**Pipeline Challenge Activity**

***Learning from C.Y. O’Connor: a STEM journey from Perth to Kalgoorlie***

**Materials needed:**

* Ping-pong balls - 1 per group
* Golf balls - 1 per group
* A3 paper for drawings/design planning – 1 per group
* A3 paper and Heavy paper (Manilla folders work well) for pipes, special angle joins and supports – 5 of each per group
* Packing tape or sticky tape – 1 or 2 per group
* Scissors and cutters – 1 or 2 per group
* Tape measure or ruler – 1 per group
* Protractor for measuring angles – 1 per group

Note*:* The investigation is adapted from the “Pipeline Challenge“ activity published by IEEE on [www.tryengineering.org](http://www.tryengineering.org)

**The activity:**

1. Introduction – 10 minutes – this can be adapted to the Indonesian context
   1. The context and aim of today’s investigation
      1. Who was C.Y. O’Connor?

Charles Yelverton (CY) O’Connor was the engineer in charge of the design and building of the Goldfields Water Supply Scheme between 1896 and 1901. The pipeline, 760 mm diameter, still transports water from Mundaring to Kalgoorlie, through 530 km of pipe. 90 million litres of water is pumped every day. The pipeline holds 300 million litres of water and it was constructed from flat sheets of steel.

* + 1. The aim of the activity

Tell the students that they will have to design, build and test a pipeline. That will give them the opportunity to see a pipeline as more than a long cylinder, understand the importance of good measurement, use the geometry skills gained in the previous weeks/years to solve a problem that involves surface areas and volumes. They will also gain an understanding of the challenges engineers and scientists have to deal with and the value of teamwork.

1. Description of the task – 5 min:

The students will have to design, construct and test a paper pipeline able to transport a table tennis ball from one point of the classroom to another.

**Key requirements (Design brief):**

* + 1. **The pipeline must be able to transport the table tennis ball without outside help.**
    2. **The pipeline must have 3 angles as the pipeline has to go around environmentally protected areas. One must be 90o. The other 2 must be at least 30o. Show each group the path they need to traverse in the classroom.**
    3. **The starting point will be the chair height above ground and the finishing point will be at floor level, with necessary supports in between.**
    4. **The only materials to be used are the ones provided by the teacher.**

1. Execution of the task and reflection – 1 hour:
   1. *Planning stage* - student teams plan the pipeline on paper first (design and prototype). Encourage students to think about:
      1. What diameter would they choose for the pipe and why?
      2. What length is each section between angles?
      3. How did they design the angle connections?
      4. How much support is needed?
   2. *Construction stage* – student teams construct the pipeline. During this stage, they might have to come back and modify their plan (re-evaluate their design).
   3. *Testing stage* – students will test if the table tennis ball travels through the pipeline.
   4. *Reflection stage*
      1. What challenges did you encounter when designing and executing the pipeline?
      2. Did you need to re-design your pipeline? If yes, why?
      3. Did you find your pipeline was more effective using the ping pong ball or the golf ball? Why do you think this was true?
      4. Do you think your pipeline design would work if you used it to transport water? Feathers? Butter? Why or why not?
      5. What pipeline developed by another team do you think worked best and why?
      6. What are the advantages of teamwork vs. working alone?
2. Conclusion – (20 min). Wrap us the investigation by asking questions about the importance of STEM in our life (CY O’Connor’s pipeline and its impact on WA state society), the use of science, measurement and geometry in engineering design and the value of teamwork.

Science concepts: gravity, fluid flow, friction, strength of materials, timing, pressure, bouncing/reflection

Maths concepts: surface area (to calculate the material needed for the pipeline), measurement

Engineering concepts: design, design changes (see the reflection stage questions)