2025 Toronto Fluid Power Challenge

FLUID POWER CHALLENGE — DÉFI ÉNERGIE DES FLUIDES

NOTES FOR TEACHERS

1. RESOURCE FILES

Go to this link to access the following files.

FOR IMMEDIATE ACTION. Download and print and/or save on an electronic device the listed files 1 through 13 in the quantities indicated. The *Team Registration* and *Student Media Consent Forms* must be completed and submitted at the Workshop.

1. Team registration form (1)
2. Student media consent form (1 per student)
3. Notes for Teacher-Facilitators (1)
4. Fluid power fundamentals (1 per student + teacher copy)
5. 2025 Challenge scenario (1)
6. Lifter instructions (2)
7. Pneumatic clamp instructions (2)
8. Rotating platform from Workshop components (2)
9. Design process cube sides (legal) (1)
10. Design process cube instructions (1)
11. Portfolio checklist (1)
12. Local Challenge rubric – short (1)
13. Local Challenge rubric – detailed (1)

AFTER THE WORKSHOP DAY. Download and print/save files 14-18 to guide the design and construction of the prototypes and prepare the students for the Challenge Day.

14. Portfolio notebook template (1)
15. Examples of good design portfolio contents (1)
16. Iso-Ortho views illustrated (1)
17. Hints for overall success (1)
18. Hints for device design & construction (1)

Note there are two versions of the *Local Challenge Rubric,* a *short version* and a *detailed version.* While the *short version* is sufficient for building an outline of the *Design Portfolio,* the *detailed version* provides specific terminology that must be used in the text of some of the criteria in the portfolio to earn maximum points.

2. PRIOR TO THE WORKSHOP DAY

Ensure that your school has paid your team's registration fee by credit card before March 14th in order to confirm your participation.

Things to have your students do before they attend the Workshop Day:

A. Watch one or both of the following *videos*:
   Fluid power careers in Canada. A punchy, 3.5-minute video.
   Discovering fluid power. A 27-minute video with lots of fluid power applications.

B. Review the *Fluid Power Fundamentals* file.

3. WORKSHOP DAY

Tuesday, April 22, 2025

8:30 – 9:00 am	**Registration**
9:00 – 11:30 am	**Workshop**
11:30 am – noon.	**Lunch** *(provided)*
Noon – 1:00 pm	**Intro to Challenge Scenario & Q&A Session**
1:00 – 2:30 pm	**Lab Tours**
2:30 pm	**Departure**

Remember to bring the printouts and completed forms mentioned on the previous page.

At the Workshop, students will:

a) Explore the materials and tools

b) (Introductory activity): Make a design process cube

c) Build the *Lifter,* the *Clamp* and the *Rotating Base from Workshop materials*

d) Be introduced to the *Challenge Scenario*

e) Seek clarification of the *Challenge Scenario* through questions & answers

f) Be made aware of the importance of the *Design Portfolio* and the design process

g) Know what to bring to the Challenge Day

h) (If time permits) Review the *Hints for Success* and *Hints for Device Design and Construction* files

i) Tour various hydraulic, pneumatic and robotics labs at Centennial College

A. Explore the materials and tools

Introducing the use of tools

Demonstrate how to use a saw and mitre box safely by cutting two wood strips 10cm long using a piece from the materials kit. Show how two green cardboard corners secure the wood at 90 degrees using a SMALL amount of wood glue. The sheet from which gusset corners are cut can be used as a 90° template.

Dispensing wood glue

In the kits there are small plastic cups. These are used to hold a small amount of wood glue. Each team of four needs a bottle of wood glue and there are stirring sticks to apply the glue to the wood and cardboard when assembling a device. Emphasize that only a small amount of glue is required to secure the pieces.

B. Make a design process cube

Note: the steps in the design process are discussed in detail in step E below.

Ask each pair of students (2 per team) to make a square with external dimensions of 10cm using one long piece and using a ruler, pair of scissors, mitre box and small saw. Do not tell the students how to do it, let them make mistakes and discover that the thickness of the wood matters. The file *Design Process Cube Instructi*ons in the Challenge Resources provides instructions on how to build a 10X10X10 cube, but please don't show these to the students before they build the cube.

There are three ways to make the square: (2 X 10 cm) + (2 X 8 cm) or (4 X 9 cm) or (4 X 10 cm using 45 degree mitre cuts), demonstrating that there are different ways of assembling the same thing.

The two 10 cm squares can be combined to create a cube with the addition of four 8 cm pieces and then covered with the Process Cube Sides. The sides will identify the six steps of a Design Process.

C. Build the devices

Draw attention to the *Lifter, Pneumatic Clamp & Rotating Platform from Workshop Kit Instructions*. Have students open the Workshop Kit and pull out the bags and the wooden base block. The box will contain additional materials (wood and dowel) for later use.

Temporarily put aside the *Lifter* and *Pneumatic Clamp* kits and focus on getting the parts for the *Rotating Platform*: the small bag of parts "Parts for Rotating Platform" and the extra materials from the unlabeled bag. Once organized, start one pair of students on the Lifter (which requires a fair amount of construction) and the other pair on the *Pneumatic Clamp* and the *Rotating Platform*.

Notice that the parts are cut to size and drilled where needed and that the axle holders (white) are pre-cut and hole-punched in the Lifter Kit and one of the syringes is pre-drilled in the kits.

Both models demonstrate important techniques. The plunger can be used for linear movement directly, but where linear-to-rotary movement is required, the syringe must pivot or turn – hence, the syringe platforms. This is important as undue stress, particularly twisting force, or torque, will apply sufficient pressure to the clip for it to tear away from wood.

There are two types of clips – gray (with larger sticky pad) and white. Both the white clips and the gray clips are included in the Workshop and the Challenge kits and there are extras of each in the Facilitators' Kits.

At some point during the construction, demonstrate how to drill a hole in the plunger of a 20ml syringe using the mitre box or vice. It is best to have 2 pairs of hands available for this operation. This demonstration is for when students explore prototypes for the Challenge and need to attach syringes as actuators.

D. Introduce the Challenge Scenario

Read through the *Challenge Scenario* and review the isometric drawing in the *Challenge Scenario* with the students. Make it clear that all movements of the device MUST be controlled using fluid power. *(This is explained in more detail in Section 3C below.)*

Go over the *Challenge Rules* emphasizing safety requirements.

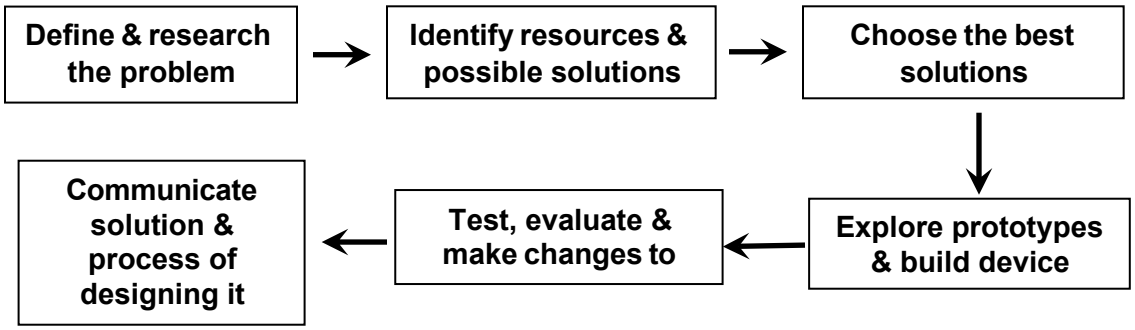
Go through the *Local Challenge Rubric* which will tell the students how their efforts will be graded.

During the time between the Workshop and the Challenge Days, each team will:

- Design, build, test and fine-tune one or more prototypes of a device to meet the requirement of the Challenge Scenario
- Produce a *Design Portfolio* that comprehensively documents their design process.

E. Make students aware of the importance of the Design Process and the Design Portfolio that they will use to document it

The following chart explains the introductory design process illustrated by *Process Cube Sides (legal)*.



Stress the importance of the *Design Portfolio* and refer to the *Portfolio Checklist* and *Portfolio Notebook Template* and the *Iso-Ortho Diagram.*

Refer to *Samples from Successful Portfolios* to get a better idea of what a good Design Portfolio looks like.

Emphasize the need to explore different designs! Usually the first idea is **not** the best!

F. Seek clarification of the Challenge Scenario through questions and answers

At the Workshop we will go through the *Challenge Scenario* paragraph-by-paragraph, accepting questions.

Typical questions are “What happens if the object is dropped or falls over outside the boundary of the destination area?” or “Can we clamp our device to the footprint wall?”

The students must understand that they will be limited to using the materials and tools that are in the *Prototype Kit* that they are being provided at the end of the Workshop for constructing their Challenge Scenario prototype(s) at their schools.

G. Review the Hints for Overall Success and Hints for Device Design and Construction files

At the end of the Workshop Day, these files will provide additional tips that, if followed, will improve each team's chances of success.

H. Know what to bring to the Challenge Day

Each team will bring only two copies of the *Design Portfolio* and their tools to the event. One of the Portfolio copies must be a printout that can be submitted for review by the judges. The other copy, to be used by the team to guide the construction of its device, can be another printout or an electronic version on a tablet or laptop computer.

I. Review the Hints for Overall Success and Hints for Device Design and Construction files

At the end of the Workshop Day, these files will provide additional tips that, if followed, will improve each team's chances of success.

3. CHALLENGE DAY

A. Challenge Day Schedule

Wednesday, May 14, 2025

8:15 – 8:45 am	Registration
8:45 – 11:00	Construction (with no involvement by teachers)
	Judges circulate among the teams
11:00 – 11:30	Construction continues (with involvement by teachers if necessary)
11:30 – Noon	Lunch (students can continue working on their devices)
Noon – 1:00	Completion of construction and testing
1:00 – 2:15	Demonstrations of devices
2:15 – 2:30	Clean up, judges' deliberations, and presentation of awards
2:30	Departure

Upon arrival on the Challenge Day, the teams will be provided with a *Challenge Kit* containing the materials that they will use to build their devices. No other materials, e.g. unused materials from the *Prototype Kits,* will be allowed.

B. Basis of evaluation

The *Local Challenge Rubric* is used to evaluate each team's performance. Attached to this rubric are these interview questions (which the judges will ask as they circulate among the teams):

1. What alternative designs did you look at before selecting the design you are building today?
2. Why did you select this design to use for the Challenge scenario?
3. What other materials might be useful to have?
4. How did you decide who on your team would be responsible for which parts of the project?

C. Point deductions for use of hands and dropped objects

There are specific rules about the use of hands:

- ***All movements*** of the device **MUST** be controlled ***using fluid power.***
- If your team manufactures ***a device that only works when it is stabilized by hand(s)*** then ***only 50% of the 'moving object' score will count.***
- ***If your team breaks the device*** during the allocated demonstration time, then your team can repair it during the demonstration time but ***subsequent 'moving object' scores will only count 50%***. *(Sometimes, in the excitement of the Challenge a team member will pull too much on a plunger and lose its operation. Hence the proviso that a quick repair may be untaken.)*
- ***If your device is touched by hand IN ANY OTHER WAY, then the 'moving object' score will be zero for the pick and place cycle during which the touching occurs.***

In addition:
If an object is **dropped in transit** from the pick-up point to one of the drop-off zones, the object is returned to the pick-up point and the next attempt is made. No penalty is assessed.