

NOTES FOR FPAC  
TEACHERS & FACILITATORS –  
COMMUNITY CHALLENGE



## ***1. WORKSHOP ACTIVITIES***

In teams of 4, students will follow the Workshop activities as per the Introducing the Challenge presentation including the Portfolio requirements where students will document their team's possible solutions to the Challenge.

Students will, if time allows:

1. Watch a 10-minute video about fluid power, if available
2. Be aware of safety considerations
3. Explore the cutting tools and jigs
4. Make the Lifter and the Rotating Platform devices
5. Be introduced to the Challenge
6. Be made aware of the importance of the Portfolio and the process of design
7. Seek clarification of the Challenge through questions & answers
8. Understand what is required of them
9. 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 bag without a label, inside the "Workshop Kit" box, there are small 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. Extra cups and stirrers are in the Facilitators' kits.

### ***1C. INTRODUCING THE USE OF TOOLS***

Demonstrate how to use a saw, miter box and clamp safely by cutting two wood strips 4" long using a piece from the Facilitator's Kit and the miter jig. 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.

#### **Introductory Activity:**

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 3/4" 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 on the Challenge Day with 13/64" & 7/32" drill bits.

### ***1D. BUILDING THE WORKSHOP DEVICES***

If you are a Facilitator, it is advisable to have the two models pre-made to show how the Lifter and the Rotating Platform work. There is an extra kit of both in the Facilitator's Kit. The instructions for building the kits are pdf files. They will display on cellphones, but tablets or computers are best.

*In addition, in the Facilitators' Kit only there is a small bag of extra materials to build a working hydraulic rotating base. This is the weakest part of the students' solutions so demonstrating this base would be well worth it. The instructions for this device are "Rotating Platform from Workshop Kit" and the extra materials for this device are in the Facilitators kit.*

#### 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

#### Rotating Platform Objectives:

- i. Use drilled wooden pieces to hold a circular platform in place
- ii. Mount syringe on platform to achieve horizontal rotation
- iii. Identify limitations of the device and how it could be re-designed to be useful in Challenge

Draw attention to the *Lifter* and *Rotating Platform* instructions. Have students open the Workshop Kit and pull out both. 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 Rotating Base. Those making the base will finish first. They can jump into the Lifter instructions at slide 11.

Sometimes the time pressures of the event force facilitators to focus only on the Lifter. In this case the second pair will start at slide 11.

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 both kits. The Lifter comes together after a fair amount of construction. The Rotating Platform is less “glamorous” than the Lifter and is easier to make.

**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

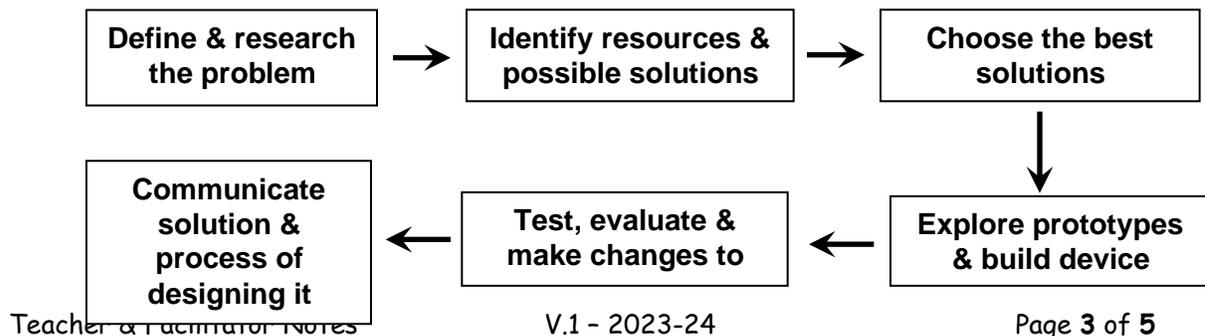
### ***1E. INTRODUCING THE CHALLENGE SCENARIO:***

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*.

1. Read through the *Challenge Scenario* and show the *Layout Board* to the students.  
All movements of the device MUST be controlled using fluid power.
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* and *Attaching Piston-Syringes* files. These documents describe 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:***

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

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 *Rubrics* 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 3 to 3½ hours for a team to build their device and a further 15 minutes to organize and operate it. Finally, the device will be operated for a two-minute 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 2 minutes, then your team can repair it during the 2 minutes 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.***

***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.

At the start, a Challenge Kit is handed to the team containing the only 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 Lifter and Rotating Platform kits) plus another 2 of 20cc syringes, extra tubing and glue sticks.