



3-5: Science Playground

Curriculum Connections

Physical Science

- Understand how different forms of energy and a variety of forces including friction and gravity affect the motion of objects, such as how an inclined plane's surface impacts the motion of a sliding object.
- Describe the position, direction and motion of objects and understand forces that affect their motion such as gravity and friction.

Scientific Communications

- Acquire information from observation, experimentation, print and non-print sources
- Use information gathered from experiments and other sources to explain observations and events, including actively listening for alternative interpretations and ideas

** Based on the New York State Elementary Science Core Curriculum and the New York City New Standards™*

National Standards

Content Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Content Standard B: Physical Science

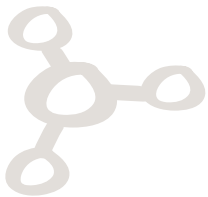
- Properties and changes of properties in matter
- Motion and forces
- Transfer of energy

Content Standard E: Science and Technology

- Abilities of technological design
- Understandings about science and technology

3-5 Exhibits List

Archimedes Screw
Ball Run
Energy Wave
Giant Lever
Giant Seesaw
Propeller/Water Wheel
Slides
Standing Spinner
Stream Table
Vertical Energy Wave
Wave Machine
Windmill
Whirlpool Dish
Whirlpool Column





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Guide Theme

The theme of these guides are based on popular crime and detective show investigations on TV; a mystery unfolds, questions are asked, evidence is gathered, conclusions are drawn. This process is similar to what scientists go through with the inquiry method. For more details see About the Guides.



Begin the Investigation At School

A mystery unfolds, questions are asked...

There are several ways you can introduce the topic and start the investigation. Here are some ideas that will help students start thinking about the topic and generate questions:

- Create a mystery about how a thief escaped the police by choosing the right slide when leaving the scene of the crime. (Mystery solved at Slides exhibit)
- Create a mystery about how a screw could move water from one place to another (Mystery solved at Archimedes Screw exhibit)
- Create a mystery about how a spy was able to tell secrets to someone a hundred feet away in a crowded playground. (Mystery solved at Speaking Tube exhibit)
- Create a mystery about a Science Playground. What kinds of activities could be there? (see Continuum Activity-Make Your Own Playground)
- Demonstrate one of the Laboratory Activities with no explanation-let the questions begin
- Do one of the Laboratory Activities and facilitate a probing discussion



Prepare for Investigation at the New York Hall of Science

Once students have generated questions around the topic tell them they are going to continue the investigation at the New York Hall of Science.

At this point you may want to begin one of the Continuum Activities. These activities have the following features:

- Vary in length and depth
- Provide continuity and purpose for the visit
- Provide a way of assessing student understanding



Orientation and Planning: If you do nothing else, do this!

Here are five reasons to conduct student orientation and planning before going on a field trip:

1. Students focus on exploring and investigation versus the novelty of the location
2. Students don't have to worry about logistics like restrooms, schedule, eating etc.
3. Students who understand the plan and purpose of the visit are more likely to stay focused
4. Students who have clear goals for their visit are less likely to race from one exhibit to another with little understanding
5. Students who get involved in the planning of the visit, take ownership and are less likely to misbehave

Read more about the Orientation and Planning Process





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Investigation at the New York Hall of Science

Evidence is gathered...

Okay. The class has arrived at the next phase of the investigation. The students have questions and seek answers. Everyone knows what exhibits they should visit and why. Everyone knows the schedule for the day. Students have materials to record findings or work on a Continuum Activity if required.

If all of the above is true, congratulations on a successful Orientation and Planning.

If you are curious about what teachers can do on site, we've put together a little piece called Teacher Role.

Finish the Investigation Back at School

Conclusions are drawn...

There are several ways you can complete the investigation. Some require less time than others. Here are some ideas:

- Student or group oral or written reports on investigation questions and answers
- Student or group illustrations of visit with answers to questions or mystery
- Do one of the Laboratory Activities
- Complete the Continuum Activity

Continuum Activities

Continuum Activities are designed to carry through the entire investigation. Some activities require less time than others.

Investigation Map

Description: Detectives will often map out related events, evidence and suspects during an investigation. This helps them get an overall picture. Students can map out their investigations with a concept map. The concept map will help you assess what students learn.

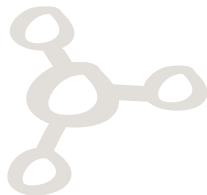
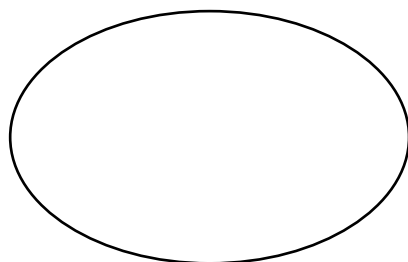
Time: (3)15-30 min. Sessions

Materials Needed:

- Blank paper
- Pencils, colored markers

Procedure:

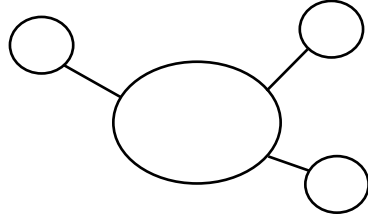
1. Begin with a center circle and write in the name of the main topic. (Students who do not write can have an adult assist or draw a representation of the main topic)



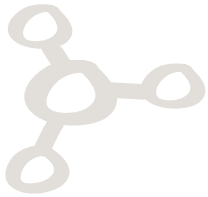


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2. As students generate questions about the topic, they can add offshoot circles. They can also add circles for facts they know about prior to the visit to the New York Hall of Science.



3. When students return from their investigation at the New York Hall of Science they add additional circles of information. Their final map should reflect everything they know about the topic. Teachers can easily assess what is learned based on how the map develops.



Investigation Journals

Description: Investigation journals provide a way for students to record their questions and findings throughout the investigation.

Time: (3)15-30 min. Sessions

Materials Needed:

- Blank or lined paper
- Pencils, pens or colored markers
- On-Site Investigation Handout (print out from this web site and make copies)
- Zip-lock bags (for on-site handout only)
- Soft yarn or thick soft string (for on-site handout only)

Procedure:

1. Ask students if they have ever seen a detective take notes when trying to solve a mystery. Tell students that as “science detectives” they too will make a record of the mystery.
2. Have students begin their journal or report with questions that are generated when they Start the Investigation at School.
3. Students who do not have writing skills can make a large question mark and draw representations of their questions. If an experiment or demonstration is done, non-writing students can sketch what they observe.
4. Older students with writing skills can list their own and other students questions in their journal.
5. We strongly advise students not bring journals to the New York Hall of Science where they can get lost. We have provided an On-Site Investigation Handout that can be copied if students want to record observations or make sketches.
6. When students return from their investigation at the New York Hall of Science have them write answers to questions or draw what they observed.





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Science TV- Investigative Reporters

Description:

In this activity, students plan and produce a TV show featuring investigative reports on the topic. This is a cooperative learning activity that integrates language arts, science and technology. There is a significant amount of writing involved, however students who are not prolific writers can also contribute as camera people, script supervisors, directors and on-camera reporters. Students will video tape at school and at the New York Hall of Science so pre-planning is essential for this activity.

Time: (3) 45 minute sessions (writing)

- (1) video shoot at school
- (1) video shoot at the New York Hall of Science
- (1) 45 minute session (writing)
- (1) video shoot back at school
- (1) 30 minute session for viewing final TV show

Materials Needed:

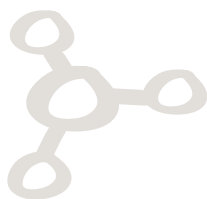
- Video camera
- (1) video tape per student group
- External wired microphone for camera (optional but suggested for good audio)
- TV
- Cables to run camera to TV for viewing
- Student internet access (optional for research)
- Lined paper and pencils
- Large plain paper and markers (cue cards)

Procedure:

First Session-Planning

1. Tell students they are going to plan and produce a TV show with investigative science news stories that are 4-5 minutes in length.
2. Divide the class into groups of four or five students.
3. Have students or the teacher chose a writer/script supervisor, camera person, director and on-camera reporter for each group.
4. Tell students about the various roles in the production team:
 - Writer-writes groups ideas for script, makes revisions
 - Cameraperson-operates camera
 - Director-supervises camera person and on-camera reporter, calls for action and cuts
 - Script Supervisor-makes cue cards for on-camera reporter, makes sure script is followed
 - On-Camera Reporter-person who reports and appears in video
5. Tell students that everyone the group will work together to create the script.
6. Remind students of the topic of study and the trip to the New York Hall of Science.
7. Instruct students to begin to create questions around the topic for the news show. They may want to create questions for interviews with New York Hall of Science “Explainers” too.
8. Tell students to watch the local news on TV so they can observe how news reporters do their job.

Second Session-Location Scout and Scriptwriting





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1. Tell students they are going to do a location scout of the location they will be shooting at the New York Hall of Science.

Scouting the location will help them think of more questions and give them ideas for what to shoot on location.

2. Make prints outs of the exhibits the class will visit at the New York Hall of Science OR have students access the exhibits online themselves.
3. Once students have become familiar with the exhibits, allow time for more scriptwriting. Make sure scripts have the following components:

- Introduction to the report (name of reporter, where they are, news headline)
- Questions the investigative report will answer
- Conclusion (to be done after video shoot at New York Hall of Science, comment, opinion about answers, reporter sign-off)

Third Session- Rehearsals and Final Script

1. Remind students about the various roles in the production team:
 - Writer-writes groups ideas for script, makes revisions
 - Cameraperson-operates camera, responsible for video tape
 - Director-supervises camera person and on-camera reporter, calls for action and cuts
 - Script Supervisor-makes cue cards for on-camera reporter to read, makes sure script is followed
 - On-Camera Reporter-person who reports and appears in video
2. Have groups rehearse their roles using the scripts. (Camera people can use their hands to frame shots)
3. Advise groups to make script revisions if they notice problems during rehearsal.
4. Rehearsals can be done in front of whole class or in individual groups depending on your classroom space and noise level.
5. After rehearsal have groups meet and finalize the pre-New York Hall of Science script.

Homework

Have groups give script supervisor the pre-New York Hall of Science script so they can make cue cards. (Script supervisor can ask others to help make cue cards too)

Video Shoot at School

During this session each group will shoot the introduction to their news story. Each group will have their own video tape. Make sure each group tape is labeled. If possible you may want to have groups shoot in a quiet separate location from the others or schedule group shoots during breaks in the day. If the entire class is present during shoots, make sure the others are quiet and don't distract the shooting. After shooting make sure camera people return the group tape to the teacher for safe keeping.

Video Shoot at the New York Hall of Science

1. Make the shooting schedule for the day.
2. Allow 15-20 minutes for groups to shoot in their location.





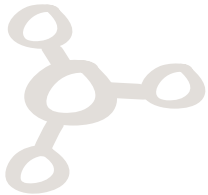
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3. Choose a central location for production groups to meet the adult who will have the video camera and group tapes.
4. Make sure production groups stay together at the New York Hall of Science and Chaperones know the schedule for the day.
5. If students plan to interview a staff “Explainer”, locate the Explainer in the area before shooting and ask for their assistance and cooperation for the shoot.
6. After shooting make sure camera people return the group tape to the adult for safe keeping.

Conclusion Script Back at School

1. Production groups will need to write the conclusion to their video script after their New York Hall of Science video shoot.
2. The conclusion should include a summary or opinion of the overall story as well as the reporter sign off.
3. Allow production groups to review their video footage (if necessary) so they can form opinions or summaries.
4. Have script supervisors and others in the group make up the final cue cards and conduct short rehearsals.



Video Shoot at School

During this session each group will shoot the conclusion to their news story. If possible you may want to have groups shoot in a quiet separate location from the others or schedule group shoots during breaks in the day. If the entire class is present during shoots, make sure the others are quiet and don't distract the shooting. After shooting make sure camera people return the group tape to the teacher for safe keeping.

View the Show

Hook up the camera to the TV and run the group tapes from the beginning. Enjoy the show.



Become an Explainer

Description: Students investigate one exhibit with the goal of being able to explain it when they return to the classroom. Students can choose a variety of methods to explain and make presentations.

Time: (1) 30 min. Session
(2) 45 min. Sessions (for in-class presentations)

Materials Needed:

- Interesting objects (used for student observation)
- Print outs of On-Site Investigation Handout

(optional suggestions)

- Variety of craft materials Variety of craft materials (pipe cleaners, popsicle sticks, straws, string, paints)
- Variety of clean, household recyclables (meat trays, cardboard tubes, aluminum foil, plastic wrap)
- Any other odds and ends students can construct with
- Poster board or paper
- Markers, crayons, colored pencils



Procedure:

First Session



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1. Tell students as they will be investigating exhibits at the New York Hall of Science and will choose one exhibit to explain to the class when they return. (students can work in groups or individually)
2. Help students prepare for careful observation of exhibits by distributing interesting objects.
3. Now ask students to verbally describe what they see. Encourage details.
4. After students have described the object in great detail, tell them they will need to use these same observation skills when they are investigating their chosen exhibit.
5. Lead a discussion on what students can do at the New York Hall of Science to help explain and record what they see. Ideas include:
 - Sketching
 - Writing
 - Using exhibit pictures on this web site
 - Photography
6. Distribute The On-Site Investigation Handout (if needed) for use at the New York Hall of Science.
7. Go to the New York Hall of Science.



Second Session

1. Upon return to class from the trip, tell students they will spend time preparing to explain one of the exhibits they saw.
2. Here are some suggestions for student presentations:
 - Verbal explanation (with or without picture)
 - Labeled diagram
 - Group or individual poster showing how an exhibit worked
 - Group or individual model using materials to represent exhibit (materials can be used to substitute and represent real materials from exhibit— ex. Clear plastic wrap simulates glass, cardboard tube becomes a rocket etc.)



Third Session (optional)

Use this time for students to make their class presentations if they made posters, drawings or models.

Make Your Own Playground Model

Description:

This is a class project where students plan and construct their own Science Playground activities/ components using available materials. Student projects become part of the overall class project, which is a model of a Science Playground.

Time: (1) 15 min. Session

Class visit to the Science Playground at the New York Hall of Science

(2) 45 min. Sessions (for in-class construction and presentations)

Materials Needed:

- Variety of craft materials (popsicle sticks, pipe cleaners, string, paints, glue, tape, colored paper, scissors, etc)





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- Variety of clean, household recyclables (meat trays, cardboard tubes, aluminum foil, plastic wrap)
- Any other odds and ends students can construct with

Procedure:

1. Tell students the class will be constructing their own Science Playground model.
2. Tell students they will be investigating at the New York Hall of Science with the goal of getting ideas and constructing models with available materials. (students can work in groups or individually depending on your supply of materials)
3. Lead a discussion on what students can do at the New York Hall of Science to reach their goal and record what they see. Ideas include:
 - sketching
 - writing
 - using exhibit pictures on this web site
 - photography
4. Give students The On-Site Investigation Handout (if needed) for use at the New York Hall of Science.
5. When students return from their visit they can begin constructing their own exhibits/playground components in class in groups or individually.
6. When students have completed their construction, they should be given an opportunity to explain and present their finished project in class.
7. Combine all the science playground models in one large area to complete and present the class project.

Laboratory Activities

Laboratory Activities are designed for the classroom and generally require simple materials. These activities can be done before or after a visit to the New York Hall of Science. To help students use higher-level thinking and generate questions, facilitate discussion with these types of questions:

- What do you notice here?
- Tell me about this.
- What do you see?
- Why do you suppose this happens?
- What can you conclude from the evidence?

A Screw is Really an Inclined Plane

Description:

Students create a simple model screw from an inclined plane. A short discussion of how an Archimedes Screw can pump water sets the stage for a visit to the Science Playground.

Time: (1) 30 minute session

Materials Needed:

- Large screw(s)
- Paper tube that fits a large screw tightly (per student)
- Strips of paper
- Dark marker





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- Rulers
- New pencil

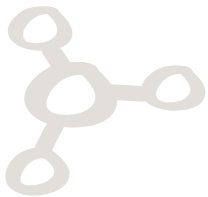
Preparation:

- Cut 8x11 paper in half length-wise to create strips
- Create paper tube for large screw to fit in

Procedure:

1. Create intrigue by showing students one of the strips of paper and telling them that they are going to discover how water was pumped uphill during ancient times.
2. Distribute materials.
3. Have students draw a thick diagonal line with the dark marker on the paper strip.
4. Instruct students to cut along the line, but make sure the marker line still shows up.
5. Tell students they have now created a model of an inclined plane. Ask the students what they think an inclined plane is used for? Inform the students that an inclined plane allows you to slide or pull a heavy object upward without lifting it directly. Examples of inclined planes are stairs, slides and wheelchair ramps.
6. Now have students flip the paper so the thick line is facing downward. They should use the new pencil and wrap the inclined plane around the pencil starting at the arrow indicated in the diagram above and they should start to see the screw forming as they wrap.
7. Tell students they have now created a model of a screw.
8. Pass around large screws so students can compare their models to the real thing.
9. While students are looking at real screws, ask them:
 - What do you think screws have to do with pumping water uphill? (students may guess the answer or come up with their own creative ideas, however the point is to get them thinking about how a screw could pump water)
10. To reveal the answer, hold up a large screw and tell them that:
 - Now you know we usually use screws to attach things.
 - To make a screw go into something you have to turn it clockwise. (turn the screw)
 - To unscrew something you turn it counter-clockwise. (turn the screw)
 - Now imagine this screw was HUGE and placed inside a big tube. (place screw in paper tube)
 - The tube with screw inside is placed in a water source and turned counterclockwise.
 - What do you think will happen? (water will be brought up through the tube)
 - This was a real water pump used in ancient times and it's called an Archimedes Screw Pump.

End Note: If your class has gone to the Science Playground you can remind them of the Archimedes Screw. If they have not gone to the Science Playground yet, you can tell them they will see a real Archimedes Screw in action.





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Rolling Bottles

Description:

Students experiment with rolling bottles filled with air, sand and water to see which one goes farther. The experiment presents an interesting phenomena and is a good way to examine the forces of friction.

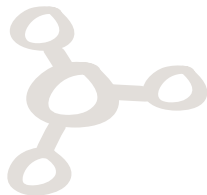
Time: (1) 45 minute session

Materials Needed:


- Masking tape
- Ramp/ inclined plane large enough to fit soda bottle (per student group)
- 3 soda bottles with screw-on caps
- water
- sand or dirt
- long hallway or room with lots of open floor
- measuring tape
- paper, pencil

Procedure:

1. Divide the class into groups according to the amount of materials you have for each student group.
2. Tell students they will be conducting an experiment with three different variables (the bottles) and recording the results.
3. Have students create a recording sheet with four columns. The headings for the columns should be set-up like this:
Distance
Bottle with Sand/Dirt
Bottle with Water
Bottle with Air
4. Tell students to fill one of the bottles with water and put the cap on tightly.
5. Tell students to fill another bottle with sand or dirt. Put the cap on that one too.
6. Ask students to predict which if their three bottles will roll the farthest?
7. Now for the fun part. Find a long hallway or room with lots of open floor.
8. Set up the ramp (inclined plane).
9. Have students place the sand filled bottle on the ramp and let it go. Measure and record the distance.
10. Have students roll the water filled bottle and measure and record the distance.
11. Have students roll the air filled bottle and measure and record the distance.
12. Ask students to report on their findings. (The bottle with the sand rolled farther. It gradually slowed down and finally stopped. The bottle with the water started rolling just fine, but it slowed down very quickly instead of gradually and did not roll as far.)
13. Ask students to give their ideas about why the bottle with sand rolled farther ?



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14. Have students roll the water filled bottle again and tell students to pay close attention to how the water behaves inside the bottle.
 15. Have students verbally describe what they notice about how the water and sand behave.
 16. Point out that the bottle with the sand acted like a solid. As it rolled, all of the sand rolled with it. With the bottle of water, things are very different. When you roll the water bottle, the bottle rolls but the water in the center does not. The friction (or resistance) between the bottle and the water, and between the spinning water and the water in the center slows the bottle and stops it from rolling.
 17. Try one more test with the water bottle by swirling the bottle before you roll it. This gets the water spinning so that it will all move with the bottle. In this case the bottle behaves much more like the one full of dirt. The water is moving along with the bottle, so there is less friction. Be warned that if you swirl the water in the wrong direction, there will be more friction and it will stop even faster than it did unswirled.

Adapted from Experiment of the Week #245, Robert Krampf's Science Education Company www.krampf.com



An Easy Swing?

Description:


This activity is based on a carnival game where you try to swing a weight on a string and knock over a bottle. Students experiment with friction, gravity and inertia to see how carnival gamers use science to make a game harder than it looks.

Time: (1) 45 minute session

Materials Needed:
(per student group)

- two chairs
- string
- masking or scotch tape
- a broom handle, yard stick or similar long rod
- a small, heavy weight that can be tied to the string (a battery, taped coins or fishing sinker work)
- an un-sharpened pencil or dowel with one end flat enough that you can stand it on end

Procedure:

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1. Ask students if they have ever been to a carnival or fair and played a game where they had to swing a weight on a string and knock over a bottle.
 2. If any students reply "yes", ask them if they won a prize. (It should have been hard to win a prize)
 3. Tell students they are going to look at the science behind this game and discover why the game is harder than it looks.
 4. Divide students into groups according to the amount of materials you have for each group. (the smaller the group the better)
 5. Have one student from each group collect materials needed for the activity.
 6. Tell students, the first thing they need to do is to make a pendulum.
 7. Place the two chairs about 3 feet apart, with their backs towards each other.
 8. Place the broom handle across the backs of the two chairs.
 9. Tie one end of the string to the heavy weight and reinforce the tie with tape.

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10. Stand the pencil or dowel on its flat end, directly under the center of the broom handle.
11. Tie the other end of the string to the center of the broom handle, so that the weight is just low enough so that it will hit the end of the pencil or dowel.
12. Tell students, now they are ready for the game. It seems very simple at first. The idea is to pull the weight and release it so that it will knock over the pen. Easy, right? But wait. There is one more thing. You must swing the weight past the pen and have it knock the pen over as it swings back to you. Sounds easy. Try it. Yes, it can be done. It takes practice.

13. Allow time for students to make several tries.

14. After several tries discuss what happened. Here are some talking points:

- Why is it so hard to knock over the pencil or dowel?
- If you swing it forwards, then it reaches a point where it reverses direction and comes back to you, and it goes almost as high as it did at the other end of its swing.
- It does not go quite as high because it loses a little of its energy to friction.
- The same is true if you swing the weight to the right. It moves to the right and then reverses to swing back to the left. It will swing left almost as high as it did to the right.



15. Now ask students if they can swing the weight to the right so that as it swings back, it will not swing up to the left. (Impossible to do)

16. Explain to students that as long as it does not hit anything, it will continue to swing. Inertia will keep the weight moving until gravity, friction of some other force slows it down. That is the clue for why the game is so hard.

17. Now tell students that there are ways to win this game.

18. Ask students for ideas on how to win the game and let them try different solutions.

19. After several tries, give students these two ways to win.

Method One

One is to just barely miss the pen on the outward swing. Most people try to swing the string far to the right, thinking that it will make a small circle and hit the pen on the way back. Really, the farther to the right you swing the weight, the bigger the circle and the farther it will miss to the left as it swings back. If you can just barely miss the pen on the outward swing, it will lose a little of its energy, due to friction, and will hit the pen on its way back.

Method Two

Another way to win is to give the weight a spin as you release it. This spin alters the path of the swing and with practice you can learn just the right amount of spin to get the weight to hit the pen. The people that run this game are not cheating and the game is not rigged. They are just using science in a game that looks easy but is not.

Adapted from Experiment of the Week #254, Robert Krampf's Science Education Company www.krampf.com





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Science Friction-A Tribologist Tale

Description:

Students become Tribologists (scientists that study friction) by observing and measuring two kinds of friction, static and kinetic.

Time: (1) 45 minute session

Materials Needed:
(per student group)

- A large rubber band
- a shoe
- aluminum foil
- masking tape
- tablespoon of cooking oil
- paper towel
- uncarpeted floor
- carpeted floor (or carpet pieces)
- rocks or other weights that fit in a shoe
- ruler
- pencil, paper

Procedure:

1. Tell students they are going to become Tribologists, (scientists that study friction).
2. Divide students into groups according to the amount of materials you have for each group. (the smaller the group the better)
3. Have students create a measurement recording sheet like the one below or print out:

Measurement Recording Sheet

Surface

Static Measurement

Kinetic Measurement

Un-carpeted floor

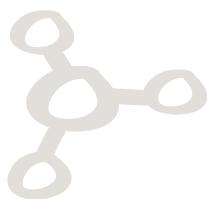
Carpeted floor

Aluminum foil

Aluminum foil with weight

Aluminum foil with oil

4. Have students cut a rubberband, so that they have a long string of rubber.
5. Have students tie one end to a shoe and set the shoe on the floor.
6. Tell students to grasp the other end of the rubberband and begin pulling. Pull gently at first and then pull harder and harder until the shoe begins to move.
7. Now use the ruler to measure how long the rubberband stretches before the shoe begins to move. Write down the measurement.
8. Tell students that before the shoe begins to move, it is experiencing static friction between the shoe and the floor. Their



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measurement represents static friction.

9. Now have students pull the shoe measure how far the rubberband is stretched as they keep it moving. Write down the measurement.

10. Have students compare rubberband measurements between getting the shoe moving and while moving. (Students should notice that the rubberband stretches farther when getting the shoe started)

11. Tell students that when the shoe was sitting still, they had to overcome the static friction to get it going. Once it was going, they had to contend with kinetic friction, which is less than static friction. In other words, once you get the thing moving, there is less friction to resist its movement. Their rubberband measurement while the shoe is moving represents kinetic friction.

12. Now change the amount of friction. Have students move the shoe over carpeting.

13. Have students pull the rubberband and measure the static and kinetic friction over carpet. (static measurement is length of the rubberband before shoe moves, kinetic measurement is length of rubberband during movement)

14. Now have students try using aluminum foil on the floor and place the shoe on top.

15. Did the shoe slide across the foil, or did the foil slide across the floor with the shoe?

- If the shoe slid across the foil, they are measuring the friction between shoe and foil.
- If the foil slid across the floor with the shoe they are measuring the friction between foil and floor.

16. Try it both ways and compare.

17. Now have students add some weight by putting some rocks into the shoe. Have students pull the shoe again and see how increased weight changes the friction.

18. Now have students tape the foil to the floor and rub it with a little cooking oil in a paper towel.

19. Have students try the shoe again, measuring static and kinetic friction.

20. Ask students the following:

- What did you notice?
- Does this give you an idea of why they use oil as a lubricant in cars and other motors?
- Can you think of why the layer of oil would change the friction?

21. Conclude by telling students:

The kind of material, weight, roughness and lubricants can all have an impact on the amount of friction. Of course, Tribologists argue about these all the time. Some say that roughness is different from friction. Others say that friction is a result of chemical attractions. Some even say that friction is due to conversion of energy into sound waves, which explains why dragging something heavy always seems to make such a terrible screech. It is interesting that even something as common as friction can still cause professors to argue over how it works. Isn't it nice to know that there are still so many mysteries in science.

Adapted from Experiment of the Week #268, Robert Krampf's Science Education Company www.krampf.com



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Book List

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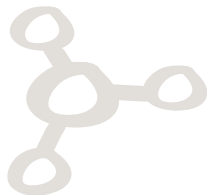
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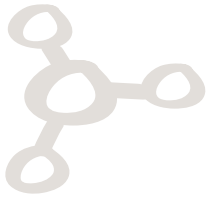
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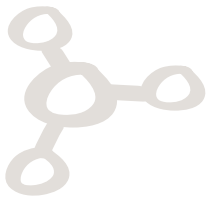


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