Welcome to the
Hydraulic Arcade

Driving Question

How can we investigate the power of air and water and their ability to do work?

By the end of this workshop:

- Understand the properties of hydraulic and pneumatic systems and how they function
- Explore and make observations about the different types of systems in biological and mechanical models
- Determine how the ability of water to do work is different than that of air
- Identify how can we harness the mechanical advantage produced by hydraulic and pneumatic systems to make fun and functional games and vehicles

What are some examples of hydraulic and pneumatic systems? What fluids do they each use? How do they function? What are their limitations?

Watch *Video 1: Introduction* to start to gather some information and observations. Some things you might want to consider:

- What are some examples of each type system within your own life or community? Can you think of any historical examples?
- Which type of system uses a compressible fluid? How does this quality, and the other properties of fluids, impact how the systems function? How might the properties of each fluid limit where and how each system can be used?
- What other questions do you have about each system?

Hydraulic systems use WATER / AIR (circle one)	Pneumatic systems use WATER / AIR (circle one)

Challenge 1: Exploration 1- A-maze-ing Air and Water

- Watch *Video 2: A-maze-ing Air and Water* or try out some hydraulic and pneumatic games for yourself. What observations can you add? What features do you consider important in a "good" maze (or other game) design? Why?
- What would you improve about each of the games? How else could the maze games be used?

Challenge 1: Exploration 2

Sink it to Win it

Hydraulic and pneumatic systems exist in living bodies as well as mechanical ones. Can you think of any examples in the human body? What about in other living things?

Using your inquiry cards and *Video 3: Body Systems* as a guide, model your own example of either a Cartesian Diver, a fish swim bladder, or a human respiratory system to add to the Hydraulic Arcade!

What model did you choose? Sketch it!

What observations can you make about pneumatic and hydraulic systems from your model? From those of your peers?

What does your model tell you about the living system it represents? About other living systems?

Does your model, and the living system it represents, use hydraulics or pneumatics? How might it function differently if it used the other type of system?

How do these models show the relationships between pressure, density, and volume? Do you find this easier to understand these relationships with the models or with the PASCO sensor?

Challenge 2

Make your own go-kart track vehicle

Use the information in *Video 4: Make your own go-kart track vehicle*, your previous knowledge of hydraulic and pneumatic systems, and your observations so far to design your own vehicle for our Hydraulic Arcade!

- Consider what system you'll use and why, the materials you require, how your vehicle will move, and how you will achieve mechanical advantage to power your vehicle

How do you choose?

Make a pro and con list to compare the systems before circling what type of system you will use.

	Pros (benefits of this system)	Cons (downsides of this system)
Pneumatics		
Hydraulics		

Draft a design and mark your materials!

Outline your materials and your vehicle's design in the space below

Materials	Design

Make your vehicle and try it out. Consider what adjustments and modifications you would like to make, and be prepared to share your design with your class

Challenge 3

Present your vehicle design

- Observe your classmates' hydraulic and pneumatic vehicles, record the elements of their design that you like
  - How did each person's perspective affect their design?
  - What would you change about your own design having seen your classmates'?
- Share your own design and record your classmates' feedback
  - Demonstrate what system your vehicle uses and how it attains mechanical advantage
  - Explain why you chose this design

Record your observations and ideas

Suggest at least one modification to your design!

Which design worked the best? Why? Did it use a hydraulic or pneumatic system?