

Penguin Hockey (Aim is the Game)

Exhibit Content Focus:

This exhibit focuses on transformation of momentum after a collision. Basically, when the puck strikes a hard surface, the force with which they hit is transferred into the solid surface. The surface, in turn, pushes back against the puck causing it to move back away from the surface (with some loss of energy due to friction, sound, etc.). Newton's Third Law of Motion is at work (for every action, there is an equal and opposite reaction). The other point to note is the actual ricochet of the puck: when there are no other forces acting on the puck (ex. spin, gravity, angles surface), a collision results with the angle at which the puck strikes the surface equals the angle that the pucks ricochets from the surface. In technical terms, angle of incidence equals angle of reflection. Or, more simply, angle in equals angle out. This angle idea can help you have a more accurate aim when shooting for the center goal and trying to avoid icebergs.

Related Apps:

- **Name: Air Hockey**



- Description: This can be a one- or two-player game with the goal to hit the puck into the opponent's goal. There is very little friction at play and it is not affected by gravity. The first to score 7 wins. You can play with 1 or 2 pucks.
- Relation to Exhibit Content: Application of the idea that angle in equals angle out. Depending how you strike the puck will determine its motion. Because your paddle is round, there isn't one single flat surface to hit (rather, an infinite number of points where they strike), so the angle in=angle out is much more subtle and harder to predict (esp. if the puck is traveling quickly). But, when it hits the wall, the rule is very obvious.
- Helpful Hints: At the end of each game, ads will appear. At the bottom right corner of the screen is a bar with an "x" inside a box. Once a certain amount of time has elapsed, you will be able to click the "x" to go back to the game.

- **Name: Ball**



- Description: You can touch the "ball" to grab it, then swipe your finger to "throw" it and watch it bounce. This app does respond to gravity, so tilting the iPad will cause the ball to fall.
- Relation to Exhibit Content: This is a great way to demonstrate the idea of "angle in=angle out" provided no other forces act on it. You can also point out how the ball slows down after time, just like a puck on the table – it is a loss of momentum due to friction.
- Helpful Hints: Lay the iPad on a flat surface to demonstrate angle in=angle out. Then tilt it to show how outside forces (like gravity) can change that. You can demonstrate it on the table by giving the ball a "spin" when rolling it.

- **Name: Holes and Balls**



- Description: This is a one player game that is very similar to Penguin Hockey. You use your finger to pull back on a silver ball. A line of sight appears and shows the direction the ball will travel. The goal is to get the ball into the hole on the board. As you go through the levels, there are obstacles the ball must go around to get to the hole (just like the icebergs block the center goal on Penguin Hockey). Gravity does not affect the game, but there is friction which slows the ball down.

- Relation to Exhibit Content: Application of the idea that angle in equals angle out. You can have children predict if the ball will reach the hole by using the line of sight and using the knowledge about angle in=angle out.
- Helpful Hints: Watch how children pull back on the ball, sometimes they accidentally hit the Retry button at the bottom.

Additional Information/Resources:

<http://www.thirteen.org/edonline/afterschool/activities/math/bouncing.html>

<http://mathworld.wolfram.com/Billiards.html>

<http://www.physicsclassroom.com/class/newtlaws/u2l4a.cfm>

<http://library.thinkquest.org/TQ0013321/thescience.html>

Challenges

Try to set up Challenges for the visitors on the table after talking about each app and concept.

Examples:

- Try to hit the center post with the puck after one bounce.
- Try to hit the center post with the puck after multiple bounces.