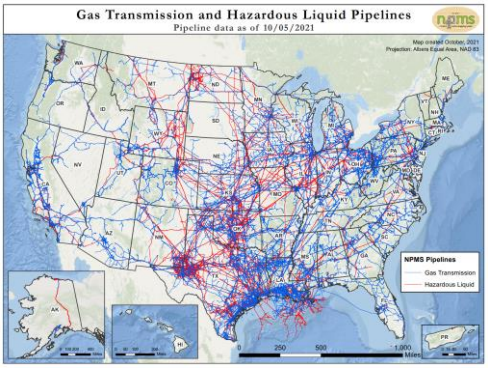
# Introduce a Girl To Engineering 2021

## Pipeline STEM Activity: Student Guide

**Plan: Background**

- Then: Rome used aqueducts to bring water sources from higher grounds to the city of Rome.
- Now: The United States has 229,523 miles of oil and 319,374 miles of gas transmission pipelines to move energy fuels from production areas to end-users.




- **Aqueducts are a channel built to move water to the city**
  - **Gravity flow from a higher elevation flowing downhill to a lower elevation was used in the design.**
  - **Water was carried through underground channels, concrete pipes, or lead pipes where the city governments funded the projects.**
  - **When there were dips in elevation, a siphon was created to generate enough momentum of the water to continue the flow further downhill.**
- **Women Working on Pipelines**
  - **Women comprised as much as 10% of the 28,000 employees on the Trans-Alaska Pipeline Project between 1974 – 1977**
  - **Diane Schenker, a welder for the Trans-Alaska Pipeline, is pictured on the right in the photo.**

**Build A Pipeline Activity Materials**

Objective: move water from one cup to another.

- Three (3) foam cups
- Straws (non-bending, bending straws, various diameters)
- Craft sticks
- Masking tape
- Not included:
  - Scissors
  - Water
  - Paper towels
  - *Optional:*
    - Food coloring
    - *Honey, vegetable oil, other viscous liquids*
    - Timer
    - Measuring cup


| Steps | Actions |
|---|---|
| Plan | Consider how to move water from one cup to another using the provided materials. |
| Do | Assemble the pipeline system. |
| Check | Troubleshoot if needed. |
| Act | Make repairs, redesign, or optimize. |


**Do: Procedure**

1. Use the scissors to carefully poke a small hole in the bottom of one Styrofoam cup.
2. Insert a small diameter straw in the hole of the first cup ("straw cup").
3. Consider, design, and build a stand for the "straw cup" so the "straw cup" is a higher elevation than the "receiving cup" using the provided cups, straws, wooden craft sticks, and tape.
4. Configure the "straw cup" and stand to empty through the straw pipeline into the "receiving cup."
5. Pour water into the taller cup.
6. Troubleshoot, as needed:
   a. If there are leaks, use tape to repair them.
   b. If the structure elevating the first cup is not structurally sound, reinforce it.
   c. If the water does not flow into the second cup, re-design the pipeline system.

**Check: Testing & Modification**

| What happened? | |
|---|---|
| Observations: | |
| Research: | |
| Hypothesis: | |
| Testing: | |
| Analyze Data: | |
| Conclusions: | |

**Act: Data Gathering Activity**

Constants: Use 50 mL or ¼ cup of fluid

Variables:

- Use two fluids with different viscosities such as water and honey or water and oil.
- Change the narrow diameter straw out with the thicker diameter smoothie straw and see how the average time to move the water changes.

Using a timer, record three-time trials for each fluid type and straw diameter. After recording the times, take the average of each test and compare the results to the hypothesis.

| | Thin Straw | Thick Straw |
|---|---|---|
| **Fluid 1: Water** | | |
| Time 1 | | |
| Time 2 | | |
| Time 3 | | |
| Average | | |
| | | |
| **Fluid 2: _____** | | |
| Time 1 | | |
| Time 2 | | |
| Time 3 | | |
| Average | | |

$$\text{Average} = \frac{(\text{Time 1} + \text{Time 2} + \text{Time 3})}{3}$$

Science principles demonstrated in this activity:

- Pipelines
- Fluid Viscosity
- Bernoulli Principle
- PHMSA Website
- Pipeline construction
- Deming Plan Do Check Act (PDCA) Cycle