building process of completing the architect's design. They would be responsible for assuring that all design features were incorporated per the prints. They would also check the build site to maintain a safe work environment.

A human factors engineer would design a jet fighter cockpit layout for maximum human efficiency. All aspects of pilot safety would be considered: operational fatigue, pilot comfort, crash avoidance and safety, among other factors.

A weather scientist, meteorologist, would study atmospheric conditions with the intent of giving us long-range predictions of weather conditions. They would use advanced mathematical models to predict future weather conditions. Being able to predict bad weather early will allow many people to seek safe shelter. A meteorologist would help with the design of systems that would also collect data on temperature, wind speed, barometric pressure, and other variables that can predict weather conditions.

Materials and Manufacturing Directorate
The Air Force Research Laboratory's Materials and Manufacturing Directorate develops materials, processes, and advanced manufacturing technologies for aircraft, spacecraft, missiles, rockets, and ground-based systems and their structural, electronic and optical components. Air Force product centers, logistic centers, and operating commands rely on the directorate’s expertise in materials, nondestructive inspection, systems support, and advanced manufacturing methods to solve system, expeditionary deployment, and operational challenges. (http://www.wpafb.af.mil/afrl/rx/)

Section II: STEM Lesson Plan

Title of Lesson	**Lesson One: Humpty Dumpty: "Stay on the Wall"**
Time Required	30-60 minutes
Materials	For each student: Lab Journal (Appendix E) Writing utensils Pre-test (Appendix A) For the class: Story - Humpty Dumpty: "Stay on the Wall" (1) Chart paper (1 sheet) Chart markers Large Craft Sticks (5) Cutout pictures (in Appendix F) of Humpty Dumpty, Rain, Wind, Snow, and Sun (1 each) Interactive White Board (if available)
Objectives	Students will be able to describe and explain the events, including the problem, in the story Humpty Dumpty: "Stay on the Wall!"
Instructional Process	This lesson sets the stage for the unit's learning goals as well for as the engineering design challenge at the end of the unit. Lesson Preparation: 1. Print story to read aloud to students. Optional: Print extra copies of the story for students to look at during extra time. 2. Copy the pictures of Humpty Dumpty, Sun, Rain, Wind and Snow. Glue each picture on a craft stick to make a “puppet.” Optional: Make more than one set for use in small groups. 3. Prepare chart paper for steps 5 and 6. Write “Humpty Dumpty’s Problem” at the top, leave a space for responses, and about half-way down the sheet, write “Solutions to Humpty Dumpty’s Problem”. 4. Prepare lab journals. Copy the pages from Appendix E that you will need to create the lab journals.

5. Plan a time for students to complete the lab journal entry for the day.

6. Print and copy the pre-test. (Appendix A, in the Printable Resources document)

Instructional Process:

1. Give students the pre-test. Read all printed questions to the students, but allow students to figure out the pictures on their own. Score item 7 based on recent observations of the students as they work in pairs or groups.

2. Gather the students in the class meeting area. Ask, "Does anyone know the nursery rhyme about Humpty Dumpty?" Give students time to think.

3. Ask, "Can anyone recite (say) the rhyme?" Allow a child to recite the rhyme or if most or all raised their hands when asked if they remembered the rhyme, allow the class recite the rhyme together.

(Optional literacy extension. For kindergarten students, ask "Why do we call this a rhyme?" Call on a student to answer. For pre-k students, say “Listen as I say the last word in each of the lines of the rhyme. What to you hear?" (wall/fall; men/again) Discuss rhyming words with the students.)

4. After reciting the rhyme, ask “What was Humpty Dumpty’s problem?” Children’s answers may include: he fell off the wall, he got broken, the king’s horses and men couldn’t put him together again. Affirm all answers. It is not necessary to identify one answer to the question.

5. Say "I have a new story about Humpty Dumpty. Listen to this story to learn more about Humpty Dumpty’s problem." Read the story and allow students to engage in understanding. If possible, display the illustrations from the story on an interactive white board for students to view features of weather and the interlocking nature of the wall construction more easily.

6. Ask "What was Humpty Dumpty’s problem in this story?" Answers may include: he fell, he got wet, the wind blew him off the wall. Record students' answers on chart paper or an interactive white board. The focus is to have children recall events and identify the role weather played in the story. If none of the children mention the weather in their answers, ask: “What kind of weather did Humpty Dumpty experience?” (Sun, rain, wind, and snow). Ask, “What happened to Humpty when it rained? When the wind blew? When the snow fell?”

7. Ask children to brainstorm solutions to Humpty Dumpty’s problem. Record students' answers on the chart. Allow all possible solutions, no matter how far outside-the-box they may seem. Especially acknowledge those that address the

problem of keeping Humpty safe.

8. Show children the stick puppets. Depending on the size of your class and the age of the children, allow children to take turns “acting out the story” using the puppets. Pre-k classroom option: pass out puppets and let the children “act out” the story as you read. (Optional: Make several sets of the puppets so several groups can act out the story at a time.) Tell children that you will have a set of puppets available for them to use during self choice time at one of the centers so everyone will get an opportunity to act out the story using the puppets.

9. Show students the lab journal. Explain that scientists and engineers keep track of what they have learned in a lab journal. Have students sketch a picture of Humpty Dumpty and a solution to his problem. Have students work in their journals right away or set the journaling time aside as a separate activity for the day, such as during writing time.

Differentiation

Write out nursery rhyme using rebus method to illustrate words and make it easier for younger and learning disabled students to read.

Make several sets of the weather and Humpty 'puppets' for use in small groups.

For younger students or students with a learning disability, show pictures of - wind, water, falling, broken egg - to facilitate answering question "What was Humpty's problem in the story?"

Enlarge the book so visually impaired and younger students can see it.

For younger students, students with a learning disability, or students with fine motor delays, have an egg shape template to trace into their journal.

For younger students, consider making a large class journal that the teacher will write/draw in for the class.

Assessments

Pre-test
Individual lab journal entries
Teacher observations

Section II: STEM Lesson Plan

Title of Lesson	**Lesson Two: Humpty Dumpty Sat on the Wall (Wall Construction)**
Time Required	30-45 minutes
Materials	For each team Lab Journals 8 bump rectangular Duplos (20/group -- 100 total Duplos) Paper or plastic bag (1) Appendix D (1 per team) Crayons For the class: Chart paper (1) Interactive white board (optional)
Objectives	Students will work together to construct a wall.
Instructional Process	This lesson provides students the opportunity to practice teamwork and problem-solving, as well as counting to 10 (pre-k) and skip counting by 10s to 100 (kindergarten). Lesson Preparation: 1. Students will need to work in 5 teams of any size. Choose students that will work well together. 2. Copy Appendix D for student teams. 3. Make 10 stacks of 10 Duplos. 3. Plan time for students to complete the journal entry for this lesson. Students will color a picture of a wall to match the wall they are building. Instructional Sequence: 1. Gather students in class meeting area. Re-read “Humpty Dumpty: Stay on the Wall!”. Have students look closely at the illustrations of the wall and describe what they see. This can be projected on an interactive white board if available. Encourage

them to notice that the bricks are staggered from one row to the next.

2. Model a poorly built wall. Set the stacks of Duplos next to each other on a table. Do this clumsily, allowing some stacks to fall down and others to sit crookedly. Exaggerate the task of straightening and fixing the wall. Ask students if they think you have a good wall. Elicit from students that your wall should be more like the wall in the story.

3. Explain that teams will work together to build sections of the wall. Break students into 5 teams, with as equal a number of students in each team as possible. Explain that each team will need to make two rows, or layers, of the wall.

4. Have students assemble a section of the wall using a copy of Appendix D as a guide. Encourage cooperation and persistence as students work together. As students are working, have them color the blocks on the page for lesson 2 in their lab journals.

5. When each team's part of the wall is complete, all of the students will come together to put all of the pieces of the wall together to complete the final product. When the students put all of the layers together they can count by ones and/or tens to one hundred.

6. Have students circle the completed wall in their journals that shows what Humpty Dumpty's wall looked like.

Differentiation

Give each team 2 colors of Duplos so the staggered pattern stands out for younger and visually impaired students.

Have younger and visually impaired students look at and feel a brick or concrete block wall in the school to feel how they and staggered.

Assessments

Individual lab journal entries
Teacher observations

Section II: STEM Lesson Plan

Title of Lesson	**Lesson Three: Down Came the Rain (Precipitation)**
Time Required	30-60 minutes
Materials	For each student Lab Journal (appendix F) Writing utensils For the class Humpty Dumpty: Stay on the Wall! story (1) Sensory sand/water table or large tub (1) Sand for sensory table Water for sensory table Different types of cups, watering can, etc. (3) Large rocks or materials that will not be easily moved by water (2) 8 bump rectangular Duplos (100) Modeling clay (2 small balls) Ice shavings (2-3 quarts) OR Instant snow (2-3 quarts) (See Materials List in Section III for suggested purchase options) Sentence strips or index cards (3) Chart paper (3 sheets) Weather Graph (1)
Objectives	Students will describe what precipitation is and where it comes from. Students will discriminate between several forms of precipitation.
Instructional Process	This lesson provides students with background knowledge about the effects of rain and snow, which will play a role in students' preparation for the engineering design challenge in Lesson 9. Lesson preparation: 1. Find photographs of rain and snow. One possible resource for these would be National Geographic: http://education.nationalgeographic.com/education/encyclopedia/precipitation/?ar_a=1 Visit the National Geographic Education website. Familiarize yourself with the images of precipitation and the definition of precipitation. “Precipitation is any type of

water that forms in the Earth's atmosphere and then drops onto the surface of the Earth." Select several images to show students during class. Potential discussion topics for several photographs are listed below.
Photograph 1- Hail Storm Clouds.
Point out the clouds in this photograph. Students should begin to notice that the clouds are thick as well as the several types of clouds in the photograph. Ask the students where they think precipitation is falling in the photograph.
Photograph 2- Child and adult crossing the street
Allow students to notice the look on the child's face as her and an adult cross the street in the middle of a snow storm. Also bring students attention to the clothing they are wearing and allow students to make connections to why they need to be wearing this type of clothing.
Photograph 3-Flamingos
Allow students to notice how animals in nature take cover from precipitation.
Photograph 4-Fog
Allow students to notice that fog is a cloud very close to the ground. Fog is a commonly misunderstood type of precipitation. Fog is actually a type of precipitation. It is a type of stratus cloud that is made up of water droplets or ice crystals that are suspended in the air close to the Earth's surface
Photograph 5- Hail
Allow students to see the balls of hail all over the ground and sidewalk.

2. Preview and collect materials for teacher demonstrations. Prepare a sheet of chart paper titled "Precipitation" and plan to record student responses.

3. Elevate one side or add a ramp inside the large tub or sensory table. Place Humpty's wall inside the table, securing it to the bottom with clay. Add sand and a couple of heavy objects such as rocks. Have watering tools and water prepared, as well as ice shavings or instant snow. This will be used multiple days and will need access to an electrical outlet in later lessons.

4. Plan student organization. The investigations part of this lesson is designed for students to work together in groups of 3 or 4. Students can observe, and talk about each other's investigations. This experience will work best if used in a center where students spend about a few minutes at the sensory table.

5. If you are not already using a weather graph, prepare a weather graph for your classroom. The weather graph may include, but not be limited to; rainy, snowy, sunny, windy, cloudy, partly cloudy, foggy. As a class, document the type of weather and clouds that are observed on a daily basis.

6. Use sentence strips, index cards, or paper to write down vocabulary words that will be taught and used throughout this lesson (precipitation, rain, snow). Vocabulary words can be posted on a word wall, a pocket chart or on a large sheet of paper throughout this unit.

7. Plan for student safety. Before allowing students to explore on their own or in small groups, discuss the safety risks with the students. Nothing should be consumed during the exploration. The sand, rocks, Duplo wall, and water are not to be removed from the table. Students should only pour one cup of water at a time.

Instructional Process:

1. Begin the lesson by asking students “What is precipitation?” (Explain that precipitation is any type of water that falls from the clouds and then drops onto the surface of the Earth.) Then ask students to think about their personal experiences with or about precipitation (rain, sleet, hair, ice, snow, fog).
For example: “Have you ever been caught outside in a rain storm? Have you ever seen snow or played in the snow? Have you ever noticed or wondered where precipitation (rain, sleet, hair, ice, snow) comes from?”
Record student observations on a sheet of chart paper titled "Precipitation."

2. Discuss the classroom weather graph. (If you do not graph the weather already, have students think about the weather over the past few days.) Reflect on the different types of weather that have occurred in the last several days and what the clouds looked like (if they can recall them).

3. Review with the students the story "Humpty Dumpty: Stay on the Wall!” Have students briefly discuss why Humpty Dumpty fell off the wall. Explain that today they will learn more about rain and snow.

4. Briefly discuss the vocabulary words precipitation, snow, and rain. Add these words to the word wall. Also share with the students that weather comes from the sky. When the drops of water that make clouds get too heavy, precipitation forms. Discuss that there are many forms of precipitation. It can come in the form of rain, snow, sleet, hail, and fog but the two most common types are rain and snow.
Add these words to the word wall.

5. Show students the photographs of rain and snow using an interactive white board or other display device. Discuss the photographs with the students using the discussion prompts in the Lesson Preparation section.
Ask students what the effects of freezing rain, hail, sleet or snow can have on roads or structures like Humpty Dumpty’s wall. Ask “What happens to land and other land objects when different types of precipitation fall?" (Possible answers include: Streets get slippery when it rains freezing rain. Large puddles begin to form in a bad rain storm.)

6. Using a glass of water, watering can, or other type of watering tool, pour the water into the sand and allow students to watch the effects of the "rain". Students should observe what the force of the moving water does to the sand. Repeat the process

with large rocks in the sand. Students will observe how the rocks do not move as easily as the sand. Have students share and record responses.

7. Repeat the process with "snow" falling on both the sand and rocks. Have students share their observations and comparisons. Record student responses on chart paper.

8. After students have observed the rain and snow on the sand and rocks, have them document their observations in their lab journal. Students will document their learning by sketching, labeling, and/or writing their observations about how precipitation affected items in the sensory table. Have students work in their journals right away or set the journaling time aside as a separate activity for the day, such as during writing time.

9. Optional extension activity: Have students take turns adding rain and snow to the sand and rocks inside the sensory table or have them do so in small groups during center/choice time. Allow students to test the effects of rain and snow on "Humpty" by providing a plastic egg to students as they are testing.

Differentiation

Frontload new vocabulary for younger students and students with a learning disability by discussing the words with them before beginning the lesson. Start a word wall paired with pictures.

Project photographs onto an interactive white board or by using a document camera for visually impaired students.

Allow younger and learning disabled students extra time for hands on exploration on the effects of the water and snow.

Assessments

Individual lab journal entries
Teacher observations

Section II: STEM Lesson Plan

Title of Lesson	**Lesson Four: I'll Huff and I'll Puff (Wind)**
Time Required	30-60 minutes
Materials	For each student Lab Journal Writing utensils “Experimenting with Wind” record sheet (part of Lab journal in Appendix F) Drinking Straw (1) Safety goggles (1) For the class "Humpty Dumpty: Stay on the Wall!” (1) Electric fan or blowdryer (1) Sensory sand/water table or large tub (inlcuding materials as set up in previous lesson) Sentence strips or index cards (1) Chart paper (1-2) Weather Graph (1) Interactive white board For each group Paper lunch bag (1) Rocks varying sizes and weights (5) Cotton balls (5) Marbles (5) Heavy magnets (3) Tablespoons of cornmeal or salt (2 TBSP) Sheets of paper (5) (some crumpled, folded, flat) Modeling clay (1 small ball Paper Clips (5)
Objectives	Students will describe wind and its effects.
Instructional Process	This lesson provides students with background knowledge about the effects of wind, which will play a role in students' preparation for the engineering design challenge in Lesson 9.

Lesson Preparation:

1. Find photographs of windy weather. One possible resource for these would be National Geographic: http://education.nationalgeographic.com/education/encyclopedia/wind/?ar_a=1
Visit the National Geographic Education website. Familiarize yourself with the images of wind and the definition of wind. Wind is air that is in motion. Select several images to show students during class. Potential discussion topics for each photograph are listed below.
Photograph 1 Wind Sock.
Students will notice the wind sock blowing in the sky. Talk about what it would look like if the wind was not blowing. Ask the students if they can see the wind or just the effects of the wind.
Photograph 2- Sand Dunes
Students will notice the wind can't be seen but the lines in the sand have been created by the wind.
Photograph 3 - 90-degree tree
Wind is so strong where this photo is taken that the tree doesn't grow straight up and down. The tree is growing sideways.

2. Collect materials listed in the materials section of this lesson. Ensure that all materials are readily available as needed during the lesson. Tape the paper bag at the end of each table so it can lay open on its side like a soccer goal. Students will attempt to blow objects into it. Materials for group exploration can be put into plastic bags for ease of distribution.

3. The investigation part of this lesson is designed for students to work together in groups of 4-5. Students can observe and talk about each other's investigations. Students should have about 5-7 minutes to explore effects of wind on everyday materials.

4. Determine how and when your students will complete the day's journal entry. The data collection sheet for this lesson is included in the lab journal (Appendix F). If students are using different journals, this page can be copied and cut to fit in a composition book or other science journal.

5. Before allowing students to explore on their own or in small groups discuss the safety risks with the students.
Students are only to put their own straw in their mouths. No other materials go into their mouth. Students are only to blow through the straw. Students are not to chew, or walk around with the straw in their mouths. When blowing materials, ensure you are not blowing them at someone. All students should wear safety goggles for this part of the lesson.

Instructional Process:

1. Ask students to make connections to their personal experiences with wind. For example: “Have you ever been in a wind storm? How does wind make your body feel when it’s windy outside? Have you ever seen wind push or move objects?” Record student responses on chart paper.

2. Review the weather graph with students. Ask them to think about days when it was windy outside.

3. Review with the students the story of “Humpty Dumpty: Stay on the Wall!” Discuss with students how and why Humpty fell off the wall due to high winds. Explain that today we will be learning more about wind and what wind can do.

4. Briefly discuss the vocabulary word wind. Add this word to the word wall. Wind is air that is in motion. Explain that they can see the effects of wind, but they cannot see the wind itself.
Discuss some of the effects of wind and reflect upon students previous connections made earlier. Discuss that wind is strong enough to dry clothes outside in the summer, can blow a sailboat across the ocean, or make a tree grow sideways.

5. Show students the photographs of wind using an interactive white board or other display device. Discuss the photographs with the students using the discussion prompts in the Lesson Preparation section.
Ask students how wind affects roads, cars, plants, animals, or structures like Humpty Dumpty’s wall.

6. Gather students around the sensory table. Use a fan or blow dryer to show how the “wind” affects the sand, rocks, wall or other objects in the sand/water table. This will simply be a demonstration for the students. They will need to keep an appropriate and safe distance from the fan and blow dryer. Students observe what the force and effects of the wind on the objects will be in the table.

7. Ask students how they can create their own source of wind. Students may suggest their hands waving back and forth or their mouths. Demonstrate for the students that if you blow through a straw you can create wind. Introduce and name all the materials that the students will be trying to blow.

8. Model how students will use the straw to create wind and blow objects across the table. Students will try to blow all objects into the paper bag. With each object that is blown, students will record on their “Wind Observations” record sheet to document information for their science journal. Teacher will model how to fill in their data on their record sheet. They will be documenting the materials that are easy to blow into the bag, difficult to blow into the bag, or objects that couldn’t be blown into the bag.

9. Before allowing students to explore on their own or in small groups discuss the

safety rules with the students. Distribute safety goggles along with the bag of materials.

10. Place students into groups of 4-5. Give all students a straw and allow them time to explore wind by blowing the objects across the table.

11. After students have observed the wind on all the objects, students will document their observations on their “Experimenting with Wind” record sheet in their lab journals. Have students work in their journals right away or set the journaling time aside as a separate activity for the day, such as during writing time.

12. Optional extension: Demonstrate the effects of the fan or hair dryer on the plastic egg (Humpty Dumpty) as it sits on top of the wall. Students can also use their straw to try to blow Humpty off the wall.

Differentiation

Project photographs, as above, for visually impaired students.

Have pictures/diagrams of each object the students will try to blow with their straw for younger students and students with a learning disability to glue into their wind observation record sheets to facilitate this task or have small groups work as a team and record answers on one form.

Provide ear protection to students with sound sensitivity.

Assessments

Individual lab journal entries
Teacher observations

Section II: STEM Lesson Plan

Title of Lesson	**Lesson Five: How I Wonder What You Are (Materials Exploration)**
Time Required	30-60 minutes
Materials	For each student Paper lunch bag (make 1 extra for teacher) filled with the following materials: Plastic egg (1) 2 cup section of egg carton (1) Craft sticks (4) Cotton balls (4) String (12 inches) 8 Bump Rectangular Duplos (2) Clay (1 small ball) Chenille stick (1) Cloth/Fabric scrap (6 inches square) Cardboard (6 inches square) Soft wire (6 inches) Lab Journal For the class: Digital Camera (1) Chart paper (2-3) Marker (1) Masking Tape (1 roll) Clipboard (1) Interactive white board
Objectives	The students will manipulate various materials, observing, examining and analyzing their observable properties.
Instructional Process	This lesson provides students with background knowledge about the properties of the materials that they may choose to use for the engineering design challenge in Lesson 9 as well as vocabulary that they can use to describe those properties. Lesson Preparation: 1. The activity is designed for each student to independently explore the provided materials. Individual desk/table space will be needed. Students should be near enough to talk to each other about what they observe.

2. In order to maximize exploration time, materials for student exploration should be placed in a paper bag for each student. Prepare an extra bag for the teacher. (Optional: Materials could be placed on trays on each table.)

3. Create a Materials Key using chart paper and a marker. Write the names of each of the materials in advance on the chart paper and leave enough room to attach the materials next to the word. Masking tape should hold all the materials. The students will use this key as a reference when completing their journal prompts and in future lessons.

Instructional Process:

1. Tell the students that they are going to be engineers today. Specifically, they are going to be materials engineers. Explain that materials engineers look at different materials and examine their properties.
Inform students that they will each be given a brown lunch bag filled with different materials. Explain that each material will be held up and described and they are to find the same object in their bag. Tell students that they will have a chance to explore all the materials in their bags, but everyone will be looking at the same material at the same time.

2. Introduce the vocabulary terms material and property.

3. Pull materials out of the bag, one at a time, and have students find the same material. Materials can be introduced in any order. Briefly describe each material, attach it to the Material Key, and allow students a few minutes to explore the material. For each material, ask “What words can we use to describe this material’s properties?” Encourage students to tell each other what they observe about each material.

Sample material introductions:
Plastic egg: Plastic eggs are oval, come in different colors, and can be opened and closed to store goodies. What other words can we use to describe this material’s properties? Think about more ways to describe this material as you explore it.
Craft Sticks: Craft sticks are thin and made of wood. What other words can we use to describe this material’s properties? Think about more ways to describe this material as you explore it.
Cotton Balls: Cotton balls are soft, fluffy and white. What other words can we use to describe this material’s properties? Think about more ways to describe this material as you explore it.
Chenille Stick: Chenille sticks are long, skinny, flexible, and come in different colors. What other words can we use to describe this material’s properties? Think about more ways to describe this material as you explore it.
Wire: Wire is thin and flexible and has to be handled carefully. What other words can

we use to describe this material's properties? Think about more ways to describe this material as you explore it.

4. Allow students time to explore each material. During the time students are exploring each material, circulate around the room, asking students to describe the properties of the materials. Use questions such as: "What can you do with this material? What about the material allows you to do this?"
While observing students during their exploration of the materials, record any descriptive words that you overhear the students using. These words will be recorded on chart paper to display for the whole class. The students will reference this chart when completing the journal prompts and in future lessons.

5. When all students have had time to explore all the materials, have them return all undamaged items to the bag. Collect bags and set aside for use in Lesson Five.

6. Gather students in the class meeting area. Explain to students how you recorded words they were using to describe the materials as they explored. Record the words on chart paper. Add any words that students may not have known (see lab journal page 4). Encourage the students to reference this chart and the Materials Key when completing their journal entries. If you use an interactive white board to display these words, be sure to save the page for later reference.

7. Allow students time to complete their journal entry for the day. The students will sketch a material of their choice, labeling its name and words that describe its properties. Have students work in their journals right away or set the journaling time aside as a separate activity for the day, such as during writing time.

8. Extension to journaling experience:
If time permits, students could take pictures with a digital or Polaroid camera of the material in their journal entry, and place the picture next to their journal entry on page 4 of their Lab journal. Students could also choose to tape a sample material in their journal.

Differentiation

Pair more and less able students to explore materials together to aid concentration.

Set a visual timer to help younger students stay focused while working in their own.

Introduce descriptive words - waterproof, breakable, absorbent, smooth, strong, weak, bendable - prior to beginning the lesson and add to word wall.

During sharing of journal entries allow younger students and students with a learning disability to show actual material instead of drawings .

Assessments

Individual lab journal entries
Teacher observations

Section II: STEM Lesson Plan

Title of Lesson	**Lesson Six: Eeny Meeny Miny Moe (Sorting Materials)**
Time Required	30-60 minutes
Materials	For each student: Paper lunch bag (make 1 extra for teacher) filled with the following materials: Plastic egg (1) 2 cup section of egg carton (1) Craft sticks (4) Cotton balls (4) String (12 inches) 8 Bump Rectangular Duplos (2) Clay (1 small ball) Chenille stick (1) Cloth/Fabric scrap (6 inches square) Cardboard (6 inches square) Soft wire (6 inches) Lab Journal Ruler (optional) For the class Digital Camera (1) Chart paper (2-3) Marker (1) Materials Key for objects (labeled) Interactive white board
Objectives	The students will arrange materials by their properties.
Instructional Process	This lesson provides students with background knowledge about the properties of the materials that they may choose to use for the engineering design challenge in Lesson 9, as well as vocabulary that they can use to describe those properties. Lesson Preparation: 1. The activity is designed for students to work in pairs to explore and sort their provided materials. Students can be partnered with others with complementary skills to maximize learning through discussion.

2. Go through each of the bags from Lesson Four and replace any materials that were destroyed through exploration. Student teams may share one or two bags.

3. Plan to add "flexible" and "breakable" to the word wall.

4. For this activity, the students will record each of the material's descriptive qualities, properties and/or characteristics in order to find ways that the materials are alike or different. The chart on this page already has words inserted into the rows. Words may be added or replaced in order to match the words recorded during Lesson 4. Plan to allow students time to complete their lab journal entries.

5. Plan to display the students' journal page on chart paper, an interactive white board, or an overhead projector. This activity will be completed whole group. The students will need to refer to this display. If using an interactive white board, be sure to save this page for later reference.

6. In order to display the different ways that the students were able to group the materials, document with a camera and display these groupings at the front of your instruction area. If you cannot access a camera, you may designate a table to display the actual materials, using cards to label the properties used. This will be completed in step 5. Step 5 may need to be completed the following day if displaying pictures.

Instructional Process:

1. Inform students that they will each be given a brown lunch bag filled with materials. Instruct the students to pull out each of the materials, place them on their desk, and store the bag on the floor under their chair. Place a bag in front of each student.

2. Choose a property from the list from lesson 5 in the students' lab journal. Instruct students to sort through their materials to find objects with this property. Ask the students to share which materials they selected. Repeat the activity with the next card.

3. Help the students find lesson 5 in their lab journals by displaying the chart on interactive whiteboard (or chart paper or overhead projector) and check to see that all students are on the correct page. The students will complete page 5 together as a class.

4. Begin with the first material listed; together go down through the chart checking off the properties of each material. Have student teams decide which properties should be checked off. Continue until the entire chart is completed. Optional: Students may use a ruler to help them keep their place as they follow the rows and

columns on the chart.

5. Allow the students time to explore other ways that the materials can be sorted. Show students how they can use their charts to aide them while deciding how the materials can be grouped together. Explain how by using the chart, they can easily see how some materials are flexible while others are stiff

6. While the students are completing this activity independently, circulate around the room. Take pictures using a camera to document their different groupings. If a camera is not accessible, have the students display the different groupings on a designated table in the room.

7. As a class, discuss the different ways the students were able to group the materials. Be sure to label the groups displayed with the common properties. This step may need to be completed the following day if using pictures.

8. Collect paper bags with materials and store materials for use in later lessons.

Differentiation

Pair more and less abled students to sort materials together to aid concentration and comprehension.

As much as possible, pair pictures or actual objects with property words on cards to be drawn out of box. Do this on the chart displayed for the whole class as well.

Assessments

Individual lab journal entries
Teacher observations

Section II: STEM Lesson Plan

Title of Lesson	**Lesson Seven: What Jack Built (Constructing with Materials)**
Time Required	60-90 minutes (2 days)
Materials	For each student: Lab journal Writing utensils For each group: Small tub/shoebox (1) Egg carton sections cut apart (6) Paper (5 sheets) Cardboard squares, 6 in. (5) Play dough (1 tub) Modeling clay (1 ball) Glue (1 bottle) Yarn (small ball) Craft sticks (10) Cloth/Fabric squares, 6 in. (5) Chenille sticks (10) Soft wire, 6 in. (5) Team role name tags (Appendix C) For the class: Single hole punch (1) Card stock (4-8 sheets) Yarn (small ball)
Objectives	Students will combine different materials to create a new artifact. Students will differentiate between team roles and demonstrate the ability to work together.
Instructional Process	This lesson provides students with background knowledge about how different materials can be combined to create systems of materials working together, which will allow students to be successful in the engineering design challenge in Lesson Nine. Lesson Preparation:

1. Place materials for each team in a small tub, shoebox, or other container. Any other materials added or substituted during the explorations in Lessons 4 or 5 can be added or substituted in this lesson. The container can be used at the end of the lesson to store the students' creations until the next lesson.

2. Copy the team role name tags from Appendix C on card stock. Punch holes in the top corners of each card. Cut a piece of yarn approximately 18 inches long. Tie each end of the yarn in each of the holes in the card to make a necklace.

3. Students should work in teams of 3-4. Plan for teams of multi-levels as different skills will emerge as students work.

4. Plan for lab journal:
Plan time for students to complete the journal entry for this lesson. Students will draw and label their artifacts.

Instructional Process:

Students will begin the experience in a large group and move to small groups after receiving instructions. It is suggested that in Pre-k classroom, this be done during center/work time. Kindergarten classrooms may have all of the groups working at the same time in small groups.

1. Gather students in the class meeting area. Have students share what they remember about the materials they tested on previous days. Say "Today we will learn about how to put materials together to make something new. We are also going to learn how to work in teams to construct, or build, whatever you like with these materials."

2. Show students the engineering team role cards and read the descriptions for students. Explain that they will all be different kinds of engineers.

3. Divide the class into teams of 3-4. Assign roles to team members and distribute role card necklaces.

4. Have the materials manager from each team come and get a tub of materials for their group.

5. Remind children that Humpty Dumpty had to deal with many different types of weather (rain, snow, wind) in the story. Say, "Today we are going to build something with the materials in your tub. Tomorrow, we are going to test what we have built to see what happens when it gets wet or when the wind blows on it."

6. Give children plenty of time to manipulate the materials. As children work, encourage them to think about their choices. Ask questions like, "Why did you

	choose to connect these materials with glue?" or "What is your plan for putting these materials together?" 7. When students are done working and have an object (artifact) they have built, collect all excess materials and store the artifact in the tub the materials came in. Place student role card name tags in the tub as well. (If students need time to continue building the next day, all materials can still be stored in the container.) 8. Have students draw a picture of what they built in their Lab journal. Have students work in their journals right away or set the journaling time aside as a separate activity for the day, such as during writing time. (Kindergartners may also want to write about how they combined the materials.) 9. Optional: Have students share their journal entries with their "fellow engineers" or as a whole class.
Differentiation	Set a visual timer to help younger students and students with a learning disability plan their time wisely. For younger students, take a photograph of their finished construction to put into their journal. For students with a learning disability, pair them with more abled students to help with journal entry.
Assessments	Individual lab journal entries Teacher observations

Section II: STEM Lesson Plan

Title of Lesson	**Lesson Eight: Rain Rain Go Away (Effects of Water and Wind)**
Time Required	30-45 minutes
Materials	For each group: Artifacts from Lesson 7 Lab Journals Role cards (Appendix C) For the class: “Humpty Dumpty: Stay on the Wall!” Strainer (1) with Plastic pitcher (1) OR Watering can (1) Paper towels Fan (1) OR Blowdryer (1) Water Clear plastic tub, large enough to fit students' artifacts (1) Measuring cup or beaker (1) 100-Duplo wall (optional)
Objectives	Students will explore the effects of water and wind on artifacts created in Lesson 6. Students will collect and analyze observational data.
Instructional Process	This lesson provides students with background knowledge about how different materials withstand the effects of wind and water, which will allow students to be more successful in the engineering design challenge in Lesson Nine. Lesson Preparation: 1. Make sure that student artifacts are sufficiently dry if glued with liquid school glue. Have all of the artifacts near the class meeting area. 2. This lesson will be primarily a demonstration type of lesson. The teacher will assist students in pouring water over their artifacts and blowing on them with a fan or blowdryer. Prepare a clear container to catch the water and consider having the Duplo wall in the container. Setting the artifacts on the wall (if they will fit on the wall) will help students see their artifacts better. Access to an electrical outlet for the fan/ blowdryer is also necessary. 3. Determine how much water you will pour over the artifacts. Any amount of water

between 1 cup and 1 liter would be appropriate. Ensure that each group pours the same amount of water on their artifact.

4. Plan time for students to complete the journal entry for this lesson. Students will sketch and label what their artifact looked like after testing.

Instructional Process:

1. Gather the students in the class meeting area. Review the Humpty Dumpty story briefly. Ask students to identify the problems in the story. Review that rain and wind were two of those problems.

2. Review the team roles. Tell students that they will do different things based on their role during today's investigation. Students should keep the same role from the previous lesson.

3. Call one team to the front. Have the project engineer set the team's artifact in the tub (on top of the wall if using the wall). Ask the project engineer to tell the rest of the class what their team built.

4. Ask the materials engineer to tell the rest of the class what materials were used in the design and how the artifact is held together (tape, glue, etc.).

5. Ask the information engineer to share with the class some of the properties of the materials that were used.

6. Have the test engineer assist in pouring the water over the artifact and blowing on the artifact with the fan or blowdryer. Pour the chosen amount of water over the artifact through a sieve or a watering can. (The water should spread out like rain rather than coming down as one big stream.) After the water is poured, use the fan or hairdryer on low for a count of ten, then medium (if available) for a count of ten, then high for a count of ten.

7. Discuss the results of testing with the class.

8. Repeat the process for all engineering teams. For teams with more or less than 4 members, adapt the questioning process as needed.

9. Lab journals:
Have students sketch in their journals what their artifacts looked like after they were exposed to rain and wind. Assist students with labeling their drawings as needed. Have students work in their journals right away or set the journaling time aside as a separate activity for the day, such as during writing time.

Differentiation	Younger students and students with fine motor delays may need a scribe for reflections in their journals, or could glue in a photo of their constructions after testing.
Assessments	Individual lab journal entries Teacher observations

Section II: STEM Lesson Plan

Title of Lesson **Lesson Nine: Humpty Dumpty "Stay on the Wall!"**

Time Required 90-120 minutes (2-3 days)

Materials Materials for this project will largely depend on the ideas generated by the students. The materials and amounts suggested for the distribution station may need to be altered based on the students' work in prior lessons.

For each group:
Glue stick (1)
Plastic egg (1)
Role cards
Drawing paper (10-20 sheets)
Writing materials
Lab journals
Plastic tub or shoebox (1)

For the class:
Self-adhesive Envelope labels (1 sheet)
Copy of “Humpty Dumpty: Stay on the Wall!"
Chart paper (10 sheets)
Chart markers
Fan or hairdryer (1)
Sieve (1) with Pitcher (1) OR Watering can (1)
Measuring cup
Ruler
Access to water source (sink, pitcher, etc.)
Camera or video equipment
Appendix F (1 copy)
Popsicle sticks (2)
Copy of Appendix B: Engineering Design Process (1)
Appendix G (1 per student)
Appendix A (1 per student)

For distribution station:
2-cup section of egg carton (24)
Craft sticks (100)
Cotton balls (100)
String, 12 inches (50)

Small balls of clay (15)
Chenille sticks (100)
Pieces of cloth, 6 inches square (15)
Pieces of cardboard, 6 inches square (15)
Pieces of soft wire, 6 inches (50)
Copy paper (100 sheets)
Play dough (1 tub per group)

Objectives

Students will implement the engineering design process, applying prior knowledge to solve a problem.

Students will differentiate between team roles and demonstrate the ability to work together.

Instructional Process

Lesson Preparation:

1. This lesson will take several days to complete. Schedule to begin this lesson early in the week so that students will not have to try to remember what they are working on over the weekend.

2. Print Appendix F. Cut and glue the pictures of the seats on the left side of a sheet of chart paper, leaving enough room to record student observations on the right next to each picture. Cut out the figures of Humpty Dumpty and the stick figure and glue them on large craft sticks to make stick puppets.

3. Prepare paper and have wall space available to assist students with drawing their designs. You will need at least one sheet per team.

4. Plan to test the artifacts students create during this lesson following the same procedures used in lesson 8.

5. Set up a table where all of the available materials can be easily accessed by students. This may not be needed until the second day of this lesson. On the day when students will start building, set all materials out in advance. If the table will be needed for other purposes during the school day, determine the best way to arrange and put away materials quickly.

6. Print and copy the post-test (Appendix A) and the Performance Rubric (Appendix G). Make one copy for each student.

Instructional Process, Day One:

1. Re-read Humpty Dumpty: “Stay on the Wall!” Discuss the question of how Humpty can stay safe on top of the wall in different types of weather. Record student responses on chart paper. Ask students to think about how they stay safe in a car. Focus the discussion on car seats and ask students to think about other types of

seats that keep people safe.

2. Using the pictures cut from Appendix F, show students photos of car seats, bus seats, cockpits of rockets/race cars/airplanes, etc. Ask what part of each seat keeps people safe? Record student responses next to each picture.

3. Show students the craft stick puppets of Humpty Dumpty and a human stick figure. Ask students what the difference is between the two figures. Focus the discussion on the fact that Humpty does not have arms and legs.
Have students refer back to the pictures of the seats and think about whether these would work for Humpty Dumpty, since he does not have arms or legs.

4. Explain that Humpty needs to stay safe on the wall, but he also has to be able to go home at night. Other guards can also use the same seat when it is their turn to guard the castle so they can stay safe too. Explain that a good seat for Humpty Dumpty will be one that he can get in and out of when he wants to, but will keep him in it when he wants to stay in it. This means that they cannot tape or glue Humpty to the seat.

5. Provide students with drawing paper and pencils and have each student sketch a picture of a seat that might keep Humpty Dumpty safe on the wall. After students finish their drawings, gather the class (or small group) together and discuss student ideas. Have students share their sketches with the class/team, while the teacher draws a large sketch on chart paper based on student descriptions. Label the parts of the design by writing them on envelope labels or sticky notes and having students stick them on the chart paper.

Possible breaking point: Day Two:

6. Introduce the Engineering Design Process. Explain that the engineering design process is a way people can work to solve problems in an organized way. It has several steps, but can be repeated over and over until the problem is solved. Show students the Engineering Design Process poster.

7. Share the following story with the students, pointing to each step on the engineering design process poster as it comes up in the story:

“Kate has a lot of Legos she wants to take with her to Grandma’s house. At home she keeps her Legos in a large toy box in her room. The PROBLEM is that the toy box is too big to fit in the car to take to grandma’s house. Kate’s first QUESTION is: How can she get the Legos to Grandma’s house? She THINKs until she has an idea. She will put the Legos in a smaller container to take to grandma’s house. Kate uses the DESIGN of a laundry basket and puts the Legos in the basket. She TESTs her design by picking the basket up. When she picks the basket up, the Legos fall out of the holes in sides of the basket.

Since that didn't work, Kate asks the QUESTION, "Why didn't that work?" She THINKs again and comes up with a new DESIGN. She decides to spread one of her baby blankets in the basket first and pile the Legos on top. She TESTs it again by picking up the basket. This time the Legos cannot fall out. She found a SOLUTION to her problem. She can take her Legos to grandma's house."

8. Tell students that they have already been using the engineering design process. Have children recall Humpty Dumpty's problem and identify the question. (How can Humpty Dumpty stay on the wall?) Next, point to the think step of the poster. If you charted the question and possible solutions in lesson 1 refer back to your chart. Talk about the possible solutions. If no one has suggested building something to hold Humpty Dumpty on the wall, ask, "Do you think we could build something that would keep Humpty Dumpty on the wall? What might this look like?" Give some time for discussion.

9. Explain the steps of the engineering design process that they have already used in solving Humpty Dumpty's problem. Have students restate the problem (needs to stay safe on the wall). Explain that they have already asked questions about how they stay safe in cars and other seats, thought about the parts of the seats that keep them safe and how that would be different for Humpty Dumpty (an egg shape), and they have designed by drawing a picture on their own and sharing their ideas with their team/class to make a team design picture.

10. Show students the materials they explored in previous lessons. Say: "Today we are going to use some of the materials we have explored to build a seat for Humpty Dumpty." Refer back to team design pictures and the parts that students have labeled. Have students think about which materials would work best for different parts. (As an example, if students included straps in their designs, have them think about what would make a good strap. String, wire, or chenille sticks would work, but clay or cotton balls would not.)
As students choose materials, write a list of the materials each team has chosen. Each team will have a plastic egg (Humpty Dumpty) to place in the seat.

11. Review and re-assign team roles. Students have likely only served in one role thus far. Assign new roles for students for this lesson.

12. Have the Materials Engineer for each team collect those materials each team has decided to use and take them to the table. Have teams begin working to assemble their seats and attach them to the wooden blocks. Monitor teams to answer student questions and ensure that all team members are engaged in their work. (Allow students to create their designs with as little teacher guidance as possible. Students will have the opportunity to test their design and make it better, so it is appropriate to allow them to make mistakes.)

Possible break point: Day Three:

13. Gather the class in the class meeting area. Test the artifacts using the same procedure prescribed in lesson 8.

14. Record what happens with each test on the data collection page (Lesson 9) in the lab journal. If possible, a student or an adult could photograph or video the tests for further review.

15. Discuss what happened during testing. Prompt students to discuss what worked well and what might need to be changed. (For example, would tying string around Humpty work better than wrapping a chenille stick around him?)
Ask questions like: Was it the water or the wind or both that knocked Humpty down? What do we need to assemble differently? Why didn't it work? Record student responses on chart paper.

16. Review all of the other charts from previous days. Look at the engineering design process poster. Explain the steps of the engineering design process that students have already used in solving Humpty's problem. Guide the discussion towards restating the problem - that some if not all of the designs failed to keep Humpty on the wall.

17. Have students draw a new picture in their journal of how they think they could change their design to make it work better. Encourage students to keep portions of their design that worked well and replace parts that failed with other designs or other materials. Gather the class or small group together. Review the teacher drawn design from the beginning of this lesson. Guide the discussion towards what needs to be changed and why. Draw a new design using ideas from the team.

18. If time permits, allow the students to create a new seat with their teams using their modified designs. Follow the same process to guide students through the redesign and re-testing process.

19. Administer the post-test. This step can be done any time after finishing the final testing and data collection.

Differentiation

Use a visual timer for younger students and students with a learning disability to help them stay on task.

When discussing materials for building Humpty's seat, have examples available for younger students and students with a learning disability to handle as well as to hold up to show the rest of the class.

Have more than one copy of the book for younger students as well as students with visual impairments.

	Allow students to glue pre-made labels or stick adhesive labels onto group design during discussion.
Assessments	Performance rubric Individual lab journal entries Teacher observations Post-test

Section III: Unit Resources

Materials and Resource Master List

Non-Consumable Materials – Required:
2 x 4 Rectangular Legos/Duplos (at least 100)
Box fan (1) OR Blowdryer (1)
Safety goggles (1 per student)
Sensory sand/water table (1) OR large clear tub (1)
Sand for sensory table/tub
Watering can (1) OR Sieve (1)
Medium-sized rocks (3-5)
Small rocks, varied size and weight (approximately 1 per student)
Marbles (approximately 1 per student)
Magnets (approximately 1 per student)
1-Liter Beaker/Container (1) OR 1-Quart Container
Plastic eggs (1 per student)

Consumable Materials – Required:
Printable Resource document (various amounts of different pages)
Ice shavings (2-3 quarts) OR Instant snow (2-3 quarts) (www.stevespanglerscience.com/product/instant-snow or instasnow.com)
Drinking straws (2 per student)
Masking tape rolls, half-inch to one-inch width (1 per student group)
School glue, liquid (1 bottle per student group)
Glue sticks (1 per student)
Egg cartons (approximately 1 per student)**
Yarn (1 skein) OR String (1 roll)**
Copy paper (1 ream)
Modeling clay (approximately 2 pounds) OR Play dough (approximately 1 small tub per student)**
Craft sticks (1 large box)**
Cotton balls (1-2 large bags)**
Paper towels (1-2 rolls)
Cornmeal (1/2 cup) OR Table salt (1/2 cup)
Cardboard squares, 4-6 inches, can be repurposed from cardboard boxes (8-10 per student group)**
Chenille sticks/Pipe cleaners (1 large package)**
Soft wire, 18-gauge or higher (1-2 rolls)**
Fabric, various types, cut into 4-6 inch squares (1-2 square yards)**
Paper clips (1 box)**
Paper bags (approximately 1 per student) OR Gallon plastic zip-bags (approximately 1 per student) OR small plastic tub/shoebox (1 per group)

**Note: Many of the consumable materials will be used by students to build their designs. Amounts of these materials will vary greatly from class to class. Plan to have a variety of materials available, including any available materials not listed in this unit, to allow students to be as creative as possible.

Optional Materials:
Chart paper (1 tablet)
Sentence strips (1 package) OR Index cards (1 package)
Weather chart/graph (1)
Digital camera (1)
Single hole punch (1)
Card stock (4-8 sheets)
Self-adhesive Envelope labels (1 sheet)
Self-stick notes (1 pad)

Key Vocabulary

The following terms may or may not need to be defined to your students. The expectation at this grade level is that your students will be introduced to these terms. Introduce as many or as few of these terms as needed to ensure that your students can be successful.

Artifact- An object made by people.

Atmosphere- The air around planets.

Bendable- Something that can be twisted.

Brainstorm- A collection of ideas.

Breakable- Something that is fragile.

Build- To develop something new with select materials.

Cloud- A mass that is visible in the sky that is made up of tiny water or frozen droplets of moisture.

Combine- Bringing two or more things together to make something new.

Construct- To make something by arranging or combining materials together.

Data analysis- Taking a close look at collected information.

Data collection- Gathering information from multiple places.

Design- To sketch a plan for a project.

Documentation- A way to record information.

Engineering design process- The process of questioning, thinking, designing, testing, and redesigning something to solve a problem.

Exploration/explore- To study objects while using senses (sight, smell, hear, touch)

Flexible- Something that can be bent easily without breaking.

Fog- A type of precipitation where water droplets or ice crystals form a cloud that are suspended in the air close to the Earths surface.

Hail- A frozen ice form of precipitation.

Hard- Something that is solid or firm and is not soft.

Heavy- Something that has great weight and may not be easy to lift.

Investigating- To examine or study something.

Lab journal- A place engineers document their explorations.

Light- Something that does not have great weight and may be easy to lift.

Materials- A group of objects you might need to complete a task.

Materials engineer-The person on the team that makes sure they have all the materials their team needs.

Nursery rhyme- A short children's rhyme that usually tells a story.

Observation- To make note of something seen.

Precipitation- Forms of water falling from the clouds such as; rain, hail, sleet, fog, and snow.

Problem(story)- The thing that needs to be solved.

Project engineer-The person that helps all team members remember their tasks.

Properties- A word to describe the way things sound, smell, feel, taste, and see.

Rain- Water droplets falling from clouds.

Record- a way to document information.

Redesign- To look at a plan and make changes to make your original plan better.

Rough- Something that has an uneven surface and might be course.

Rhyme- Words that have similar endings. Example: hat, rat

Sketch- A drawling or painting to document information.

Smooth- Usually a flat surface free of bumps.

Snow- Ice crystals that are formed in the clouds.

Solution (to a problem)- The act of solving a problem

Sort- To separate objects into different groups by specific characteristics.

Stiff- Something that can not be bent easily.

Stratus cloud- A layered cloud that may be different shades of grey in color and can produce rain or snow.

Stretchy- To extend the length of something.

Sun- The bright star seen during the day that warms and provides light to planet Earth.

Team- A group of people working together to accomplish a goal.

Tear- Using force to separate an object.

Test engineer- A person that directs the testing and gathers ideas from the group on how to test what was built.

Test- To evaluate a design.

Weather-The atmosphere around us being hot or cold, wet or dry, calm or stormy, or clear or cloudy.

Wind- Air that is in motion.

Technical Brief

In many aspects of life, people and equipment must be protected from injury and damage. Personnel injuries can be the result of contact with chemicals, exposure to the environment's wind, sun, and precipitation, sudden decelerations, contact with rough or sharp objects, splashes from liquids, falls and trips, and many other hazards. Because of the vast need for protecting fragile objects, industries have been created around providing protective cases for eggs, cameras, medical devices, glass, infants and small children, and other materials.

This case uses the setting of Humpty Dumpty with prior knowledge of the traditional outcome of Mr. Humpty suffering contusions and fractures resulting from the tumble from his precarious perch. This design challenge offers the opportunity for an intervention that could potentially avert the disastrous outcome.

Student engineers will use an array of supplied resources that will include natural, simple, traditional, and composite construction materials to design, build, and test a fixture that may provide an alternate ending to the traditional, woeful tale.

The pursuit of safety entails a study of materials and their properties, the dynamics of motion and rapid deceleration, end consumer usability, and construction techniques. Knowledge of these domains is widely applicable to consumer products and commercial applications.

Safety and Disposal

Students should be reminded not to put any of the materials in their mouths during this unit of study.
Students with allergies to any of the materials listed in this unit of study should not be allowed to touch or use those materials. Materials may be substituted to accommodate students with allergies.
Students should not be permitted to handle electrical equipment (hairdryers, fans), especially near water.
Students should be directed to blow materials (especially in Lesson 3) safely, not toward other students.
Materials should not be tossed or thrown.
If available, have students wear safety googles during labs.

References

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Section IV: Appendices

These appendices are found in the Printable Resources document.

Appendix A - Pre-test/Post-test
Appendix B - Engineering Design Process Poster
Appendix C - Student Role Cards
Appendix D - Wall Construction Instructions
Appendix E - Student Engineering Lab Journal
Appendix F - Pictures for Display
Appendix G - Performance Rubric

Humpty Dumpty: Stay on the Wall! Story (separate document)