Float your boat: Transporting Agriculture

With food, you need to move it or lose it. What are the choices? What role does transportation play in agriculture?

Moving cargo requires a combination of engineering and ingenuity. Try your hand at moving a small amount of cargo a short distance. Consider the challenges of moving huge amounts of grain and soybeans to other parts of the world.

Do • • •

1. Gather these materials: scissors, tape, glue, 1/2 cup of beans, copy of the Float Your Boat Observation Log, tub or plastic baby pool filled with water and a variety of “boat-making” supplies such as paper, aluminum foil, plastic wrap, toothpicks, cardboard, straws, clay, rubber bands, balloons, etc.

2. Think about the challenge: Design a boat that can safely transport 1/2 cup of beans across the pool of water.

3. Use the Observation Log. Ask questions and imagine some solutions.

4. Draw a diagram of your best idea. Label the different materials you plan to use.

5. Create your prototype.

6. Add the beans and put the prototype into the water. A successful prototype floats without spilling the beans.

7. If successful, add additional beans to increase the challenge.

8. Improve your design. Can you produce a better boat to transport the beans?
Share • • •
Was your design successful? Describe what happened when you put your boat into the water.

Reflect • • •
Go back to the drawing board! What could you do to improve your design?

Generalize • • •
Consider other challenges that farmers face when transporting farm products: freshness, cleanliness, safety and economics. What are the issues when moving grain a short distance? What are the issues when moving grain to the other side of the planet?

Apply • • •
Look around at the transportation system in your state or city. How are goods moved? What are some of the transportation challenges farmers face in your state?
More Challenges

- Design an engineering challenge to share for a boat to carry a much larger amount of beans. What constraints will you establish? How will you set it up?
- Study the physics of displacement and buoyancy to understand how tons of soybeans are transported in ships across the ocean.
- Consider the physics challenges for transporting agriculture in liquid form such as milk. Explain the Laws of Motion that will impact the safety of a truck driver who is driving a tank that is half full.

Efficiencies of Water Transport

Water transport consumes much less energy per ton-mile of freight than either rail or truck transport.

- A semi carries one ton of cargo 59 miles per gallon of fuel.
- A train carries one ton of cargo 202 miles per gallon of fuel.
- An inland barge carries one ton of cargo 514 miles per gallon of fuel.

Source: U.S. Environmental Protection Agency.

Glossary

buoyancy—the ability of an object to float because of the greater density of the water

displacement—occurs when an object is immersed in water, pushing it out of the way and taking its place; an object displaces an amount of fluid equal to the object’s volume.
Truck  Agriculture is the largest user of freight transportation in the U.S., claiming 31 percent of all ton-miles transported in 2007. Trucks are the most effective method of moving goods short distances and for assembling quantities of products at elevators and warehouses for trans-loading to other modes of transportation. Trucks can provide efficient, special handling and refrigerated services needed to get perishable products where they need to go. However, record-high fuel, equipment and maintenance costs, combined with more stringent state and federal regulations, are major reasons why there are fewer trucking companies today than just three years ago.

Rail  More grain is heading west. The dominant route for Midwest grain is by rail to ports in the Pacific Northwest for export to Asia. Export facilities in Tacoma, Washington are several days closer by water to Asia than taking grain down the Mississippi River to the Gulf of Mexico and then on to Asia. Geographically, that offers a huge cost advantage, especially with today’s energy prices. Grain moves quickly by rail. It takes just 10 to 15 hours to fill a 110-car shuttle train with grain (roughly 440,000 bushels) and just three to five days for a trainload to trundle from western Minnesota or North Dakota to the West Coast. The round-trip cycle time is about 10 days, half the time the same journey took a decade ago.

Barge  Shipping freight via barge is an extremely efficient mode of transport. Yet it demands precision, whether piloting a 45-barge tow through the winding Mississippi river and its tributaries, or for those on shore, keeping the grain supply flowing efficiently from farm to river. Storage capacity, infrastructure improvements, and rail and truck access at the facilities on the water are also very important. Major renovations at a CHS terminal at Memphis improved safety and nearly doubled handling efficiency by moving conveyor equipment from the dock where barges are emptied to the point where trucks are loaded.
Observation Log

Create a boat to carry 1/2 cup of beans a short distance.

**Design Brief**

1. **Ask:** What is the need? What is the problem? How can I get this boat to carry beans without sinking? How can I get it to move across the water without touching it?

2. **Imagine:** What could be some solutions? What materials do I need? How can I make something that can help the boat move?

3. **Plan:** Will the boat be pushed or pulled?

4. **Create:** Build a prototype. Test your design.

5. **Improve:** How could you improve your design?