Water Tanks

The Movie:

Almost every building in New York City is topped by a water tank. Featured: Wallace Rosenwach, owner, Rosenwach Tank Company. *(Movie length: 3:08)*

Background:

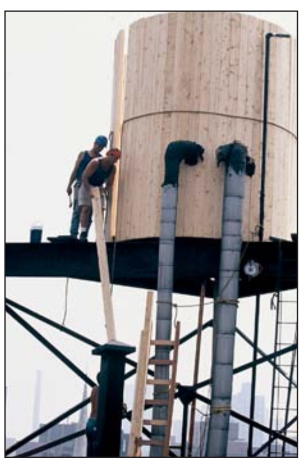
There are few cities in the U.S. with the number of tall buildings that New York City has, and also few cities with a water system as old. That combination means that the water pressure in the city is only strong enough to carry water up about 6 floors into apartment buildings. As a matter of fire prevention, taller buildings are required to have two sources of water, and one of those is usually a tank on the roof.

Surprisingly, those tanks are mostly made of wood, not just because it is cheaper that way but because wood is a better material for the purpose. Wooden tanks can be transported in pieces and assembled in one day, and they provide more than adequate insulation against New York City's cold winters and hot summers.

Curriculum Connections:

Arithmetic — 1

A water tank can cost around $25,000 to build, and there are more than 10,000 of them in New York City. What is the least it would cost to replace all of the water tanks in the city?



Fractions — 2

Suppose that in one section of New York City, out of 125 buildings, 45 have water towers on top. In another section, 35 out of 110 buildings have water towers. In which section is the fraction of buildings with water towers greater?

Geometry (cylinders) — 3

A water tank is 12 feet high and has a diameter of 18 feet. If it is made from wood planks that are each 8 inches wide and 12 feet high, how many planks are used?

Percents, Geometry (cylinders) — 4

It is important that the water in water tanks doesn't freeze, because frozen water takes up 4% more space than liquid water. Suppose you have a tank that is 10 feet high and 15 feet in diameter, full of water. If the water expands outward, rather than upward, when it freezes, how far outward would it need to expand to have 104% of its original volume?

Geometry (cylinders) 5

If a cylindrical water tank is 15 feet tall and 20 feet in diameter, how many cubic feet of water can it hold?

How many gallons can it hold (there are 7.48 gallons in a cubic foot)?

How much does that water weigh (one gallon of water weighs 8.33 pounds)?

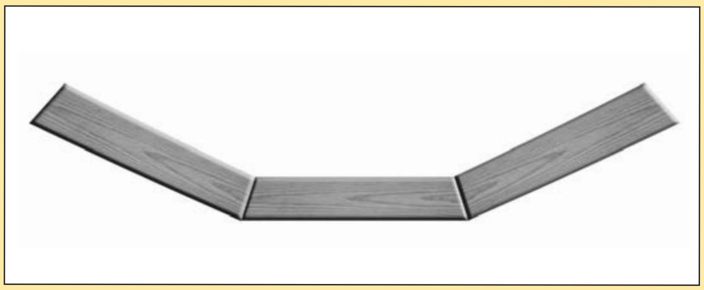
If that water is supposed to run the fire sprinklers in the building for 20 minutes, how many gallons of water per minute would flow through the sprinkler system?

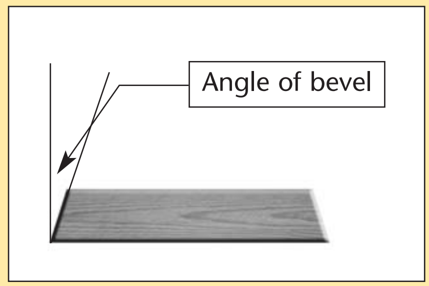
Ratios 6

One inch of cedar provides as much insulation (keeping heat out or in) as 11 inches of concrete. The planks used in building water towers are 2½ inches thick. How much concrete would be required to supply the same amount of insulation?

Geometry (circles, angles) 7

The planks that are used to build water towers must be beveled slightly so that they will fit together tightly (see diagram). For a water tower of 25 feet in diameter, with planks that are 6 inches wide, what is the angle of the bevel required?





Measurement (rate) 8

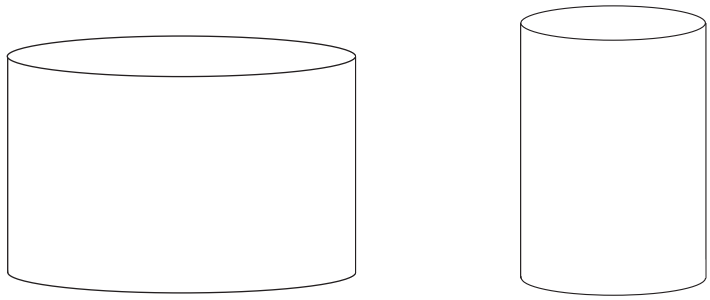
If a pump can pump water into a tank at the rate of 25 gallons per minute, how long would it take to fill a water tank which is 12 feet high and 18 feet in diameter?

Geometry (cones) 9

New York City water tanks often have cone-shaped roofs. If the height of such a roof is 6 feet, and its diameter is 22 feet, what is its surface area?

Water Tanks

Water tanks aren't all the same size. Some are taller than others, and some have bigger diameters than others.



If one tank is twice as tall as another one, how much more water can it hold? If one tank has twice the diameter of another one, how much more water can it hold?

Your teacher will give you several containers. Three of the containers (#1, #2, and #3) will have the same diameter, but different heights. Three of the containers (A, B, and C) will have the same height, but different diameters.

Start with containers #1, #2, and #3. Measure the diameter and height of each can, and the amount of water it can hold. Make a table showing your data. Is there a pattern?

Then use containers A, B, and C. Measure the diameter and height of each can, and the amount of water it can hold. Make another table. Is there a pattern?

Answer these questions:

If one tank has the same diameter as another tank, but is twice as tall, it will hold ___ times as much water. Why do you think so?

____

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If one tank has the same height as another tank, but has twice the diameter, it will hold ___ times as much water. Why do you think so?

____

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Teaching Guidelines: Water Tanks
Math Topics: Geometry (cylinders)

You will need 6 cylindrical containers for each team. Three of the containers (to be labeled “#1”, “#2”, and “#3”), should have the same diameter. The height of container #2 should be twice the value of the height of #1, and the other should be three times the height of #1. (Ideally the heights would be 2", 4" and 6")

As an alternative, you can use plastic glasses, but they must be truly cylindrical in shape, with the diameter at the top equal to the diameter at the bottom. Simply mark off the three heights (for example, at the 2", 4" and 6" level) on three different glasses.

The other three containers, labeled “A”, “B”, and “C”, should all be of the same height. The diameter of container B should be twice that of container A, and the diameter of container C should be three times that of container A. Ideally the diameters would be 2", 4", and 6". If you have containers with correct diameters but unequal heights, you can mark off a common height (say, 2") on all of the containers and have students fill to that mark.

Distribute the handout and read through the first three paragraphs with the class. Get some responses to the questions in paragraph three, and then tell students they are going to investigate what really happens.

Distribute the containers to each team, along with a measuring instrument which measures volume in milliliters or cubic centimeters, and a (plastic) pitcher of water.

Students should observe that as the height of a container is doubled, so is its volume, and as the height is tripled, so is its volume.

But as the diameter is doubled, the volume will be multiplied by a factor of 4, and when the diameter is tripled, the volume will be multiplied by a factor of 9. In discussion of this point, ask students to explain why they think this might be true, and lead them to the realization that as the diameter increases, the area of the circular base increases much more rapidly, and it is the area of the base that, along with the height, determines the volume of the container.

If you enjoyed this Futures Channel Movie, you will probably also like these:

Tunnel Number 3, #5002	Go deep underground with an engineer as she works to ensure a continuous water supply for millions of people.
Water Supply, #5001	The water that comes out of your tap has traveled a long way to get there.
The New York City Subway, #5005	The New York City subway moves millions of people every day, thanks to the skills of a team of remarkable people.