INTERNATIONAL
TENNIS HALL OF FAME

The Physics of Tennis

Lesson 1: Introduction to a system- the game of Tennis

Unit Overview: In this unit students continue to develop understanding of what can be at first glance a complicated system, the game of tennis.

Objectives:

Students will be able to-

- Understand what a system is using the game of tennis as an example.
- Identify the components of the game of tennis as a system.
- Identify boundaries of the system.
- Identify the types of energy used in this system. (restricted to potential & kinetic energy)
- Understand the introduction of inputs and outputs.

Lesson Time Required: One class period

Next Generation Science/Common Core Standards:

Standards:

NGSSHS-PS2-3: Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*

Disciplinary Core Ideas for NGSS ENGINEERING

ETS1.A: Defining and Delimiting Engineering Problems
The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)
ETS1.B: Developing Possible Solutions
A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)
There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)
Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3)
Models of all kinds are important for testing solutions. (MS-ETS1-4)

Possible Sources:

- *My First Tennis Tournament* by Nick Rudman

Materials Needed:

- *My First Tennis Tournament* by Nick Rudman (court diagram)'
- racquet photos
- tennis ball photos

Vocabulary:

- **Physical system-** portion of the physical universe chosen for analysis. Everything outside the system is known as the environment. The environment is ignored except for its effects on the system.
- **Environment-** is the remainder of the universe that lies outside the boundaries of the system. It is also known as the surroundings or neighborhood, and in thermodynamics, as the reservoir.
- **Open system-** a system where matter and energy can enter or leave, in contrast to a closed system where energy can enter or leave but matter can not
- **Closed system-** a physical system that does not allow certain types of transfers (such as transfer of mass) in or out of the system. The specification of what types of transfers are excluded varies in the closed systems of physics, chemistry or engineering.

Lesson & Activity

Focus Question: What are the components of the game of tennis as a system?

You will be asked to discuss in groups the following questions and then share your answers with the rest of the class.

1) Visualize two players engaged in the game of tennis. A system is a collection of components that are interdependent and interact in the game of tennis involving the concepts in Newton's Laws of motion and conservation of energy. What are the various components of that system?

2) Every system has boundaries. Generally, boundaries involve choosing which things are inside the system and which are outside—or part of the external environment. What are the boundaries of the game of tennis when played on a court?

3) What types of energy are used in the game of tennis? Be specific with examples.

4) If the tennis player supplies the energy to the game, then where does the player get the energy from?

5) There are two kinds of systems, closed and open. An open system is a system that has external interactions with its environment. A closed system contains limited energy available to keep the system operating. The game of tennis can be complicated to try to understand all the implications of what is going on. Think of external effects such as variations in air temperature during a game, etc. It is complicated. But, we can analyze this game to get a better understanding of the physics involved if we treat it as a closed system that includes the players, ball (s), racquets, court, and net.

6) What are the inputs and outputs in the game of tennis as a closed system in terms of energy?