

Asian Carps

Use the case study, lesson plans, learning activities, assessment questions, and the Aquatic Invader Investigator pages to enhance student understanding of Asian carps and connect these organisms to the community. Assign assessment questions as a homework assignment, or use the questions for classroom discussions or final evaluation.

LEARNING ACTIVITIES

Physics oph Phlying Phish

CASE STUDY

High-flying carp pose a threat to fishermen.
www.post-gazette.com/pg/06312/736638-358.stm

LESSON PLANS

- Going with the Flow*
- Invasion Pathways to the Columbia Gorge

LEARNING ACTIVITIES

Physics oph Phlying Phish

Created by Phil Siemens

This exercise is appropriate for students who have studied or are studying ballistics (the free motion of an object in a gravitational field). For a relatively easy exercise, with emphasis on discussion and simple computations, complete Parts A through C in order.

For a more challenging exercise or for proficient students, begin with Part B or Part C. The discussion may uncover alternate methods. For example, students may begin as described in Part A and use reasoning by symmetry instead of solving a more difficult algebraic equation arising from more complicated initial conditions.

**This lesson does not appear in this prototype, but you may obtain a draft of it by contacting Tania.Siemens@oregonstate.edu.*

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? ($gt^2/2 = 8$ feet, $g = 32$ feet/sec², $t = \sqrt{2/2}$ sec, about 0.7 sec)

A2. How fast is the bait moving when it strikes the water? ($gt = 16\sqrt{2}$ feet/sec, about 15 mph or the speed of a fast runner)

Part B. Jumping Physh

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

B1. How much time will elapse before the bass reaches the railing? (same answer as part A—time reversal invariance)

B2. How fast is the bass moving when it leaves the water? (use reasoning as in part B1 – time reversal invariance) **Can you run this fast?** (probably not for long; that's a 100-yard dash in 13 seconds, or a 4-minute mile!)

Part C. Phlying Physh

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 need to neglect the force of the air on the carp because the carp is streamlined—its fins are designed to move the carp in dense water, not thin air!

C1. How much time will elapse before the carp reaches the railing? (same as B1—horizontal and vertical motion components are independent)

C2. How fast is the carp moving when it reaches the railing? (same as B2—horizontal and vertical

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velocity components initially equal, horizontal remains unchanged as vertical vanishes at top of trajectory) **How would it feel to be struck by a jumping carp?** (ouch!)

ASSESSMENT QUESTIONS AND ANSWERS

- 1 What family do Asian carps belong to?**
Cyprinidae.
- 2 Describe the type of habitat that Asian carps prefer.** They prefer calm, slow-moving waters, such as lakes and backwaters of large rivers.
- 3 Do Asian carps care for their young?** No.
- 4 What conditions are necessary for Asian carps to reproduce?** Large riverine systems are needed for reproduction. Flooding, warmer water, and turbulence stimulate reproduction. Semi-buoyant carp eggs are carried downstream; flood plains are nursery habitat for larvae and juveniles.
- 5 Why were Asian carps introduced?** They were introduced for use in aquaculture ponds. Black carp were initially introduced accidentally as a contaminant.
- 6 Why have Asian carps been so successful in the Mississippi Basin?** The basin offers ideal conditions for reproduction and growth: large stretches of river, annual flooding, and plenty of plankton.
- 7. What physical feature distinguishes a grass carp from a black carp?** Pharyngeal teeth. **How is this feature different in each fish?** The grass carp's pharyngeal teeth are long and serrated, adapted to eating aquatic vegetation. The black carp's teeth are smooth rather than serrated, adapted to crushing mollusk shells.
- 8 Two riverine habitats are joined by an estuary (for example, San Francisco Bay). Asian carps invade one river. Is the other river at risk of invasion? Why or why not?** Yes, because Asian carps, except black carp, tolerate low levels of salinity.
- 9 How do bighead and silver carp use their pharyngeal teeth?** The fish use the pharyngeal teeth to masticate their food to break the cells, since they do not have the digestive fluids necessary to break down the cells and get at the contents.
- 10 What physical features distinguish a silver carp from a bighead carp?** The gill rakers and the ventral keel are distinguishing features. **How is this feature different in each fish?** In the silver carp, the ventral keel extends forward all the way to the anterior part of the breast, and its gill rakers fuse together, forming a sponge-like appearance, adapted for eating plankton. Big-head carp have long, close-set gill rakers, and the ventral keel extends forward to the base of the pelvic fins.
- 11 List three ways we have benefited from Asian carps. Give an economic, a social, and an ecological benefit.** The benefits have been many: various uses in aquaculture facilities, ornamental aquarium fish trade, and as a food, for example.
- 12 List three ways in which we have been negatively impacted by Asian carps. Give an economic, a social, and an ecological impact.** The sound of an outboard motor often causes the silver carp to leap out of the water and collide with boaters, causing serious property damage and human injury.
- 13 Do you think the commercial harvest of Asian carps would be a good method for controlling Asian carps and reducing their ecological impact? Why or why not?** The situation in China is a good example. In China, Asian carps are scarce due to heavy fishing pressure. Models show that commercial harvest of Asian carps can reduce their numbers and re-open habitat for native

species. However, native fish may be harmed as bycatch, and profits from the sale of Asian carps may lead to their purposeful introduction to new areas.

- 14 Bighead and silver carp may consume large amounts of blue-green algae. How may this behavior affect the use of Asian carps as a food fish?** Bighead and silver carp are practically immune to the algal toxins. However, if you grind the fish guts, there is a substantial possibility the ground slurry will contain algal toxin, which could be lethal for zoo animals.
- 15 Do you think Asian carps would be able to survive and reproduce in a river near your home? Why or why not?** Students should relate what they know about a local river to Asian carps' reproduction requirements. Duane Chapman of USGS notes, "habitat requirements are debatable, and . . . some theorize that under the right conditions, as little as 28 km of river would be enough to provide recruitment. The Kara- Kum canal has 80 km (with some fairly dead spots in it) and has reproduction most years. This is the shortest river I know of where fish are established and continue to recruit."
- 16 List some ways in which Asian carps could be accidentally introduced into your local river.** They could be accidentally introduced by anglers travelling from the Mississippi who use juvenile Asian carps as bait fish. Adult Asian carps brought to the west coast for the live fish-food trade could be accidentally or purposefully introduced.
- 17 What are some things you can do to help prevent Asian carps from being introduced to the west coast?** Organize an educational campaign in your school and informally educate others about how not to spread Asian carps. If you are a fisherman, inspect, clean, and dry all parts of your gear before entering a new body of water.

- 18 Cost benefit/risk analysis: You are the manager of a local pond valued for the wildlife diversity it supports. Unfortunately, your pond has recently been invaded by the aquatic plants elodea and parrot feather. The plants are causing huge problems: people can't swim or boat anymore, and the plants are taking up all the oxygen in the water and killing native species. Your supervisor suggests you stock the lake with grass carp to control the vegetation. What are some potential benefits of stocking grass carp?** Carp will eat the vegetation and sterile triploid fish are available. **What are some of the risks or drawbacks of stocking grass carp?** Have students list some negative ecological impacts of grass carp. What would you do, and why?



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WHAT DO YOU KNOW?

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- 5 Why were Asian carps introduced?
- 6 Why have Asian carps been so successful in the Mississippi basin?
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- 8 Two riverine habitats are joined by an estuary (for example, San Francisco Bay). Asian carps invade one river. Is the other river at risk of invasion? Why or why not?
- 9 How do bighead and silver carp use their pharyngeal teeth?
- 10 What physical features distinguish a silver carp from a bighead carp? How is this feature different in each fish?
- 11 List three ways in which we have benefited from Asian carps. Give an economic, a social, and an ecological benefit.
- 12 List three ways in which we have been negatively impacted by Asian carps. Give an economic, a social, and an ecological impact.
- 13 Do you think the commercial harvest of Asian carps would be a good method for controlling Asian carps and reducing their ecological impact?
- 14 Bighead and silver carp may consume large amounts of blue-green algae. How may this affect the use of Asian carps as a food fish?
- 15 Do you think Asian carps would be able to survive and reproduce in a river near your home? Why or why not?
- 16 List some ways in which Asian carps could be accidentally introduced into your local river.
- 17 What are some things you can do to help prevent Asian carps from being introduced to the west coast?
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B1. How much time will elapse before the bass reaches the railing?

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C1. How much time will elapse before the carp reaches the railing?

C2. How fast is the carp moving when it reaches the railing?

How would it feel to be struck by a jumping carp?