AQUATIC INVADER INVESTIGATOR

Physics oph Phlying Phish

Name _____ Date _____

LEARNING OBJECTIVES

Just how dangerous are those flying carp? In this exercise, you will learn about the invasive Asian carp and then apply your knowledge of principles of physics (Motion and Stability: Forces and Interactions) to calculate the speed and potential impact of an Asian carp when it jumps from the water. If you were a passenger in the boat, would you want to duck?

BACKGROUND

While most Asian carp reach about 10-30 pounds in weight, the grass carp and black carp can grow in excess of 150 pounds! They are able to jump barriers such as low dams, and have been known to jump into boats and hit fishermen when disturbed by boat engines. The four different Asian carp species were initially introduced into the United States in the 1970s to help control weed and parasite growth in aquatic farms. Once fish escaped into the natural systems, they successfully outcompeted native species for food and space, reduced water quality by uprooting vegetation, and have caused the loss of native species. They lay hundreds of thousands of eggs at a time and easily spread into new habitats, affecting fisheries in more than 31 states. (See Species Guide for more specifics on Asian carp.)

Fishing provides both enjoyable recreation and an excellent opportunity to sit back and explore physics. Whether dropping bait into the water or watching fish jump up, one can better understand what is happening and how by applying Newton's laws of motion. The incredible acrobatic movements of invasive carp are easily documented by video when the fish are disturbed by boat engines. Watch the video, "Thousands of fish leap out of the water at the same time—Slo-mo!" (http://www.youtube.com/watch?v=tLmJjRqXDCo), to see this aerobatic phenomenon.

PROCEDURE

Using your knowledge of physics, along with the resources and assumptions at the end of this worksheet, answer the following questions.

Part A. Dropping Bait

The fishing boat Arcadia has a railing 8 feet above the water. An angler drops a piece of bait over the railing into the water on a slack line.

A1. How much time will elapse before the bait strikes the water?

A2. How fast is the bait moving when it strikes the water?

Part B. Jumping Fish

The fishing boat Arcadia has a railing 8 feet above the water. A carp jumps straight up from the water, flops over the railing and onto the deck.

B1. How long does the carp take to reach the railing?

B2. How fast is the carp moving when it leaves the water?

Part C. Leaping Fish

The fishing boat Arcadia has a railing 8 feet above the water. A carp leaps out of the water at a 45 degree angle from the water's surface, and just clears the railing before landing on the deck. Although the fish appears to "fly," you may neglect the force of the air on the carp because it is very streamlined—its fins are made to move it in dense water, not thin air!

C1. What factors influence the "flight" of the fish?

C2. How long does the carp take to reach the railing?

C3. How fast is the carp moving when it reaches the railing?

RESOURCES

- ***Problem Solving Exercises in Physics: Conceptual Physics***, by Jennifer Bond Hickman (2002). Available at http://assets.pearsonschool.com/asset_mgr/current/20126/problem-solving-exercises-conceptual-physics.pdf
- Newton's first law of motion (law of inertia), an object in motion in a horizontal direction would continue its horizontal motion with the same horizontal speed and direction unless acted upon by an unbalanced horizontal force.
- When projection angle and other factors are constant, projection speed determines length of trajectory (range).
- h = height, g = gravity, t = time, v = velocity

  $h = 1/2gt^2$ $\quad 1/2v^2 = gh$ $\quad g = 9.8\ \text{m/s}^2$