Lesson Plan #1
“The Roots of Baseball”

**Materials:** Grass seed, Containers in which to grow grass, Soil and Water

**Before the Game:** Discuss as a class what plants need in order to grow. Provide students with materials to grow grass in the classroom and discuss how and why the grass at the ballpark is different and similar to the grass that they are growing.

**At the Game:** Have students observe where the grass is growing at the ballpark and where there is just dirt. Why is no grass growing there? What are the things before, during and after the game that the Rock Cats do to care for the field? Why is it a good idea to play baseball on grass? Are there other surfaces used to play baseball? Which is the best surface and why?

**After the Game:** Discuss the observations you made as a class. Answer the questions. Did the grass grow in the classroom? Why or why not?

Lesson Plan #2
“Rain Delay”

**Materials:** Thermometers, weather sections of the newspapers, video of weather reports in the news. *(News = North, East, West, and South)*

**Before the Game:** As a class make observations pertaining to the weather on a daily basis, and devise a means to record the observations, predictions, etc. Make notations of temperature, sky and weather conditions. Periodically have children watch weather reports as homework, and discuss what these reports expressed. How do reporters use maps, tables, charts, and graphic displays to communicate to viewers? Talk about appropriate clothing in preparing for predictions. Have your students make predictions individually about what they think the weather will be like at the game *(video record the predictions in hallway away from other students)*.

**At the Game:** Make observations of weather conditions and note if any conditions interfere with the game. Ideas may include wind, heat and sun.
After the Game: Have children in teams make full weather reports. Possibly make charts of what it was like and showcase them to the students. Show students predictions before the game to the entire class!

Lesson Plan #3
“Does the Game make Sense”?

Materials: An assortment of coins, game food, leather, sunflower seeds, cardboard, tape recorders and cassette tapes.

Before the Game: Discuss how we take in information using all of our senses and in turn, use that information to understand the world. Begin making lists that describe a day at school, classifying each list as data gained from looking, smelling, tasting, hearing or touching. Have the students try this while blindfolded and record as classified information.

At the Game: Play with the student’s senses. Predict which coin(s) will cover an outfielder or catcher’s head when held at arms length in the direction of that player. During loud crowd noise, use fingers to plug and unplug ears to make sound come and go. Try tasting the baseball related food while holding one’s nose plugged. Does it taste the same? Make a point to thoughtfully touch objects usually taken for granted. (The seats, a ticket, a hotdog bun, the railings, etc.) Have students play the alphabet game attempting to identify each of the senses for every letter of the alphabet. Incorporate a game of, “I spy I smell, I feel,” etc. and use adjectives or adverbs until students are able to guess the particular sensation.

After the Game: Have students work in teams to make games, posters, books, tape recordings, or anything else to showcase sensory experiences of the game. Possibly split teams into “Sensory Teams” and do things like have the “smellers team” make smell boxes of game day smells while a “touches team” can approximate textures in comparison with items in the classroom.
Lesson Plan #4
“Building a Stadium”

**Objective:** students will be able to list ways an area may be impacted through the building of a stadium.

**Materials:** Pictures, newspapers, and articles.

Have students build a model of a house or look at pictures of different types of structures and list all of the impacts on the environmental landscapes, waterways, and the displacement of wildlife. Have them list the types of building materials that are used in your building. Discuss various layers within the earth’s surface. Which of the items are living organisms? How do non-living organisms affect the living?

**At the Game:** Have students identify buildings around New Britain Stadium. Have the students identify some of the building materials used to construct New Britain Stadium. How does the wall affect the field? List the negatives/positives that baseball has on the environment? Before exiting the game, take a look at the Beehive, located next to New Britain’s Stadium.

**Beyond the Game:** Discuss the changes they saw between the old stadium and the new stadium. Make a chart of what is new and what is old of Beehive and New Britain Stadium? Have the children list the changes that they have seen in their own neighborhoods. Design a similar chart in reference to these changes and how they affect where they personally live.
Lesson Plan #5
“Nutrition at the Game”

Before the Game: Introduce a Nutritional Pyramid to your students. Go through examples with kids and have students monitor what they eat the week leading up to the game, while classifying each item as they note it. Students will find some items have two or three classifications. (You may have to discuss portions with them). At the end of the week, discuss if students ate a well balanced diet.

At the Game: List consumable products that you see. Create a list of the items observed or consumed. Are they healthy? Why do the Rock Cats offer this product? Why do they offer this brand?

After the Game: Create a list of food items and discuss what products on this list fall into the food pyramid. Did the students find a complete meal at the game? Have students discuss items that can be additionally sold at the game. Cover cost, preparation, time, handling, shelf life, etc.

Beyond the Game: Have students write a persuasive letter to Rock Cats about healthier, achievable items that they could make available at considerable costs.
Lesson Plan #6
“The Center of Gravity”

Materials: Variety of baseball bats and two feet of string.

Before the Game: On every bat, there is a spot where the weight is concentrated. This spot is called the center of gravity. The students can find the spot by the following directions:

1. Predict where the center of gravity is located.
2. Take the string and tie it to the bat somewhere around the middle. Make the knot loose because you may need to slide the knot up and down the bat.
3. Let the bat hang horizontally from the string so that the bat becomes balanced. This is the time when the knot should be adjusted to enable the bat to hang balanced.
4. When the bat becomes balanced, this spot is the center of gravity for the bat. Measure the distance from the thick end of the bat to place at which the knot is balancing the bat.
5. How far off were students from their predictions?
ACTIVITY 1: BERNOULLI'S PRINCIPLE

Try these activities to find out how Bernoulli's principle works and why catchers wear gloves. As you'll see, physics is elementary!

MATERIALS
• 2 tennis or ping-pong balls
• string
• masking tape

PROCEDURE
1. Attach one end of a string to a tennis or ping-pong ball with the masking tape.
2. Do the same to the other string and ball.
3. Hang the balls from a horizontal bar or a dowel rod. Place the balls at the same level and about 3 cm apart.
4. Put your mouth between the two balls about two or three inches from them.
5. What do you think will happen to the balls when you blow a steady stream of air between them?
6. Try it!
7. What did you observe?
8. Attempt to explain your observation.

ACTIVITY 2: DEMOLITIONS BY BERNOULLI

MATERIAL
• one sheet of 8-1/2" x 11" paper

PROCEDURE
9. Draw lines to divide your paper into three sections -- a 2-inch, 7-inch and 2-inch portion.
10. Fold your paper along the lines to make a "house" (walls are 2 inches high; flat roof is 7 inches wide).
11. Set the "house" on a table.

12. What do you predict will happen when you blow hard under the house?

13. Try it!

14. What did you observe?

15. How can you explain your observation?

ACTIVITY 3: FASTBALL EGG TOSS

MATERIALS

- raw eggs
- old bed sheets

Why do outfielders and pitchers wear gloves and protective padding? The answer seems obvious, but it's based on a physics principle called momentum and impulse. The momentum an object has is a product of its mass times the velocity with which it is moving (momentum equals mass times velocity). Momentum can be transferred from one object to another. Impulse is the product of a force on an object and the time it takes for the force to be applied (impulse equals force times time). The impulse imparted to an object equals the change in momentum of the object. If the time is increased, force is decreased and vice versa.

When a baseball is caught, the momentum of the moving ball is transferred to the glove. Outfielders and catchers decrease the force of the ball by moving their hand with the ball as they catch it, slowing down the impact. This, along with the padding in the glove, increases the time of impact (impulse), thus decreasing the force with which the ball hits the glove. Protective padding in all sporting equipment and shoes follows this same principle. You can see this phenomenon yourself by trying the Fastball Egg Toss.

PROCEDURE

16. Hold a flat bed sheet at each of the four corners to provide a large target for the pitcher. Make a "pocket" in the bottom of the sheet by holding it up slightly. (You want to prevent the egg from rolling out of the sheet.)

17. Throw an egg into the sheet as fast and hard as you can. The object is to break the egg by throwing it into the sheet. (You may want to place the egg in a plastic sandwich bag, just in case.)

18. An egg cannot be thrown hard enough into a sheet to break the shell because the sheet, which "gives," transfers the momentum of the egg over a long period of
time, greatly decreasing the force on the egg shell.

19. Compare what happens when momentum is transferred abruptly. Drop the raw egg (in the plastic bag) on a solid surface. Now, time is very short, making the force much greater.

Bibliography
All three activities taken from
http://www.pbs.org/safarchive/4_class/45_pguides/pguide_405/4545_bb.html

Background
Baseball fans, and even those who do not necessarily enjoy the game, may be surprised to learn how science directly influences a batter's ability to hit the home run, a pitcher's talent for throwing a curve ball, or a fielder's spectacular diving catch. While professional athletes do not necessarily understand the physics of their sport, the principles and concepts of science can enhance their performance when studied and applied to the execution of fundamental skills on the diamond. All-Star players, such as Derek Jeter, David Wright and Ozzie Smith, may intuitively understand and apply physics in using gravity, effort force, speed, momentum and velocity to their advantage. Even those players who do not comprehend the theories of science and their relevance to the game are demonstrating physics and incorporating mathematics, often unaware they are
doing so. Grasping how to use these variables to one's benefit can mean the
difference between a Hall of Fame career and a brief stay in the major leagues.
Standing waves, center of mass, the effort force on a lever, impulse, friction,
aerodynamics, and projectile and linear motion are all intricate to strategy in the
dugout and rivalries on the field as teams compete in using physics to their
athletic advantage.

B. Vocabulary
Acceleration
Aerodynamics
Air resistance
Angle
Center of mass
Collision
Conservation of Energy
Density
Distance
Energy
Effort force
Force
Friction
Fulcrum
Gravity
Impulse
Lever
Linear motion
Mass
Momentum
Newton's Laws of Motion
Node of standing wave
Pressure
Projectile motion
Rebound force
Speed
Sweet spot
Velocity
Vibration
Wave
Work

C. Suggested Pre-Program Activities
1) Have two students hold a Slinky toy between them. Stretching the Slinky on
the ground across several feet, have one student swing it back and forth, side to
side. This demonstrates the highs and lows of a standing wave caused by the
vibrating movements.
2) Discuss types of levers used in daily life. List examples of first-, second- and third-class levers and the differences between them. Different types of levers can be illustrated by using a block of wood (a fulcrum), a ruler (a lever) and a weight to create resistance.

3) Find the center of mass or gravity of different objects by balancing them on a fulcrum. Ask students why they cannot stand themselves straight against a wall and bend over to touch their toes without moving their heels. Explain that this task is challenging because their center of mass is no longer over their feet, thus causing them to lose their balance.

4) After measuring the mass and volume of different objects, calculate and compare their density. These items might include cork, wood, metal, plastic, aluminum, etc.

5) Determine the amount of friction acting on a block of wood as it is pulled across different surfaces as measured by a force measure, such as a spring scale. The surfaces might include leather, a table, sandpaper, indoor/outdoor carpeting, grass, dirt, etc.

**EXPERIMENT TO TRY:**

To demonstrate reaction time, have two students work together using a metric ruler. One student will hold the ruler with the 0 cm end between the other student's thumb and forefinger. This student will catch the ruler when it drops. Look where the ruler is caught. Look at the reaction times worksheet and read the reaction time for the distance on the ruler. Repeat the activity twice. Find the average of the reaction time trials to get the reaction time. Have the students switch places and repeat the same procedures to find the other person's reaction time. A variation of this activity is to have the student dropping the ruler say "ball" or "strike" as the ruler falls. The other student must catch the ruler if it is a strike or let it go if it is a ball.
Lesson Plan #7
“The Greatest Distance is Sound”

Materials: Hammer or a piece of wood the size of a hammer, baseball bat, and a ruler.

Before the Game: Hold the bat horizontally with one hand. With your other hand, pick up a hammer or piece of wood. Strike the bat at points that are one inch (2.5 cm) apart. Start at the heavier end of the bat. Listen to the sound the bat makes each time you hit it (note all changes of sound from one end to the other).
   1. What did you notice about the sound of the bat each time you hit it?
   2. Where is the spot that makes the clearest, most solid sound?
   3. Measure how far this spot is from the thick end of the bat (inch or cm.)
   4. Why do you think the spot is called the center of percussion?

At the Game: Observe the sound the Rock Cats’ bats make. Are these sounds different from the sounds you made? Do ground balls sound different then fly balls? Have various students close their eyes for one half inning of the game. Have these students attempt to determine the distance that the ball traveled based on the sound of the bat. Have your students track the difference between their guess and the actual distance of the ball.

After the Game: Experiment with other sports equipment (tennis rackets, racquetball rackets, hockey stick, etc.) to find the center of percussion – Why do professional players use wooden bats while little leaguers use aluminum? Note that college players are slowly being required to switch from aluminum to wood. Why is this?
Lesson Plan #8  
“Birds Eye View”

Before the Game: List all the people who the students will likely see at the ballgame. What are their roles and functions? Students may choose which role and person they would like to analyze in order to create new inventions in which to make their jobs more functional. Students may choose the pitcher, batter, fielder, catcher, ticket taker, food vendor, usher, or even the fan.

At the Game: As they enjoy the game they should make observations of their client and of their movements and the tools they use. Also make note of the inventions already in place; bills on caps, change dispensers for vendors, etc.

After the Game: Have teams discuss the observations they made about the clients. Have them choose one component of the person’s actions or attribute of the tools they use or the stadium they use it in. How are the tools applied? Also, invent improvements to simplify the work or improve their performance. The improvements may consider but not be limited to the efficiency of movement, tool improvement, or adjustments to tools and gear. Design diagrams and write descriptions of these inventions and send them to the Rock Cats!

Beyond the Game: Prep the students about how inventions play a part in our everyday lives and where and how to carry on with these inventions.