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**Life saver: can a softer baseball prevent a rare but lethal sports injury? To find out, a researcher goes to bat with the scientific method. (The Scientific Method).** Nicole Dyer.

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Last May, 7-year-old Nader Parman of Atlanta, Ga., was playing baseball in his front yard--when tragedy struck. A lightning-fast batted ball rammed him in the chest. Incredibly, the blow occurred during the one-hundred-thousandths of a second that the heart--the fist-size muscle that pumps blood to the body about 75 times per minute--pauses between beats. The impact disrupted perfectly timed electrical signals emitted from the heart's sinoatrial node, or natural pacemaker--and killed Parman instantly.

The freak accident is called commotio cordis, or sudden death from a blunt trauma to the chest. Fewer than 20 cases are reported annually in the U.S., but nearly 70 percent occur in boys under age 20--when chest bones are still growing--and are caused by baseballs. Between 1973 and 1995, baseball chest traumas resulted in the deaths of 38 kids ages 5 to 14, according to the U.S. Consumer Product Safety Commission. In response, manufacturers started making and marketing softer balls.

 But researcher Dr. David Janda, founder of the Institute for Preventative Sports Medicine in Ann Arbor, Mich., questioned the effectiveness of the so-called "safety balls." His skepticism sparked a research question: Does a softer baseball really help prevent fatal heart trauma caused by chest-impact accidents?

To sleuth out an answer, Janda used an organized step-by-step approach--known as the **scientific method**--to conduct an experiment.

AN EYE FOR INQUIRY

Serious science begins with an **observation**. Janda knew that baseball injuries, like ankle sprains and bone fractures, lead to more ER visits each year than any other sport. But few people--including doctors--have ever heard of commotio cordis. Hungry for more information, Janda hit the library to conduct background **research**: He pored through scientific articles on commotio cordis, and searched for experiments that might have already answered his question.

Janda discovered one study conducted in 1998 at the New England Medical Center (NEMC) in Boston, Mass. Researchers had fired baseballs with varying degrees of hardness at the chests of 40 young pigs. The results showed a pig's risk of fatal heart injury was significantly less with softer baseballs. But Janda also found a contradictory study that suggested softer balls actually increased the risk!

So he decided to conduct his own original research to find out. Janda began by formulating a **hypothesis**, or an educated guess about the answer to his inquiry. His hypothesis: A softer ball is not a significant lifesaver and should not be touted as a safety product. Now his task was to prove it.

Unlike the NEMC study, Janda wanted to conduct his experiment without using animals as test subjects. "When you do testing on animals, sometimes they're going to die," says Janda. "If we can get the same information from a crash-test dummy, why kill an animal?"

HEART OF THE MATTER

First on Janda's to-do list: plot a step-by-step plan, or **procedure**, to guide his experiment (see "Write a Procedure," p. 20). A well-designed study includes specific instructions on how to test the effects of one or more **variables**, or changeable factors, on another. Janda's study, for example, tested the effects of a baseball's speed and mass on the force of impact measured by a dummy chest designed to simulate the chest of an average boy.

When a researcher adjusts or manipulates a variable on purpose to test how the change affects the experiment, it's called an **independent variable**. In this case, Janda used baseballs with varying masses and core materials; he also tested the balls at different speeds.

The characteristic that responds to adjustments in the independent variables is termed the **dependent variable**. In this experiment, the dependent variable was the impact force measured by the dummy chest. The remaining variables in the experiment--such as the pressurized air cannon that fired the balls and the distance between the cannon and dummy--remained unchanged (**constant**).

ALL IN THE DETAILS

At the core of every smoothly run experiment is painstaking attention to detail. A simple flaw, like an incorrectly weighed ball, can botch the entire experiment--and send a researcher crawling back to the drawing board. "In science you have to be very meticulous if you want a thorough answer to your question," says Janda. (To check out his setup, see the diagram below.)

TALLYING THE SCORE
When the experiment trials were complete, Janda was swamped with reams of **data**, or information, in the form of raw numbers: ball speeds, weights, and chest-caving distances. His next task: figuring out what it all meant! **Charts and graphs** (see p. 22) allowed Janda to organize his findings into meaningful visual displays that helped him draw a **conclusion**, or a summary of the results.

Did his hypothesis prove true?

Absolutely, he says: "We found that many soft-core baseballs actually made the problem worse and increased the risk. of commotio cordis." How? It turns out the softer balls weigh more. According to Newton's second law of motion, mass multiplied by acceleration (speed) equals force; so the greater the mass, the greater the force of impact, and the greater the risk of injury. "The use of a softer ball--not a lighter ball--can give kids a false sense of security," Janda explains. "They may be more likely to take a bigger risk in fielding the ball or not moving away from a wild pitch if they think there's a decreased risk of injury."

Finally, Janda published a detailed report about his experiment in a scientific journal so that other scientists could learn about his results.

By working together, researchers like Janda are dedicated to making sports safer for everyone.

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| **Class Notes** **Topic:**  **Scientific Method** **Questions/Main Idea:** |  Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Date:   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **Notes:** |
| What is the scientific method? |   |
| What is the first step of the scientific method? |   |
| Why should you conduct background research? |   |
| What is a hypothesis?  |   |
| What is the purpose of a procedure? |   |
| What are variables?  |   |
| What is an independent variable and give one example. |   |
| What is a dependent variable and give one an example. |   |
| What is a constant variable?  Give at least two examples. |   |
| What is a control?  |   |
| What are trials?  And why is it good to have more trials? |   |
| What is data?  |   |
| How can data be organized? |   |
| What is a conclusion?  |   |
| **Summary: Describe the results from Dr. Janda’s experiment.** |
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