Aqueduct (Aquaducky) Engineering

The Problem: The herdsman who discovered Romulus and Remus has a problem. Remus is sad. His rubber duck was left behind in Rome. The fastest way to get the duck would be to float it through the Roman aqueducts to Remus. Can you help?

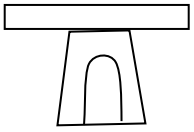
The Solution: As a civil engineer during the Roman times, you are being asked to build an aqueduct. The aqueduct must carry enough water to float the duck to Remus.
But what does an engineer do?
Engineers do many different things, but the basic elements of the engineering:

- brainstorming
- planning
- creating
- modifying
- team problem solving

Build an Aqueduct (Arcade) Model

1. Gather 4 cups, some poster board, aluminum foil, scissors, and tape.
2. Measure the width of one of the cups at the brim. Write down this number. (Example: 3 1/2 inches)
3. Carefully cut an arch on both sides of each cup starting at the brim. Allow for at least 1 inch uncut at the bottom of the cup.

4. Place the “arched, cut-out” cups (rim on the bottom) next to each other in a row.
5. Cut a strip of poster board for the water channel. The dimensions should be the width of the cup by the length of the four cups, plus three inches. (Example: If the cup is 3 1/2” at the brim, the length should be 14” plus 3” or 17 inches long by 6 1/2 inches wide.)
6. Tear off a piece of aluminum foil that is at least 2 inches larger than the poster board for the water channel. **Option 1:** Glue the aluminum foil to the poster board strip. Fold 1.5” of the poster board on each edge at 90 degrees so that it forms a wall on each edge to hold the water and looks like a trench. **Option 2:** Curve the aluminum foil over the channel so the channel is waterproof.



7. Secure the bottoms of the 4 cups to the channel with pieces of tape.
8. Don’t be too worried about the exactness, it still should work.

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Group Names_____

Rubric for Aqueduct (Aquaducky) Engineering

Points	1	2	3	4	Score
Requirement	**Beginning**	**Developing**	**Applying**	**Innovative**	
Knowledge of concepts	Does not understand how an aqueduct works	Understands some of how an aqueduct works	Able to explain how an aqueduct works and can design one on paper	Able to take and make improvements to an aqueduct design	
Design of Aqueduct	Design does not work.	Design is adequate	Design is good	Design is advanced	
Construction of an Aqueduct	Structure collapses	Structure is weak	Structure is stable	Structure is solid with use of minimal materials	
Function of Aqueduct	Does not work	Works with little spillage	Works with no spillage	Works with no spillage and moves water at a fast rate	
				TOTAL:	
Teacher comments					

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Group Work Score Sheet for Aquaducky

NAME_____ Period_____

Participation in my group:

I give myself a score of: _____/10

Reasons:

_____

_____

I give my teammate: _____/10 teammates name:_____

Reasons:

_____

_____

I give my teammate: _____/10 teammates name:_____

Reasons:

_____

_____

I give my teammate: _____/10 teammates name:_____

Reasons:

_____

_____

I give my teammate: _____/10 teammates name:_____

Reasons:

_____

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Aqueduct Essay Scoring Guide

NAME_____Period____

Requirement	Points	Self	Teacher
All parts of the aqueduct are explained-- Covered trench Pressurized pipe Wall Arcade Tunnel	5		
How an aqueduct works-- Friction Gravity	2		
Grammar--Less than 3 errors	1		
Voice--proper voice is used	1		
Format--essay	1		
TOTAL points	10		
TOTAL Score x 10	100		

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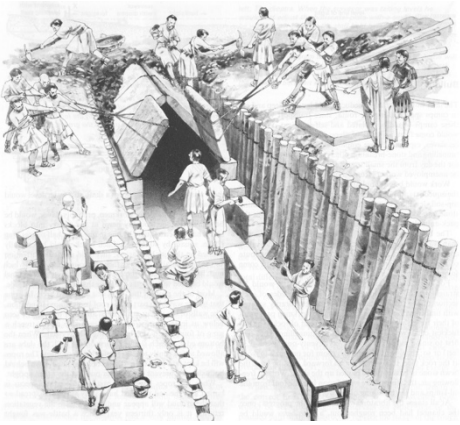
Vocabulary

http://www.romanaqueducts.info/24panels/mainelements.htm

Parts of an Aqueduct
Here are different elements a water engineer can choose to build at any point along an aqueduct:



covered trench--a long cut in the ground, a ditch
Roughly four of every five miles of Rome's aqueducts run underground, many in covered trenches. Trenches are used when the aqueduct follows the contours of the land. They are quick and easy to build for they require neither the construction of arches nor the digging of tunnels. The Romans built trenches underground to hide and protect water from enemies. They also built underground trenches because they protected the aqueduct system from the stresses of wind and erosion. Covered trenches are also less disruptive to life on the surface of the land than are walls and arcades, which divide neighborhoods and farmers' fields.

tunnel--an underground passage Sometimes, aqueduct engineers would carve a tunnel through a mountain rather than build a trench around one. When not too deep, shafts are dug down vertically from above to intersect with the proposed path of the tunnel.

By using shafts, more than one crew could work on a tunnel at a time. The shaft also served another purpose: Once the tunnel was finished, slaves could crawl down stone steps to clean the tunnel. They could fill buckets with silt or calcium deposits left behind from hard water and then haul the buckets out.

http://www.romanaqueducts.info/24panels/mainelements.htl

pressurized pipe--a tube used to conduct liquid When faced with a deep valley, Roman engineers could use pressurized pipes. With the use of siphons, water travels down one side of the valley in pipes. Water pressure forces water up the other side. Water exits the pipes at nearly the same height as it entered. The pipes are usually built of lead so the material can handle strong water pressure.

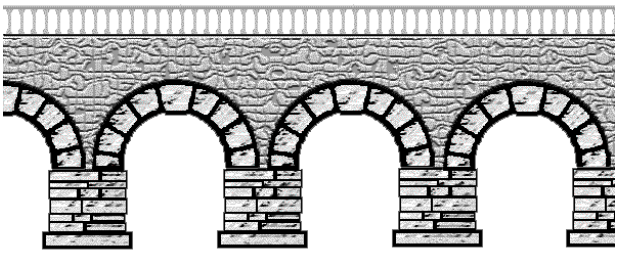
http://www.romanaqueducts.info/picturedictionary/pd_onderwerpen/pipe.htm

wall--a structure of stonework, cement, or other materials built to retain a flow of water When aqueduct engineers had to cross shallow depressions in the land, they could build the aqueduct on a wall. Simple to construct, walls were easier to build than arcades. However, when engineers needed to raise the aqueduct's channel more than five feet above the ground, they should resort to arcades, which allow people and water to move freely beneath them.

http://www.englishheritage.org.uk/daysout/properties/planetrees-roman-wall-hadrians-wall/

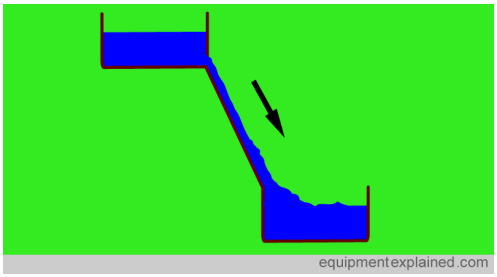
arcade--a series of arches supported by columns In a valley, water engineers used arcades. The water moved through the aqueduct by gravity.

http://www.historyforkids.org/learn/romans/architecture/aqueducts.htm



http://www.witiger.com/centennialcollege/GNED117/outline117a.htm

gravity—force by which bodies fall to earth



http://www.equipmentexplained.com/images/physics_images/electricity_images/basic_images/garden_waterfall_flow.gif

Source of information: http://www.pbs.org/wgbh/nova/lostempires/roman/manual.html

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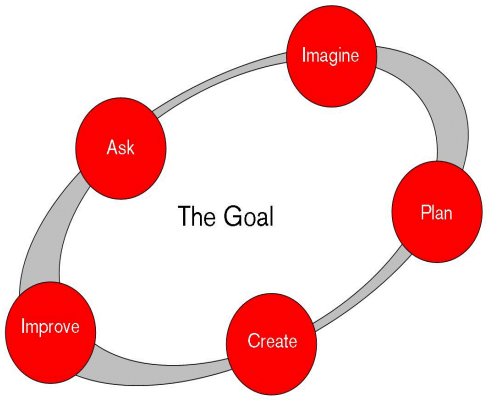
Names_____

Engineering Design Process Model



Identify how the Engineering Design Model applies to your group building the aqueduct.

Ask:

Imagine:

Plan:

Create:

Improve: