GLOSSARY:

Asymmetric: Not identical on both sides of a central line; unsymmetrical; lacking symmetry.

Barometric pressure: Atmospheric pressure as indicated by a barometer.

Biomechanics: The study of the action of external and internal forces on the living body.

Magnus force: As a spinning ball moves through the air it creates a pressure difference between its two sides. The interaction between the air layer on the side of the ball that rotates in the opposite direction of the ball movement and the surrounding air creates a low-pressure area. This effect curves its trajectory.

Tommy John Surgery: A procedure that takes a tendon from the patient's forearm or hamstring and grafts it to the elbow to replace a torn ligament. Surgeons drill holes into the unla and humerous bones and subsequently weave the new tendon in a figure eight pattern through the holes.

Torque: The tendency of a force applied to an object to make it rotate around an axis. For a force applied at a single point, the magnitude of the torque is equal to the magnitude of the force multiplied by the distance from its point of application to an axis of rotation.

Ulnar collateral ligament: A thick triangular band of tissue at the medial aspect of the elbow connecting the ulna to the humerus.

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Show Me Science Advanced

Physics - The Science of Athletics

K4578DVD

***Advanced* Teachers Guide**

SYNOPSIS:

Athletes constantly rely on physics to excel in different ways. A baseball pitcher uses a windup to generate momentum when pitching to a batter. They vary their grip on the ball to change the rotation, resulting in pitch types such as a fastball, curve ball, or knuckleball. They take into account that a professional baseball is manufactured specifically by weight with several components. Two interlocking sections of cowhide are stitched together with raised seams which are designed to aid in how the ball travels when pitched and batted.

This program explains the forces behind a moving baseball, what happens when a pitcher throws a ball, what happens when a batter hits a pitch, and all of the interacting forces in between. Using a high speed camera and three dimensional tracking, scientists dissect pitchers deliveries and study their biomechanics to aid in pitching success and avoid injury. In the event of injury, they outline several courses for recovery and rehabilitation.

CURRICULUM UNITS:

- Anatomy
- Biology
- Engineering
- Health
- Physics
- Physiology

CAREER OPPORTUNITIES:

- Athletic trainer
- Biomechanics specialist
- Exercise physiologist
- Medical doctor
- Orthopedist
- Physical therapist
- Chiropractor

PROGRAM OVERVIEW:

A baseball pitcher generates a large amount of torque in their throwing arm during delivery and must work with three forces on each pitch – gravity, air drag, and the Magnus force. Baseball pitch velocities can reach over 100 miles per hour. Air drag is proportional to the square of the velocity. This means that a ball thrown with twice the velocity, encounters four times the drag force. Air itself can also affect the flight of the ball – temperature, barometric pressure, and humidity all affect air density – the denser the air, the harder it is for the ball to push through it.

At the American Sports Medicine Institute in Alabama, researchers use a camera and three dimensional tracking to study the biomechanics of pitchers. This system helps them pinpoint particular motions that might lead to injury if not addressed. This program shows detailed accounts of how the ball travels and reacts to different forces, how a batted ball is affected, and how it travels.

ISSUES & CRITICAL THINKING:

1. Conduct research regarding why a golf ball has dimples, a football is elongated, and why a baseball has seams. Have students describe how balls from different sports have evolved and why (A football was not as elongated in the first half of the 20th century).

2. Discuss injuries in sports such as concussions in football or UCL elbow tears in baseball. How are these injuries treated? Are they avoidable?

3. Think of your favorite sport. What risks for injuries are there for a player? Is there some specialized equipment that helps to minimize this risk?

Consider the design of sports shoes, a tennis racquet, a kayak paddle, a bike seat, and think about how knowledge of anatomy and body mechanics is needed in order to design such equipment. Students might sketch a piece of equipment that is ergonomically designed.