



6-8: Sports Challenge

Curriculum Connections

Physical Science

- Observe and describe different patterns of motion, such as objects in motion continue at the same speed and in the same direction unless acted upon by some force and objects at rest tend to stay at rest (inertia).
- Explain and give examples of how energy including heat, light, electrical, nuclear, mechanical, and sound energy is transferred (a baseball bat transfers its mechanical energy to a ball).

Scientific Connections and Applications

- Develop and describe, orally and in writing, appropriate choices leading to good personal health, including choosing healthy ways to reduce stress, such as participating in sports.

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

National Standards

Content Standard A: Science and Inquiry

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

Content Standard B: Physical Science

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

6-8 Exhibits List

Wider is Better -- The Balance Challenge

And they're Off! -- The Reaction Time Challenge

Flaming Fastballs -- The Pitching Challenge

Get a Grip! -- The Climbing Challenge

Go Speed Racer! -- The Race Challenge

Take a Leap -- The Leap Challenge

That's the Way the Ball Bounces -- The Bounce Challenge

Hit the Spot -- The Trajectory Challenge





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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.

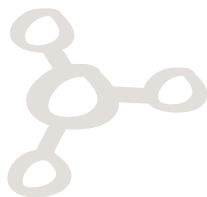


Begin the Investigation At School

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:

- Are you more likely to hit a home run if you hit the ball as hard as you can or on a certain spot on the bat?
- What does the position of your body have to do with your speed when skiing downhill or spinning while skating?
- What does the size, shape, and weight of a ball have to do with how fast you can throw the ball?
- 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

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.





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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...

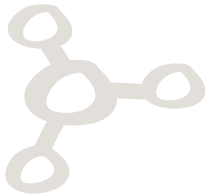
There are several ways you can complete the investigation. Some require less time than others.

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.

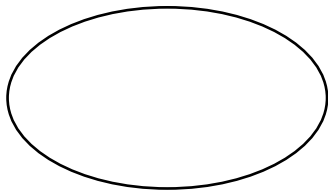
Time: (3)15-30 min. Sessions

Materials Needed:

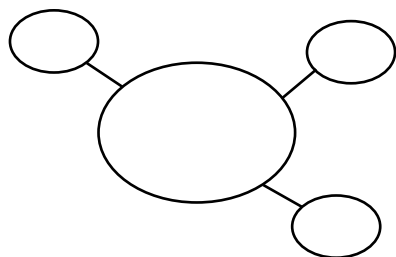
- Blank paper
- Pencils, colored markers

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)



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.



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- 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.

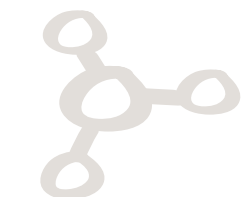
Time: (3) 15-30 min. Sessions

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:

- 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.
- Have students begin their journal or report with questions that are generated when they Start the Investigation at School.
- 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.
- Older students with writing skills can list their own and other students questions in their journal.
- 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.
- When students return from their investigation at the New York Hall of Science have them write answers to questions or draw what they observed.



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)

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





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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

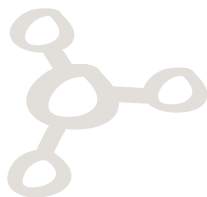
1. Tell students they are going to plan and produce a TV show with investigative science news stories that are 4-5 minutes in length.
2. Divide the class into groups of four or five students.
3. Have students or the teacher chose a writer/script supervisor, camera person, director and on-camera reporter 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

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)





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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.
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



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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 practice observation skills and 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: (3) 45 min. Sessions

Materials Needed:
(per student pair)

- Interesting objects for student observation that will fit in a lunch bag
- Lunch bag
- Print outs of On-Site Investigation Handout

(optional suggestions)

- 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

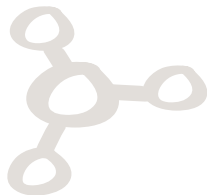
Preparation:

Place interesting objects for observation in lunch bags to keep hidden from student view.

Procedure:

First Session

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. Tell students they are going to do an activity to practice their observation and describing skills.
3. Distribute materials to student pairs.
4. Tell students that the person who is holding lunch bag will now describe the object inside to the other person without naming the object or describing what it is used for. Only descriptions of what the object looks like are allowed. The other student must guess what the object is.
5. Allow student pairs to complete activity and then switch lunch bags with another student pair. Each student pair should have a new object.





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6. Repeat activity.
7. Conclude activity by telling students they will need these same skills of careful observation and detailed describing to explain exhibits they investigate.
8. Conclude the session by leading a discussion about 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
9. Distribute The On-Site Investigation Handout for use at the New York Hall of Science.
10. 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-good for ESL students)
 - 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)

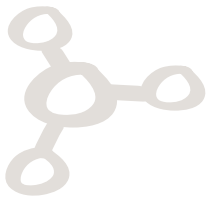
Use this time for students to make their class presentations if they made posters, drawings or models.

Note: Your class may want to make their presentations to another class or younger students as well.

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?





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Balance Yourself

Description:

In this short, simple exercise, students use their bodies to learn about the center of gravity needed to maintain balance.

Time:

(1) 10 minute session

Materials Needed:

(per student)

- plenty of space
- a chair or something to hold on to at first

Procedure:

1. Give students the following instructions:

- Stand beside a chair, so you will have something to steady yourself with.
- Stand on your left foot.
- Lift your right foot and place it on your left leg, above the knee.
- Place your palms together and raise them up over your head.
- Stand in this position and try to stay balanced.
- Notice how your body reacts when you begin to lose your balance. You wiggle and jerk, trying to maintain your balance.

2. Explain to students that:

What you are really doing is trying to get your center of gravity back over your foot. Your center of gravity is not a fixed spot on your body. For objects that are fixed in their position, the center of gravity or balance point stays the same, but your body is not stationary, you move all the time and your body has to adjust. For objects that are solid, the center of gravity or balance point stays the same, but your body is not solid. When you move your arms, lean your head, etc., you are shifting the point where you balance. Once your body learns how to do this, balancing is much easier. The more you practice; the easier it gets.

Adapted from Experiment of the Week #395, Robert Krampf's Science Education Company www.krampf.com

Sport Shoe Design

Description:

Students explore the science behind sport shoe design and create an artistic poster to present their own designs. Students brainstorm and research guided questions

Time:

(3) 45 minute sessions (one in-class work session optional)

Materials Needed:

- Old sports shoe cut in half to reveal side view of inner materials (optional) (per student team)
- Poster board
- Colored Markers
- Sports shoe (student supplied)





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Procedure:

First Session-Research and Planning

1. Tell students they are going to work in teams to explore the science behind sport shoe design and create their own shoe design.
2. Divide the class into teams. (try mixing artistic and scientific-minded students together)
3. Distribute materials. (Teams can use a sport shoe from a student on the team)
4. Explain to students that the first step in creating a new sport shoe design is to understand previous designs.
5. Instruct students to refer to their sport shoe and brainstorm answers the following questions:
 - What parts of the shoe effect the ability of the athlete to perform well?
 - How could parts of the shoe be tested to see how it impacts performance?
 - What types of injuries might a shoe prevent?
 - What types of injuries might a poorly designed shoe cause?
 - What types of materials go into making up the different parts of a shoe?
 - What types of things might an athlete be looking for in a shoe?
 - What are the types of things students look for in a shoe?
6. Once teams have answered these questions on their own, instruct students to develop questions they will need to research in order to design and present their team sport shoe.
7. To conclude this session tell students the requirements for the sport shoe design and presentation.

Presentation Requirements:

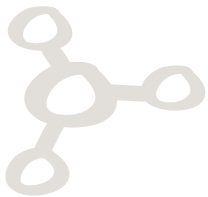
- Drawing of sport shoe design
- Explain and label special features of shoe
- Explain benefits of shoe to athletic performance
- Explain how shoe is tested for athletic performance
- Other requirements

Second Session-Optional

Use this time to have teams work together to create their presentations or assign as team homework.

Third Session

Use this time for team sport shoe presentations to the class.





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Zero Gravity Sports

Description:

Student groups design and present a sports game that can be played by astronauts in zero-gravity.

Time:

(2) 45 minute sessions

Materials Needed:

(per student group)

- Poster board or large paper
- Markers

Teacher Note:

The NASA educational video Shuttle Life in the World of Weightlessness is a wonderful look at the day-to-day realities of living in zero gravity.

29 minutes/1985

1/2" VHS

Item Number: 006.3-02V

Price: \$16.00

Toll Free Ordering Line: 866-776-CORE

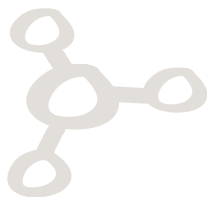
Procedure:

First Session

1. Begin by posing this imaginary scenario to students: The NASA space program is looking for ways to help astronauts on the space station get exercise and have fun doing it. Your mission is to design a sport that might be played at a space station.
2. Conduct a short brainstorming session and ask students the following questions:
 - What special conditions exist on the space station that would effect a sports game?
(The major factor they should mention is the lack of gravity.)
 - What sports played on earth could you adapt for space?
3. Divide students into groups and distribute materials.
4. Tell groups that their game design report and poster must meet the following requirements:
 - Name of the game
 - Object of the game
 - The number of players
 - The equipment needed
 - Any special gear that does not currently exist
 - Illustration showing what the game would look like as it is played
5. Use the remaining time to let students work on their game design in class.

Second Session

1. Use this time to let students present their posters and game design report.
2. If there is time, you may want to conduct a short debriefing and ask groups the following:
 - How did the team decide how the sport would work?





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- What problems did the team have to overcome?
- What similarities did the different teams' sports have?

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Bounce Tests

Description:

Students measure and record the bounce of various balls used in sports. This activity also involves mathematical averaging and comparison with US Sports Federation Ball Bounce Requirements.

Time:

(1) 45 minute session

Materials Needed:

(per student group)

- Balls from many sports (preferably not hard like golf balls): basketball, ping-pong, soccer, rugby, tennis.
- Measuring tape or stick

Preparation:

Print out US Sports Federation Ball Bounce Requirements

Procedure:

1. Explain to students that their task is to compare the bounce of the balls used in various sports.
2. Brainstorm with students how one could measure the bounce of a ball.
3. Have the class agree on what would be a fair test.
4. As a group, have the class develop a plan for the procedure to follow and the measurements to take.
5. Divide the class into groups and have each group conduct their tests and record their findings.
6. When every group has completed its investigation, reconvene the class and have groups share their results.
7. Create a combined chart on the board. (do a mathematical averaging calculation to arrive at the average bounce measurement of each ball)
8. Look at the final chart and facilitate a discussion by asking the following:
 - How did the class balls compare to the Sport Federation ball bounce requirements?
 - Rank the balls from most bouncy to least bouncy.
 - What features of the balls might make them bounce differently?
 - What else could affect the way a ball bounces?
 - Why might different sports want more or less bounce in their balls?
 - How would a particular sport be different if the bounciness of its ball suddenly changed?

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Print Out

US Sports Federation Ball Bounce Requirements

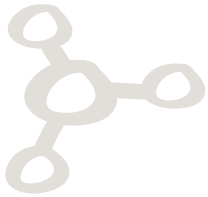
Baseball: When dropped from 60 inches onto a hardwood surface, the ball should bounce to between 16" and 20"

Tennis: When dropped onto a concrete base from 100", the ball should bounce more than 53" but less than 58".

Basketball: When dropped on wooden court from 6 feet measured from bottom of ball, rebound 49-54" measured to top of the ball.

Lacrosse: When dropped onto a hard wooden floor from a height of 72", should bounce to a height of between 49" and 54".

Ping Pong: The standard bounce required shall not be less than 22 cm (8 3/4") or more than 25 cm (9 3/4") when dropped from a height of 30.5 cm (12") on an approved table.





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Sport Safety Suit

Description:

Student teams design and construct a sport safety suit for a raw egg. Teams document their design process and then test their designs in a small collision with a wall.

Time:

(2) 45 minute sessions

Materials Needed:

(per student team)

- Raw Egg
- Construction materials such as newspaper, string, rubber bands, tape, paper, straws, toilet paper—the more variety, the better
- Newspaper for floor of egg collision site

Procedure:

First Session

1. Start the session by brainstorming kinds of sports gear that is designed to protect athletes' bones and brains.
2. Tell students they will be designing a protective "safety suit" for a raw egg that will allow it to survive a collision with a wall.
3. Divide the class into teams.
4. Distribute materials.
5. Tell teams their design must meet the following criteria for the egg safety suit:
 - Can be no more than six inches wide, high, or deep.
 - Must have away for the egg to get in and out without too much difficulty
 - Teams must document their design in some way, with a drawing, blueprint, or step by-step instructions for making the suit
6. Use the remainder of the class time for planning, design and construction.

Second Session

Preparation:

Prepare the collision site by clearing a 10 foot space away from a wall. Put newspaper down at the base of the wall for broken eggs.

Procedure:

1. Have teams move to the collision site with their suited-up eggs.
2. Before tossing the suited-up eggs, have teams share their design document and explain how they created the safety suit.
3. Have teams toss their suited-up egg against the wall.
4. If some of the suits are not strong enough to withstand impact, lead a discussion about what might have gone wrong in the design or execution of the safety suit.

To conclude the session, lead a discussion with the following questions:

- What features were similar in the all the designs?





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- What were some unique features in the designs?
- What design features might you find in protective sports gear?

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Sports Measures

Description:

Students design and construct measurement devices that could measure certain health attributes or abilities of an athlete.

Time:

(2) 45 minute sessions

Materials Needed:

(per student team)

- paper, scissors, tape, string, rubber bands, cups, cardboard and paper clips
- other common materials that will stimulate creativity

Procedure:

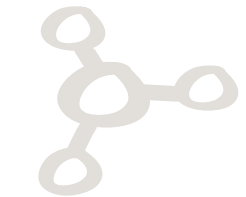
First Session

1. Tell students they are going to design and construct a measuring device that will measure an athlete's health or abilities.
2. As a class, brainstorm a list of measurements of an athlete that might be needed to give a complete picture of the athlete's health or abilities. (For example, students might suggest that it would be useful to measure an athlete's peripheral vision.)
3. Winnow the list down to those ideas that might be measurable without using some high-tech device.
4. Divide the class into teams and make construction materials available.
5. Have each team work on designing away to measure a different one of the functions or abilities they listed. Encourage the groups to come up with measuring devices that they could actually make.
6. Use the remaining time for design and construction of measuring devices.

Second Session

1. Have teams share their designs and explain both how they work and why that measurement might be important.
2. After presentations, discuss issues such as:
 - How practical is each device?
 - In which sports would this measurement matter a great deal? Why?
 - In which sports would this measurement be of little importance? Why?

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Men and Women Athletes

Description:

Student teams research statistics and graph results of men and women's sport performances over a ten year period. Student's develop a theory based on their data results.

Time:

(2) 45 minute sessions

Materials Needed:

- Almanac that lists sports statistics
- Computer access- a good site for students is <http://www.infoplease.com/sports.html>

Procedure:

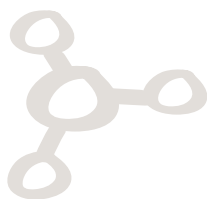
First Session

1. Tell students they are going to conduct research to find the answers to the following questions:
 - Are there some sports in which the athletes are consistently improving their performance over time?
 - Are there some sports in which there seems to be little improvement among athletes ?
 - In which sports are women's and men's records closest?
2. As a class, brainstorm sports that both men and women play. (display list of ideas)
3. Divide the class into research teams.
4. Have each team select a sport to research. (pulling the sport names out of hat is equitable)
5. Tell student teams there research must include the following:
 - statistics related to men's and women's performances in their sport for ten different years
 - the best men's scores/times and the best women's scores/times
 - a graph of results
 - two theories to explain why many women's records are different today than they were several decades ago.
6. Use the remainder of the time for teams to begin to conduct research or plan research tasks among team for homework.

Second Session

1. Have the teams share their graphs and share theories.
2. Return to questions at beginning of activity and discuss:
 - Are there some sports in which the athletes are consistently improving their performance over time?
 - Are there some sports in which there seems to be little improvement among athletes?
 - In which sports are women's and men's records closest?

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6-8: Sports Challenge

Book List

Gravity

Ardley, Neil. *The Science Book of Gravity*. Dorling Kindersley, 1992.

Forces and Motion

Friedhoffer, Robert. *Forces, Motion and Energy*. Franklin Watts, 1992.

Gardner, Robert. *Investigate and Discover Forces and Machines*. Simon and Schuster, 1991.

Taylor, Barbara. *Force and Movement*. Franklin Watts, 1990.

