A Wild Ride! Week 2: Grades K-2

Day	Topics	Related Standards
1	Exploring Properties of Matter & Motion	**Plan and carry out investigations** which demonstrate how equal forces can balance objects and how unequal forces can push, pull, or twist objects, making them change their speed, direction, or shape.
2	Investigating Force & Motion	
3	My Wild Ride: Ask and Imagine	
4	My Wild Ride: Plan and Create	
5	My Wild Ride: Improve	

A Wild Ride! Week 2

Day 1: Exploring Properties of Matter and Motion

Teacher/Parent Background

In science, the "stuff" that everything is made of is called matter. You can use your senses to detect matter. You can feel the shape and roughness of a rock. You can taste the juice of an orange. You can smell popcorn. You can see a crowd at a ball game. The characteristics of matter that we can observe with our senses are called properties. No two substances have exactly the same set of properties. The properties of matter can help us determine which type of matter to use.

Overview

In this activity, young learners will use their senses of touch and sight to explore the various properties (characteristics) of different types of matter. They will then

use their observations to make decisions about which type of matter would work best during a roller coaster engineering design challenge.

Related Standards

- **Plan and carry out investigations** which demonstrate how equal forces can balance objects and how unequal forces can push, pull, or twist objects, making them change their speed, direction, or shape.

Key Terms

- matter - the "stuff" that everything is made of
- properties - characteristics of a substance
- senses - touch, taste, hear, smell, see
- motion - a change in the position of an object

Materials List

- a variety of 3D objects which can roll or slide when placed at the top of a ramp (coins, rubber balls, marbles, Legos, blocks, empty containers, boxes, etc.)
- ramp (cardboard, wood or plastic)
- paper/pencil (optional)

Activity Description

1. Place a variety of 3D objects around the floor/table.
2. Prompt the student to begin exploring the physical properties of each object, focusing on properties he/she can experience through his/her senses of touch and sight. The student can physically sort the items by their properties or describe which objects fit the provided criteria.
    - Which objects are hard?
    - Which objects are soft?
    - Which objects are round?
    - Which objects have corners or edges?
    - Which objects are _____ (insert color)?
    - Which objects are heavy?
    - Which objects are light?
    - Which objects are large?
    - Which objects are small?
3. Once the student has made observations on the properties of each of the provided objects, encourage him/her to explore how each object moves.
    - Which objects can you blow across the floor/a table?
        - Use the floor or a table depending on the size of the object. Safety first!

    - How do they move - rolling or sliding?
    - Which object moves (rolls) the easiest?
    - Which object moves (slides) the easiest?
4. Next, set up a ramp. Ask the student to predict how each object will move down the ramp.
    - Set up a prediction chart on paper or sort objects on the floor/table prior to testing.
    - Encourage the student to share his/her reasoning for each prediction.
        - Example: I think the (object) will slide down the ramp because _____.

Objects We Predict Will Roll	Objects We Predict Will Slide

5. Once predictions are complete, test each object one at a time by putting each object at the top of the ramp and watching the resulting motion.
    - Some objects may require a push to move down the ramp. You can still record whether the push resulted in the object sliding or rolling down the ramp.
6. Guide recording of results.
7. Discuss the results.
    - Did the object do what you predicted?
    - What properties(shape) did the objects have that rolled?
    - What properties (shape) did the objects have that slid?

Closure

The student will discover that a round, or nearly round, shape is necessary for rolling. To assess how shape can predict motion, ask the student to:

- draw a picture of(or point out and describe) one object in the room that would roll down the ramp and one that would slide down.
    - Prompt him/her to explain his/her thinking.
- select one or more objects from those provided that could roll along a roller coaster track.
    - Prompt him/her to explain his/her reasoning.

Explain that later in the week, he/she will be designing and building a

rollercoaster. He/she will need to select an object to use as the coaster that will roll along the track. This activity will assist him/her in making a selection.

Extension

Explore ways to get the objects that would not move down the ramp without a push to do so without applying a push. Try different types of ramps (i.e., different materials for the ramp or varying the height of the ramp).

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A Wild Ride! Week 2: Grades K-2

Day 2: Investigating Force and Motion

Teacher/Parent Background

When you kick a ball, you are applying a force to the ball. When you pull your brother in a wagon behind you on the way to the park, you are applying a force to the wagon. A force is a push or a pull. Pushes and pulls (forces) can cause objects to move/change position (motion).

Overview

In this activity, young learners will explore forces (pushes and pulls) and their effects on objects' motions. They will then use their observations to make decisions about which objects would work best during a roller coaster engineering design challenge.

Related Standards

- **Plan and carry out investigations** which demonstrate how equal forces can balance objects and how unequal forces can push, pull, or twist objects, making them change their speed, direction, or shape.

Key Terms

- force - a push or a pull
- motion - a change in the position of an object

Materials List

- 3D objects which can roll from Day 1
- ramp (cardboard, wood or plastic)
- roller coaster track (pool noodles cut in half, pipe insulation cut in half, empty paper towel rolls, empty toilet paper rolls, paper plates, straws, K'NEX kits, etc.)
- paper/pencil (optional)
- videos and/or books about roller coasters (optional)
    - Wild Waves Enchanted Village
    - Little Dipper
    - Road Runner Express
    - Roller Coaster by Marla Frazee
    - Zoom! by Diane Adams

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Activity Description

1. Revisit the 3D objects the student explored during Day 1, focusing on the objects that rolled.
    - Yesterday we explored objects that can roll or slide. We determined that these objects roll down a ramp. What properties (characteristics) do they have in common?
        - Round or nearly round shape
2. Remind the student that the goal of this week's science lessons are to explore ideas that will help him/her design a roller coaster.
    - Let's think about a roller coaster (if the student does not have experience seeing and/or riding a roller coaster, use a video or book to introduce). A roller coaster has many different parts. What part do the rolling objects represent on a roller coaster?
        - The passenger cars.
    - What part of a roller coaster might the ramp represent?
        - A hill.
3. Once the student has discussed what the rolling objects and ramps represent/act like in a roller coaster. Discuss the other features of roller coasters using the images from the videos/books if needed.
    - What are some other characteristics of roller coasters?
        - Long, flat stretches
        - Loops
        - Turns
4. Show the student the available materials and ask:
    - If we want to build a long, flat stretch for our roller coaster, which material could we use? Why would you use that material?
    - If we want our roller coaster to have a loop, what could we use? Why?
    - How could we use these materials to make turns?
5. Provide the student with an opportunity to explore the various materials to determine which would be best suited for each section of the roller coaster track. Remind the student that they are not building the entire roller coaster at this time but experimenting with the properties of the different materials to see which ones work best for specific features of the coaster.
    - This is a great opportunity for the student to practice problem-solving and experience how a problem can have multiple solutions. For example:
        - Paper towel and toilet paper tubes work great for long, flat stretches or the downward slope of hills.
        - Paper plates can be cut to form loops or turns.
        - Pool noodles or insulation can be used for straight stretches as well as curled to form loops or turns.

Closure

After providing the student with ample time to explore the materials, discuss his/her thoughts.

- Which material(s) do you think will work best for straight track/loops/hills/turns? Why do you think this?

Explain that tomorrow, he/she will be designing a roller coaster. He/she will need to select an object to roll along the track as well as materials to make the track. This activity will assist him/her in making those selections.

Extension

Explore how quickly a rolling object travels across the various track materials.

- Do some materials cause the object to roll faster or slower than others? Why?
- How might this impact the materials selected when creating the roller coaster?

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A Wild Ride! Week 2: Grades K-2

Day 3: My Wild Ride: Ask and Imagine

Teacher/Parent Background

Scientists and engineers are always faced with challenging questions and problems. In order to best explain the world around them or propose valuable solutions, scientists and engineers follow steps to accomplish these goals. In engineering fields, engineers use the Engineering Design Process to propose solutions to problems in order to make the world a better place or to provide some much needed fun!

Overview

In this activity, young learners will use their experiences with force (pushes and pulls) and motion (a change in position)to make decisions about which objects

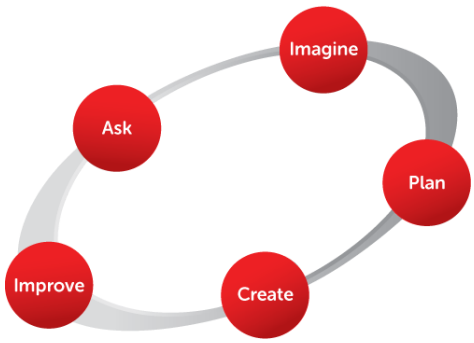
would work best to design a roller coaster.

Related Standards

- **Plan and carry out investigations** which demonstrate how equal forces can balance objects and how unequal forces can push, pull, or twist objects, making them change their speed, direction, or shape.

Key Terms

- matter - the "stuff" that everything is made of
- force - a push or a pull
- motion - a change in the position of an object
- engineers - people who design and/or build things to solve problems
- engineering design process - a set of steps engineers use to propose solutions to problems



The Engineering Design Process

- blueprint - a design plan

Materials List

- 3D objects which can roll from Day 1
- roller coaster track supplies from Day 2
- Imagine handout
- crayons or pencils
- videos and/or books about roller coasters (optional)
    - Wild Waves Enchanted Village
    - Little Dipper
    - Road Runner Express
    - Roller Coaster by Marla Frazee
    - Zoom! by Diane Adams

Activity Description

1. Revisit the 3D objects explored during Day 1 and the track materials explored during Day 2.
    - We have been exploring different types of matter (stuff).
    - We explored objects that can roll or slide.
        - What did we decide those objects had in common?
            - Round or nearly round shape
    - We explored matter or materials that could be used to create a track for our round objects to travel on.
        - What type(s) of matter or material(s) did we decide could be used to create a hill?
            - Paper towel/toilet paper rolls, pool noodles, insulation, etc.
        - What type(s) of matter or material(s)did we decide could be used for long, straight sections of track?
            - Paper towel/toilet paper rolls, pool noodles, insulation, straws, etc.
        - What type(s) or matter or material(s)did we decide could be used to make loops or turns?
            - Paper plates, pool noodles, insulation, etc.
2. Remind the student that he/she has been exploring matter and its properties, including how it reacts to forces, in order to figure out how to design a roller coaster.
    - Today we are going to be engineers! Engineers are people who design and build things to solve problems.
    - We have a fun problem to solve today. We are trying to build our very own roller coaster!

3. Before the student can begin building his/her roller coaster, first he/she must begin the engineering design process by asking questions. Guide your student through asking questions that are important to designing and building a roller coaster given the available materials.
    - Before an engineer can start solving a problem, he/she needs to ask questions. An engineer asks questions about the problem, what materials are available, how long he/she has to solve the problem, etc.
    - As an engineer of a roller coaster, what questions do you have about the challenge?
        - How big can my roller coaster be?
        - What can I use to build my roller coaster?
        - Where am I building my roller coaster?
        - How much time do I have to build my roller coaster?
        - Is someone helping me build my roller coaster?
4. Now that the student has asked and received answers to various questions about the designing and building of a roller coaster, it is time to facilitate imaging what the roller coaster will look like given the constraints (space, size, materials, etc.) To do this, provide the student with a copy of the Imagine handout. Prompt him/her to draw his/her ideas.
    - Engineers record their design ideas on paper so they can look at them while they are building and so they can share their ideas with others.
    - These design plans have a special name called a blueprint.
    - You are going to create a blueprint for your roller coaster. Using crayons or pencils, draw what your roller coaster is going to look like on this paper (Imagine handout).
    - Draw more than one idea. Engineers need to consider multiple ways to solve the same problem. What are two ways you could create a roller coaster?
5. Provide the student with time to draw his/her roller coaster plans. Frequently check in with the student to encourage him/her to include as much detail as possible. You may decide to give the student constraints such as requiring a certain number of hills or loops or using only certain materials depending on what you have available.

Closure

Once the student has completed his/her blueprints, discuss the plans while helping the student to label key attributes (hills, loops, tunnels, etc.) and materials (paper towel tubes, straws, etc.) as needed.

- Describe your plan. Tell me what will happen from the start to the end of the ride.
- What material(s) will you use to build _____ (i.e., hill, tunnel, loop, etc.)? Why do you think that material is best?
- How will you keep the different parts of the track together (i.e., tape, glue, etc.)?

- How is Plan 1 different from Plan 2? Why did you design it that way?

Encourage the student to make necessary revisions based on thinking that might have changed during his/her conversation with you. The goal is to have detailed plans that the student can follow when building. Making changes during the actual building process will be discouraged. The student will have time to consider and make changes to his/her design during the Improve stage of the engineering design process.

Extension

Encourage storytelling by creating a theme for the roller coaster. What story can your roller coaster tell? Include related decorations on tunnels or loops. Create a catchy name. The sky's the limit!

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Imagine Handout

Draw two different roller coaster designs here. Remember to label the:

- different parts of the track (hills, loops, turns, and tunnels)
- starting and stopping point
- materials used (straw, paper plate, etc.)

Idea #1

Idea #2

A Wild Ride! Week 2: Grades K-2

Day 4: My Wild Ride: Plan and Create

Teacher/Parent Background

Scientists and engineers are always faced with challenging questions and problems. In order to best explain the world around them or propose valuable solutions, scientists and engineers follow steps to accomplish these goals. In engineering fields, engineers use the Engineering Design Process to propose solutions to problems in order to make the world a better place or to provide some much needed fun!

Overview

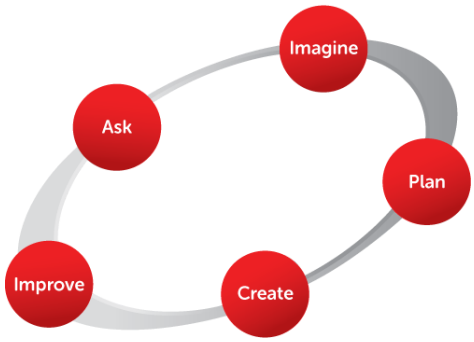
In this activity, young learners will use their experiences with force (pushes and pulls), motion (a change in position)and the engineering design process to build a roller coaster.

Related Standards

- **Plan and carry out investigations** which demonstrate how equal forces can balance objects and how unequal forces can push, pull, or twist objects, making them change their speed, direction, or shape.

Key Terms

- matter - the "stuff" that everything is made of
- force - a push or a pull
- motion - a change in the position of an object
- engineers - people who design and/or build things to solve problems
- engineering design process - a set of steps engineers use to propose solutions to problems



The Engineering Design Process

- blueprint - a design plan

Materials List

- 3D objects which can roll from Day 1
- roller coaster track supplies from Day 2
- Imagine handout from Day 3
- crayons or pencils
- building supplies (tape, scissors, glue, etc.)
- videos and/or books about roller coasters (optional)
    - Wild Waves Enchanted Village
    - Little Dipper
    - Road Runner Express
    - Roller Coaster by Marla Frazee
    - Zoom! by Diane Adams

Activity Description

1. Revisit the student's roller coaster plans on the Imagine handout. Briefly review his/her ideas and then discuss which plan his/she thinks is best.
    - You have two different blueprints for your roller coaster. You can only build one. Which one do you want to build? Why?
        - The student's decision could be based on style, types of or quantities of materials available, building space available, etc. There is no wrong answer to this question.
2. Provide the student with time, space, materials and adult support (as needed) to create his/her roller coaster based on his/her selected plan.
    - Reminder you can:
        - build only what you drew (i.e., If the plan shows one loop, the roller coaster has only one loop).
        - use only the materials labeled in the plan (i.e., if the tunnel is labeled as a paper towel tube then a pool noodle or other material cannot be used to make the tunnel).
        - build for _____ minutes (time allotment is flexible to your schedule/student's attention span).

Closure

Once the student has finished creating or the allotted time has elapsed, provide the student with time to test the roller coaster. Assist him/her in recording the results (i.e., video record using a phone, record on paper, etc.) Then discuss successes and struggles that he/she experienced during the Create stage of the engineering design process:

- What part(s) of creating your design did you find easy? Why?
- What part(s) of creating your design did you find difficult? Why?
- What did you most enjoy about creating your roller coaster? Why?
- What was your least favorite part about building your roller coaster? Why?
- If you had more time/materials/space, what would you do next?
- Were there any materials you wish you had but didn't? Why?
- What advice would you give another student who is trying to design and create a roller coaster?

Before wrapping up the lesson, be sure to remind the student that he/she will have the opportunity to complete the next stage of the engineering design process tomorrow - improve. It may be difficult for the student to "walk away" from the challenge at this point. He/she will probably want to test more and begin improvements right away. Try to avoid this as it is important to provide time for the student to reflect on his/her plan, the results of his/her test and possible improvements.

Extension

Encourage learning from failure using available resources:

- The Most Magnificent Thing by Ashley Spires
- Succeed by Failing: Crash Course Kids video
- Rosie Revere, Engineer by Andrea Beaty
- Ish by Peter H. Reynolds
- Beautiful Oops! By Barney Saltzberg

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A Wild Ride! Week 2: Grades K-2

Day 5: My Wild Ride: Improve

Teacher/Parent Background

Scientists and engineers are always faced with challenging questions and problems. In order to best explain the world around them or propose valuable solutions, scientists and engineers follow steps to accomplish these goals. In engineering fields, engineers use the Engineering Design Process to propose solutions to problems in order to make the world a better place or to provide some much needed fun!

Overview

In this activity, young learners will use their experiences designing and testing a roller coaster to propose and implement improvements.

Related Standards

- **Plan and carry out investigations** which demonstrate how equal forces can balance objects and how unequal forces can push, pull, or twist objects, making them change their speed, direction, or shape.

Key Terms

- matter - the "stuff" that everything is made of
- force - a push or a pull
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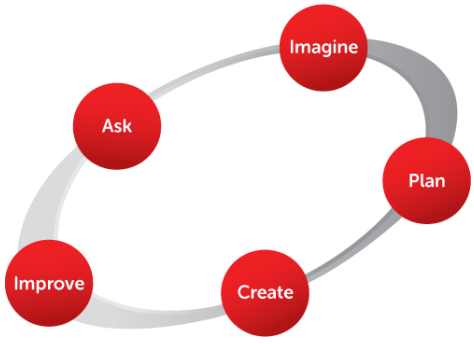

The Engineering Design Process

- blueprint - a design plan

Materials List

- roller coaster from Day 4
- additional roller coaster track supplies
- Improve handout
- crayons or pencils
- building supplies (tape, scissors, glue, etc.)

Activity Description

1. Revisit the student's roller coaster using the Improve handout. Guide the student in determining which improvements he/she wants to make to the coaster. These improvements may be structural or aesthetic based on his/her responses to the reflection questions from Day 4.
    - What is the first thing you would like to change about your roller coaster design? How do you think this will improve your coaster?
        - The student should record (if able) his/her idea on the Improve handout using words, phrases and/or pictures.
    - What is another improvement you would like to make to your roller coaster? Why do you think this improvement is needed?
        - The student should record (if able) his/her idea on the Improve handout using words, phrases and/or pictures.
2. Once the student has communicated and recorded all of his/her proposed improvements, provide the student with time, space, additional materials and adult support (as needed) to recreate his/her roller coaster based on his/her revised plan.
    - Reminder you can:
        - build only what you drew (i.e., If the revised plan shows one loop, the roller coaster can only one loop).
        - use only the materials labeled in the revised plan (i.e., if the tunnel is labeled as a paper towel tube then a pool noodle or other material cannot be used to make the tunnel).
        - build for _____ minutes (time allotment is flexible to your schedule/student's attention span).

Closure

Once the student has finished recreating or the allotted time has elapsed, provide the student with time to retest the roller coaster. Assist him/her in recording the new results (i.e., video record using a phone, record on paper, etc.) Then discuss successes and struggles that he/she experienced during the Improve stage of the engineering design process:

- How was your roller coaster's test results the same or different than last time? Why do you think this happened?
- What improvements did you find easy? Why?
- What improvements did you find difficult? Why?
- What did you most enjoy about improving your roller coaster? Why?
- What was your least favorite part about improving your roller coaster? Why?
- If you had more time/materials/space, what would you improve next?
- Were there any materials you wish you had but didn't? Why?
- Do you have any new advice to give another student who is trying to design and create a roller coaster? If so, what would you tell him/her?

Extension

Record a video of your final design and creation. Share with Arizona Science Center via Instagram @azscience for Facebook.

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Improve Handout

Proposed Improvement	What Problem It Solves

Revised Plan with Improvements