



## 3-5: Sports Challenge

### Curriculum Connections

#### Physical Science Concepts

- Begin to understand how different forms of energy and a variety of forces affect the motion of objects, such as the effect of gravity on a thrown ball.
- Describe the position, direction, and motion of objects and understand forces that affect their motion such as gravity and friction.

#### Scientific Connections and Applications

- Develop and describe, orally and in writing, appropriate choices leading to good personal health, such as recognizing the importance of exercising.

#### Scientific Communication

- 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
- Understanding about scientific inquiry

#### Content Standard B: Physical Science

- Properties of objects and materials
- Position and motion of objects

### 3-5 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  
In for Spin -- The Pirouette Challenge

### Guide Theme

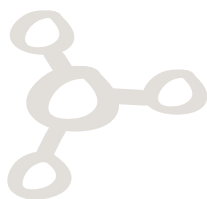
The theme of these guides are based on popular crime and detective show investigations on TV; a mystery unfolds, questions are asked, evidence is gathered, conclusions are drawn. This process is similar to what scientists go through with the inquiry method. For more details see About the Guides.

### 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 homerun if you hit the ball as hard as you can or on a certain spot on the bat?





## 3-5: Sports Challenge



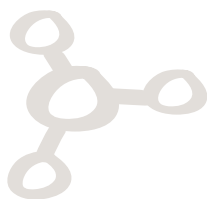
- What does the size, shape, and weight of a ball have to do with how fast you can throw the ball?
- Demonstrate one of the Laboratory Activities with no explanation-let the questions begin
- Do one of the Laboratory Activities and facilitate a probing discussion

### **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.

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





## 3-5: Sports Challenge

### 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.

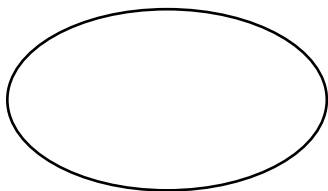
**Time:** (3)15-30 min. Sessions

*Materials Needed:*

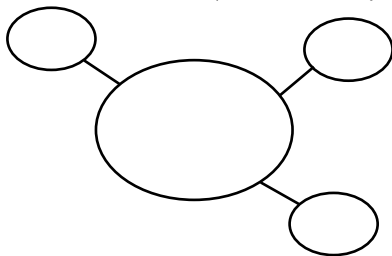
- Blank paper
- Pencils, colored markers

*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.



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)





## 3-5: Sports Challenge

### *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.

### **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.



## 3-5: Sports Challenge

3. Have students or the teacher choose 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 out 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.



## 3-5: Sports Challenge

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*

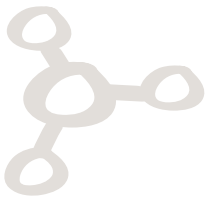
1. Production groups will need to write the conclusion to their video script after their New York Hall of Science video shoot.
2. The conclusion should include a summary or opinion of the overall story as well as the reporter sign off.
3. Allow production groups to review their video footage (if necessary) 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.





## 3-5: Sports Challenge

### 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:**

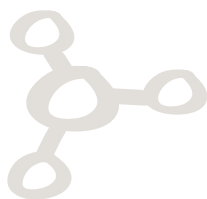
##### *First Session*

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





## 3-5: Sports Challenge

substitute and represent real materials from exhibit— ex. Clear plastic wrap simulates glass, cardboard tube becomes a rocket etc.)

### *Third Session (optional)*

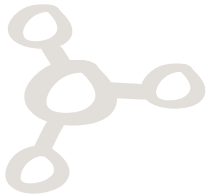
Use this time for students to make their class presentations if they made posters, drawings or models.



### 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?



### Reflexes Demonstration

Description:

In this quick simple activity, two students demonstrate knee reflexes. The class learns about how reflexes help balance.

#### **Time:**

(1) 10 minute session

#### *Materials Needed:*

- a tall chair, desk or table

#### *Procedure:*

1. Ask for two student volunteers
2. Have one student sit on a chair, desk or table so that their feet do not touch the floor.
3. Instruct the other student to locate the reflex spot located just below the knee cap. The knee cap is a round bone called the patella. The spot is just below the bottom edge of the patella.
4. Once the right spot is located, have the other student give it a gentle tap with the side of their hand. Do not hit too hard. It should not hurt. They may have to tap a few times to find exactly the right spot. When they do, the leg should kick slightly.
5. Ask the sitting student if they made their leg kick on purpose. (the answer should be no)
6. Ask the students that if the kick wasn't on purpose, what made him/her kick? (student responses may touch on the real explanation so become familiar with the explanation below.
7. Tell students that the kick was triggered by a reflex. Reflexes are automatic reactions that help control and protect your body. They jerk your hand away from something sharp or hot to minimize the injury. The knee jerk reaction is one of the fastest reflexes, only taking about 50 milliseconds, which is much faster than you could do it on purpose.



Doctors use the knee jerk to test your nervous system, but what is the real reason we have this reflex? If the amount of weight on your leg suddenly increases, this reflex pushes back, helping you absorb the shock and keep your balance. It plays an important part in helping you walk and run, without falling on your face.



## 3-5: Sports Challenge

Adapted from Experiment of the Week #368, Robert Krampf's Science Education Company [www.krampf.com](http://www.krampf.com)



### Tip Toe Balance Demonstration

Description:

Students observe a balancing demonstration and learn about the center of gravity needed to maintain balance.

**Time:**

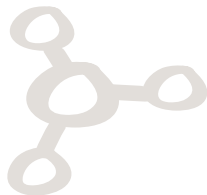
(1) 20 minute session

*Materials Needed:*

- a wall
- a student volunteer

*Procedure:*

1. Ask for a student volunteer.
2. Ask the student to stand on their tip toes. No problem right?
3. Now have the student get as close as possible to a wall and bring the tips of their toes to the bottom edge.
4. Tell the student to put their hands behind their back.
5. Now ask the student to stand on their tip toes. (they won't be able to do it)
6. Facilitate a discussion with the following questions:  
(student responses may touch on the real explanation so become familiar with the explanation below.
  - Why is it so hard to stand on tip toe standing so close to a wall?
  - Why would the wall keep you from doing it?
  - What does the wall keep you from doing? (Leaning forward!)
7. Tell the students that when you stand on your tip toes, you lean forward to keep your balance. With the wall in the way, you can't lean forward and so you can't keep your balance while standing tip toe.
8. Now pose this question:  
Why do you need to lean forward in order to keep your balance?
9. Tell students it has to do with your center of gravity. Think of the center of gravity as sort of a balancing point. As long as the center of gravity of an object is directly over its base, it will not fall over.
10. To demonstrate the center of gravity ask the student volunteer to stand with their feet together.
11. Tell students that if you drew a line straight down from your center of gravity, it would hit the floor under your feet.
12. Now ask the student volunteer to lean far enough to the side so that their center of gravity moves past their feet. (the student should lose balance)
13. Finally, tell students that when you stand on tip toe, you change your base. Instead of your entire





## 3-5: Sports Challenge

foot forming the base, now only your toes are supporting you. Suddenly, your center of balance is not directly over your base (tip toes). You either have to lean forward to move your center of gravity back over your base, or you will fall backwards.

Adapted from Experiment of the Week #371, Robert Krampf's Science Education Company [www.krampf.com](http://www.krampf.com)



### 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](http://www.krampf.com)





## 3-5: Sports Challenge

### 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

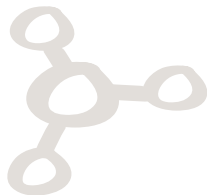
**Procedure:**

*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:





## 3-5: Sports Challenge

- How did the team decide how the sport would work?
- What problems did the team have to overcome?
- What similarities did the different teams' sports have?

*Adapted from Sports Challenge Teacher Guide © 2000 The Franklin Institute*



### **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?

*Adapted from Sports Challenge Teacher Guide © 2000 The Franklin Institute*





## 3-5: Sports Challenge

### Print Out

#### *US Sports Federation Ball Bounce Requirements*

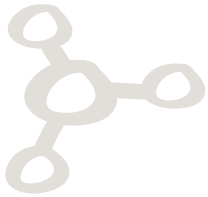
**Baseball:** When dropped from 60 inches onto a hardwood surface, the ball should bounce to between 16" and 20"

**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.





## 3-5: Sports Challenge

### 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 a way 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:*

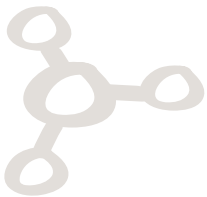
Prepare the collision site by clearing a 10 foot space away from a wall. Put newspaper down at the base of the wall for broken eggs.

*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?





## 3-5: Sports Challenge

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

*Adapted from Sports Challenge Teacher Guide © 2000 The Franklin Institute*



### Book List

#### Gravity

Ardley, Neil. *The Science Book of Gravity*. Dorling Kindersley, 1992.  
Cobb, Vicki. *Why Doesn't the Earth Fall Up?* Lodestar Books, 1988.  
Lefkowitz, R.J. *Forces in the Earth*. Parents' Magazine Press, 1976.  
VanCleave, Janice. *Gravity*. John Wiley and Sons, 1993.

#### Forces and Motion

Ardley, Neil. *The Science Book of Motion*, Gulliver Books, 1992.  
Watson, Philip. *Super Motion*, Lothrop, Lee & Shepard Books, 1982.

#### Physics

Bowan, Andy Russell. *Robert Fulton: A Head Full of Notions*. Carolrhoda Books, 1997.  
Jennings, Terry. *The Young Scientist Investigates: Energy*. Children's Press, 1984.  
Kent, Amanda. *Introduction to Physics*. Usborne Publishign Ltd., 1983.  
Lyon, Sue. *Science in Action – Experiments in Physics*. Marshall Cavendish Corp., 1989.  
Wiese, Jim. *Sports Science: 40 Goal Scoring, High Flying, Medal Winning Experiments for Kids!* John Wiley & Sons, Inc., 2002.  
Wood, Robert W. *Physics for Kids 49 Experiments with Heat*. Tab Books, 1990.

