Physics

Hockey Physics

Grade Level: 2-4

Classroom Time: 20 minutes

Materials:
Hockey Physics handout

Objectives:
Students will review the forces acting on hockey skates, sticks and pucks.

Instructions:
Have students read and discuss the Hockey Physics handout.

Watch a video on the Physics of Hockey: Projectile Motion at:
http://science360.gov/obj/video/a9995560-c0e7-4854-abed-fae3c35fb2e/science-nhl-hockey-projectile-motion

Ask students questions that help them to understand the forces involved in hockey.

Physics of Hockey. Real World Physics Problems. Retrieved from:

Physics of Hockey: Projectile Motion. [Video]. Science 360. Retrieved from:
http://science360.gov/obj/video/a9995560-c0e7-4854-abed-fae3c35fb2e/science-nhl-hockey-projectile-motion

Physics of Shooting. Physics of Hockey. Retrieved from:
https://sites.google.com/site/physicsofhockey1/spring-constants-for-hockey-sticks
Hockey Physics

A hockey player propels himself forward by pushing off the ice with a force perpendicular to the skate blade. The component of the force $F$ that points forward (in the direction of motion) is what pushes the player forward. To push off the ice with greater forward force (and accelerate faster), the skater increases the angle $\alpha$, which increases the component of force in the direction of motion.

The physics of hockey related to skating backwards is similar to that of skating forward. The player pushes against the ice with his push-skate facing inward, while his other skate glides. As he moves backwards he then switches to the other leg and pushes off the ice with that one, and the process is mirrored.

To maintain his balance when accelerating forward, a hockey player will crouch forward in the direction of motion. This prevents him from falling (tipping) backwards due to the torque caused by the forward component of the force $F$. 
The design of the hockey skate is another important factor related to the physics of hockey. A hollow is ground into the center of the ice skate blade, which creates two sharp edges which "bite" into the ice, and prevent slipping.

Hockey pucks are frozen prior to being used in a game. This reduces the level of friction the puck has with the ice and allows it to travel further on the ice, without "sticking". Freezing the puck is also done to intentionally reduce how much it bounces during play. This enables better control of puck movement.

One of the key features of a hockey stick that affects puck control is the curvature of the blade. When the puck is struck the curvature of the blade "forces" it towards the bottom of the curve, so that it will fly off the same part of the blade every time. Some players curve their blades closer to the end of the blade, which makes it a bit easier to scoop the puck away from another player.

Another feature of a hockey stick that affects puck control is the "loft" or "face" of the blade. This is the tilt angle of the blade, visible when looking at the stick from directly above. A greater tilt angle makes it easier for a player to lift up the puck and get it airborne.

A third feature, the angle of "lie", is the angle the blade makes with the shaft. This is represented by the angle $\theta$ in the figure. Players usually seek a lie angle that will put their blade flat on the ice while they are in their typical skating stance.

A wrist shot is a slower shot, where the player does not wind up but rather uses his wrists to snap the shot quickly; these shots are usually more accurate.

A slap shot is the hardest shot in hockey, where the player winds up before the shot. Players swing the blade so it hits the ice about one foot behind the puck. As the hockey stick slides across the ice, it can bend to almost a 30-degree angle. When the blade strikes the puck, it launches the puck at more than 100 miles an hour because of all the energy in the bent stick.