NOTES FOR FPAC
TEACHERS & FACILITATORS –
IN-SCHOOL CHALLENGE

1.CLASSROOM ACTIVITIES

In teams of 4, students will follow the activities including the Introduction to the Challenge and Using the Portfolio where students will document their possible solutions to the Challenge.

Students will, if time allows:

1. Watch a 10-minute video about fluid power, if available
2. Explore the cutting tools
3. Make the Lifter, Clamp and Rotating Platform from Workshop Kit materials
4. Be introduced to the Challenge
5. Be made aware of the importance of the Portfolio and the process of design
6. Seek clarification of the Challenge through questions & answers
7. Understand what is required of them
8. Know what to bring to the Challenge event

1A. INTRODUCTION TO FLUID POWER – VIDEO PRESENTATION

This is a 26-minute video. If you don't have time to view the entire video, watch at least the first 10 minutes. The full-scale earthquake simulation is a must-see! http://www.tpt.org/fluid-power-a-force-for-change/video/tpt-documentaries-fluid-power-force-change/

1B. DISPENSING WOOD GLUE

In the kits, there are small cups. These are used to hold a <u>small</u> 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. Extra cups and stirrers are in the Facilitators' kits.

1C. INTRODUCING THE USE OF TOOLS

Demonstrate how to use a saw and miter box safely by cutting two wood strips 4" long using a piece from the Facilitator's Kit. Show how two green cardboard corners secure the wood at 90° using a SMALL amount of wood glue. The sheet from which gusset corners are cut can be used as a 90° template. It's best to have this sample cut and glued prior to the workshop.

<u>Introductory Activity:</u>
Ask each pair of students (2 per team) to make a square with external dimensions of 4" using one long piece taken from their Workshop Kit box. Do not tell the students how to do it, let them make mistakes and discover that the thickness of the wood matters.
There are three ways to make the square: using (2 X 4") + (2 X 3¼") or (4 X 3⅝") or (4 X 4" (long side) using 45-degree miter cuts), demonstrating that there are different ways of assembling the same thing.

Optional Extension Activity

The two 4" squares can be combined to create a cube with the addition of four 3¼" pieces and then covered with the Process Cube Sides. The sides will identify the six main steps of an introductory Design Process.

Alternatively the cube can be used in the construction of the Lifter if time is short at the Workshop.

Demonstrate how to drill a hole in the plunger of a 20ml syringe using the miter box. It is best to have 2 pairs of hands available for this operation. This demonstration is for when students explore prototypes and need to attach syringes as actuators. However the alternative of using the white axle holders avoids the use of the hand drill and drill bit. Another option, to speed up drilling generally, is to have a "manned" desk-top drill press available with 13/64" & 7/32" drill bits.

1D. BUILDING THE DEVICES

Draw attention to the *Lifter, Clamp & Rotating Base from Workshop Kit pdf instructions*. Have students open the Workshop Kit and pull out the kits. The box will contain additional materials (wood, dowel and bags of parts) for later use.

Organizing the kits and their construction:

The usual situation is that the students work in pairs. One pair begins the Lifter and the other the Clamp and Rotating Base (from Workshop Kit). Those making the clamp and base will finish first. They can jump into the Lifter instructions at slide 11.

Clamp Objectives

i. Build a device that uses linear motion

ii Demonstrate hoe an object may be clamped using 2 piston-syringes

iii. Demonstrate the use of a white clip to hold a piston-syringe

Lifter Objectives:

i. Build "two-dimensional" square and "three-dimensional" cube using gusset corners

ii. Use white axle-holders to hold axles as an alternative to drilling

iii. Make and use a small rotating platform and clip to hold a syringe

iv. Build a working Lifter device that demonstrates linear to rotary motion

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. The Lifter comes together after a fair amount of construction.

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 extra of each in the Facilitators' Kits.

For detailed methods of attaching the syringes to devices made from the kit materials see "Attaching piston-syringes" file

1E. INTRODUCING THE CHALLENGE SCENARIO:

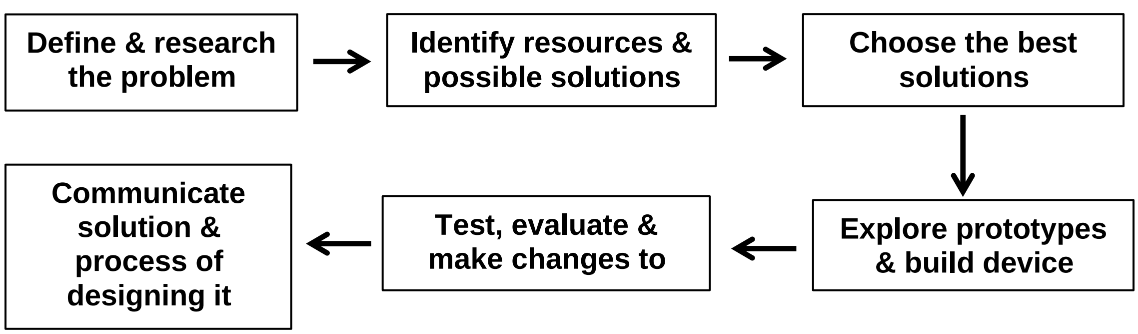
Next, students will be introduced to the Challenge. They will explore possible solutions and investigate them by designing and making sub-systems that perform specific functions, e.g. a mechanism for picking up the object, a mechanism for achieving the required rotation, etc. Teams will combine the sub-systems to make a prototype device and record their work in a portfolio following the instructions found in the *Portfolio Checklist* and *Portfolio Template*. Workshop facilitators should refer to the Challenge Layout Board and the *Introducing the Challenge* PowerPoint presentation.

Once all this material has been distributed:

1. Read through the *Challenge Scenario* and show the *Layout Board* to the students. <u>All movements of the device MUST be controlled using fluid power</u>.
2. Go over the *Challenge Rules,* emphasizing safety requirements.
3. 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?"
4. Go through the *Challenge Rubric* and tell the students how their efforts will be graded.
5. Stress the importance of the portfolio and refer to the *Portfolio Checklist*, *Portfolio Template* and *Iso-Ortho Views illustrated*
6. Emphasize the need to explore different designs! Usually, the first idea is **not** the best!
7. Draw attention to the *Hints for Device Design Construction* file. This document describes how the components of the kit go together and ideas for lifting, turning and grabbing.

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)*.



1F. USING THE RUBRICS:

<u>Judges frequently comment that teams do not maximize their scores in the portfolio because they do not read what is required from the rubric.</u>

The detailed *Judges Rubric* specifies exactly how to score the most points in the portfolio. For example, in the "Rationale used to decide on the type of fluid power used and where to place the piston-syringes" section, the rubric clearly indicates that to score the maximum number of points certain terms, written in coherent sentences, need to be written in the portfolio:

“Our team decided to use water in the piston-syringes making our device hydraulic” (1 point)

“Water is approximately 800 times denser than air, so using water in the piston-syringes enabled us to control the movement of our device with more speed and greater accuracy” (1 point)

“From our science lessons we knew that Pascal’s law tells us that when there is an increase in pressure in the piston-syringe (because the plunger is pushed in) that force is equally applied to our system of two piston-syringes joined by a piece of tubing” (2 points)

In our lifting arm we placed the pivot point to raise it with as little effort as possible while maximizing the lift” (1 point)

The *Judges Rubric* is also used to evaluate device performance and team interview responses:

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 did you find most difficult with the project overall?
4. How did you decide who on your team would be responsible for which parts of the project?

2. THE CHALLENGE EVENT:

2A. INTRODUCTION TO THE COMPETITION:

A team will:

- Build, test and fine-tune a prototype of the device.
- Produce a portfolio that documents their design process.
- Build their solution to the Challenge under a strict timeline.

Normally it takes 2½ hours for a team to build their device, at least, and a further 15 minutes to organize and operate it. Finally, the device will be operated for a period in the competition so that the “moving object” score can be determined.

- ***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 time, then your team can repair it 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.)*

2B. WHAT TO BRING TO THE CHALLENGE EVENT:

A team will bring only two copies of the Portfolio and their tools to the Challenge event and, in addition, the working Rotating Base, if they so wish.

At the start, a Challenge Kit is handed to the team containing the materials that the team is allowed to use. The team must build their device from scratch using their portfolio work to guide them. The Challenge kit has the same materials as in the workshop kit materials (except for the smaller kits) plus another 2 of 20cc syringes, extra tubing and glue sticks.