Get Rid of the Waste: Lose Weight & Save Money!

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Subject/Grade: Gr. 2 social studies/science

Background
Taconite is low grade iron ore. Years ago, it was considered waste. Today, taconite is refined through a special procedure at a processing facility usually located at the ore mine. Taconite is useful to the iron ore buyer and cheaper to ship, if unwanted components are removed. The cost of most natural resources shipped via the Great Lakes is determined according to the weight of the product. Simplified, that is one reason taconite is “refined” before shipping. Processing the taconite to remove impurities and unwanted materials upgrades the value of this previously wasted material. Reshaping the taconite into spherical pellets makes shipping and balancing the load easier as well. This process of refining low grade ore has given us a way to revitalize mined areas that were once considered ruined geographical terrain.

Student introduction
Have students examine the pennies that they used in the loading process during Activity #1. Identify the metal that a penny is made from. Remind them that like iron ore, copper is mined. When first removed from the ground during the mining process, copper may be mixed with other natural elements that are not used to make the penny. Any material other than the copper that is needed to make the penny must be removed. Tell them that the same is true of taconite. Taconite is refined, to separate the useable iron ore. (You may want to have an unopened roll of pennies available. Acknowledge that the pennies form a cylinder when stacked against one another side by side because they are same size. Open one side of the roll to reveal this.) Much like pennies are identical in size and shape, taconite is shaped into identical spherical pellets for shipping. Their size and shape makes them easier to load.

Materials
Photos of 1000-footers loading taconite
Big Fitz book
Three transparent containers or large measuring cups of identical size, weight, and shape.
1 container should be (at a minimum) a 4 C. measuring cup.
2 containers should be (at a minimum) 2 C. measuring cups.
1 large sieve or screen frame (A small framed window screen is perfect)
Fine-grain sand (approx. one pound)
50-100 small glass marbles
Student record/worksheet
Examples of actual taconite pellets
Balance to weigh
Flexible ship model to demonstrate improper loading

Procedure
Today we will pretend that we are “refining” a natural resource for purposes of shipping. We are doing this because the cost of shipping is determined by how much the cargo weighs. The buyer does not want waste material. The buyer probably cannot take the waste material out of the taconite. We must do that at our mine, or we will not have a product that anyone wants to buy. We will separate or extract the useful portion of our
resource before shipping, because that is the portion the buyer wants. At a taconite mine, the ore is separated from waste material by using a magnetic process. Today, we will use sand and glass marbles. The sand will represent the unwanted material that is not iron ore. The marbles will represent the taconite pellets. Once refined, taconite pellets are closer to pure ore. The taconite has also been reformed into spherical shapes that lend themselves to easier leveling for loading and shipping purposes.

Begin with container (A). It is loaded with a mixture of sand and marbles. The marbles are taconite. The sand is “garbage” or waste material that we do not want to ship, because it will make our load heavier and cost more to ship. (Remind students that at a real taconite mine, the pellet shape is not achieved until going through a special tumbler.) Weigh the contents of container (A) and record it before proceeding.

Pour the contents of container (A) through a large sieve or screen that is held over container (B). Sand will fall into container (B). This is the garbage or waste material that will not be shipped. Weigh the contents of container (B) and record it before proceeding. Note that removing this unnecessary weight will allow us to save money.

Pour the contents that remained in the sieve (all the marbles, and possibly some residual sand) into container (C). This container holds the refined taconite pellets, which have been shaped into pellets and will be the cargo that we ship. Weigh the contents of container (C). Record your findings. Compare the difference in weight. How much “unnecessary” shipping weight have you removed?

Assessment
Assessment is based on participation, conversational observations, and an ability to express an understanding that the marbles represent “refined ore” and the sand is the “garbage” that has been removed. A student with a high level of understanding will express an awareness that both items are weighted. However, the shipper is only paying for the shipment of the “pure” ore, not the waste product. Students should be able to identify the combined weight value before sifting, the individual weight value of the two separated materials (marbles vs. sand), and ultimately, the difference between the combined weight value and the weight of the sand. Students should be able to explain that shipping the “refined” taconite pellets (marbles) will be less expensive than the combined weight. They should also realize that the refined substance has more value to the buyer.

Extensions
- Research and identify other natural resources shipped on the Great Lakes that undergo some type of refinement before shipping.
- Use magnetic shavings mixed with dry table salt. This becomes your experimental “taconite.” Extract the useable ore from the taconite with a magnet. Your waste product, the salt, will not adhere to the magnet. The salt is now the unnecessary weight value. Using a magnetic component for this experiment is a more realistic reminder to students that magnetism is actually a technique used in extracting the ore.
Student Log Sheet

Get Rid of the Waste

1. Weigh the container that holds your “unrefined” material (marbles and sand combination): __________ (oz.)

2. Pour the entire contents over the screen/ or through the sift and into a second container. The contents of the second container will be comprised only of sand. Weigh the container, and record your findings: ________________(oz.)

3. Remaining on top of the screen are the marbles. Pour all into the third container. Weigh the container of marbles ______________(oz.)

Weight of combined marbles and sand was: _______________
   (minus) (-) ________________ (weight of extracted sand)
   (equals) (=) ________________ (weight of your refined resource, or “taconite pellets“)

This new number represents your new shipping weight. How much less is the new shipping weight of the refined product?

Weight of combined materials: __________________________
   (minus) (-) __________________________ (weight of refined resource)
   (equals) (=) __________________________ (weight of extracted sand, or waste material That has no value to the customer, and adds unnecessarily to the shipping weight.)
**Vocabulary**

**Hogging:** This occurs when the majority of a vessel's load has shifted to the middle of the hull. It causes the center of the hull to rest lower in the water, while the bow and stern are higher. You could use a banana to visually illustrate this. Hold the banana horizontally, with the two ends pointing up.

**Listing:** This occurs when the vessel's load shifts unevenly to one side more than the other. The boat tips to that side, causing the entire vessel to be off center. Tipping too far, will cause the entire vessel to fall to one side and sink.

**Taconite:** Low grade iron ore, once considered a waster material. After refinement, the resulting taconite pellets have renewed value to industrial consumers.

**Schooner:** A wooden hulled ship that is powered by wind. Such vessels populated the Great Lakes throughout the 1800’s. In the late 1800’s steam powered vessels began to replace them. Steel hulled vessels were replacing wooden hulled vessels in the early 1900’s

**Steamer:** A wooden or steel hulled vessel that is powered by steam. The steam is created by burning coal. (Example: The Badger Car ferry that sails between Ludington, Michigan and Manitowoc, Wisconsin.

**Resources**


*Great Lakes Marine Transportation System* by Richard D. Steward, Ph.D., Co-Directory Great Lakes Maritime Research Institute.