NOTES FOR FACILITATORS & TEACHERS

1. PRIOR TO THE WORKSHOP

Download and review the Introducing the Challenge PowerPoint Presentation and the below files from the Resource Center on the NFPA website: http://nfpahub.com/fpc/resources/#!/event/25

Print the following:

One Copy for Each Team	
Workshop Lifter Power Point Instructions	*Rotating Platform PowerPoint Instructions*
Judges Rubric	*Challenge Rules*
Building a Cube Instructions	*Process Cube Sides (legal)*
Portfolio Checklist	*Portfolio Template*
Challenge Layout Dimensions ISO_ORTHO	*Design Process Diagram*

Two Copies for Each Team	
Challenge Scenario	*Challenge Rubric*
Hints for Device Design Construction- Illustrates use of components in the Fluid Power Kits	

One Copy for Each Person	
Pre-Survey for Students- Workshop Day	*Post Survey for Students- Challenge Day*
Teacher Feedback Survey- Challenge Day	

2. WORKSHOP ACTIVITIES

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

Students will:

1. Watch a 10-minute video about fluid power, if available
2. Explore the cutting tools
3. Make the Lifter and the Rotating Platform devices
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

2A. 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/

2B. 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. Extra cups and stirrers are in the Facilitators' kits.

2C. POSSIBLE SEQUENCE OF WORKSHOP EVENTS

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, these kits are pre-cut and drilled. The instructions for building the kits are PowerPoint files. They will display on cellphones, but tablets or computers are best.

2D. 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.

Optional 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.

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 a *Design Process*. The cubes can also be used in the construction of the Workshop Lifter.

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.

2E. BUILDING THE WORKSHOP DEVICES

Draw attention to the *Workshop Lifter* and *Rotating Platform PowerPoint instructions*. Have students open the Workshop Kit and pull out the Lifter and Rotating Platform Kits. The box will contain additional materials (wood, dowel and bags of parts) for later use.

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.

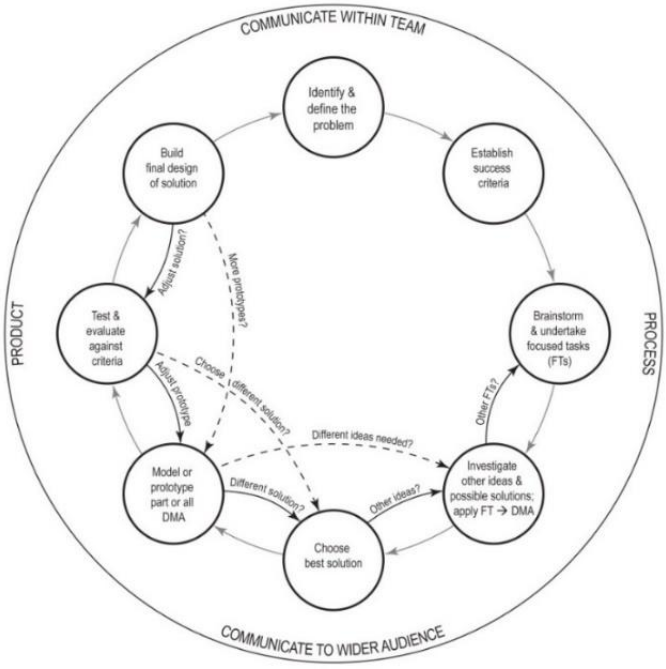
2F. INTRODUCING THE CHALLENGE SCENARIO:

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 PPT* and the *Fluid Power Fundamentals PDF*

Once all this material has been distributed:

1. Read through the *Challenge Scenario* and show the *Layout Board* to the students. Refer to 3A. <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 the *Iso-Ortho Diagram.*
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.

The diagram of a detailed *Design Process* below illustrates the iterative procedures involved with an advanced process.



Note: *The Design Process diagram refers to FTs (focused tasks) and DMA (design and make activity). A focused task is the exploration and investigation of a sub-system of the planned device. For example, the students will need to design a mechanism for picking up an object and this may involve an understanding of levers. The FTs here will be understanding the three classes of levers and incorporating that knowledge into the design of the pick-up sub-system. The design and make activity (DMA) the design and making of the prototype device*.

2F. USING THE JUDGES RUBRIC TO EVALUATE THE TEAMS:

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 *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?

3. THE CHALLENGE EVENT:

3A. 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 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.***

3B. 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, an extra white syringe holder, extra tubing and glue sticks.