NOTES FOR TEACHERS & FACILITATORS

1. PRIOR TO THE WORKSHOP

Download the documentation required for each team from the NFPA website:

http://nfpahub.com/fpc/resources/

You will need to print the following for each team:

- One copy of *Workshop Lifter* and *Rotating Platform PowerPoint instructions*
- Four copies of the *Challenge Pre-tes*t (and the *Challenge Post-test f*or the Challenge Day)
- Two copies of the *Challenge Scenario* and the *Challenge Rubric*. There are 2 versions of the *Challenge Rubric*, a *short version* and a *detailed judges' version*, so choose the most appropriate version – I recommend the short version for the students and a copy of the detailed judges' rubric for each teacher.
- One copy each of the *Challenge Rules*, *Process Cube Sides (legal)*, *Cube Instructions (legal)*, *Portfolio Checklist*, *Portfolio Template* and *Iso-Ortho Views explained* for each team.

2. WORKSHOP ACTIVITIES

All students, in teams of 4, will:

1. Complete the Pre-test
2. Watch a 10-minute video about fluid power, if available
3. Explore the materials and be introduced to construction techniques
4. Make the Lifter and the Rotating Platform devices
5. Be introduced to and clarify the details of the Challenge
6. Be made aware of the importance of the Design Portfolio and the process of design
7. Understand what is required of them
8. Prepare a portfolio documenting their process of design
9. Know what to bring to the Challenge event

The *Introducing the Challenge* PowerPoint presentation can be used for the Workshop; it contains hints and tips for the workshop activities and for the preparations for the Challenge as well as some information about fluid power

2A. PRE-TEST

Please have the students each complete the *Pre-Test* at the start of the Workshop and the Post-Test at the start of the Challenge day, one *Post-Test* for each student. These will provide feedback to the NFPA Challenge organizers about the effectiveness of the overall Challenge event. Please emphasize to the students at the beginning of the Workshop that they are not expected to know most of the answers – they will learn these during the Challenge!

2B. INTRODUCTION TO FLUID POWER – VIDEO PRESENTATION

http://www.tpt.org/Fluid-Power:-A-Force-for-Change/

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!)

2C. DISPENSING WOOD GLUE AND USING SYRINGES TO CONNECT TO DOWELS

In the Facilitator's Kit 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 in the kits 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.

2D. POSSIBLE SEQUENCE OF WORKSHOP EVENTS

2D-1: Introductory Activity: making a design process cube

Draw attention to expected standards of safety.

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 a sample cut and glued prior to the workshop.

Ask each pair of students (2 per team) to make a square with external dimensions of 4" using one long piece taken from their long 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 each pair of students make can be combined to create a cube with the addition of four 3¼" pieces and then covered with the *Process Cube Sides (legal)*. The sides will identify the six main steps of a Design Process. A "Help Sheet" is available for the construction: *Cube Instructions (legal)*.

2D-2: Using the drill to drill holes

While the frame of the cube is drying demonstrate how to drill a hole in a piece of wood and 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.

2D-3: 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 *PowerPoint* files and although the instructions will display on cellphones, iPads or similar tablets are best

Students open the Workshop Kit and pull out the Lifter and Rotating Platform Kits. The box will contain additional materials (wood, dowel and a bag of parts) for use later and it is suggested that

a minute or two is taken to put other materials back into the long box. Only the scissors, ruler and glue are required to make the two kits.

Draw attention to the *Workshop Lifter* and *Rotating Platform PowerPoint instructions*.

Open the two kits. Notice that the parts are pre-cut and drilled and one of the syringes is pre-drilled in both 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 – hence, the syringe platforms that turn, albeit a small amount, to accommodate the rotation.

2D-4: INTRODUCING THE CHALLENGE SCENARIO:

During the next phase, the 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. Each team of four students will combine the sub-systems to make a prototype device all the while recording their work in a Design Portfolio following the instructions found in the *Portfolio Checklist* and *Portfolio Review Templat*e.

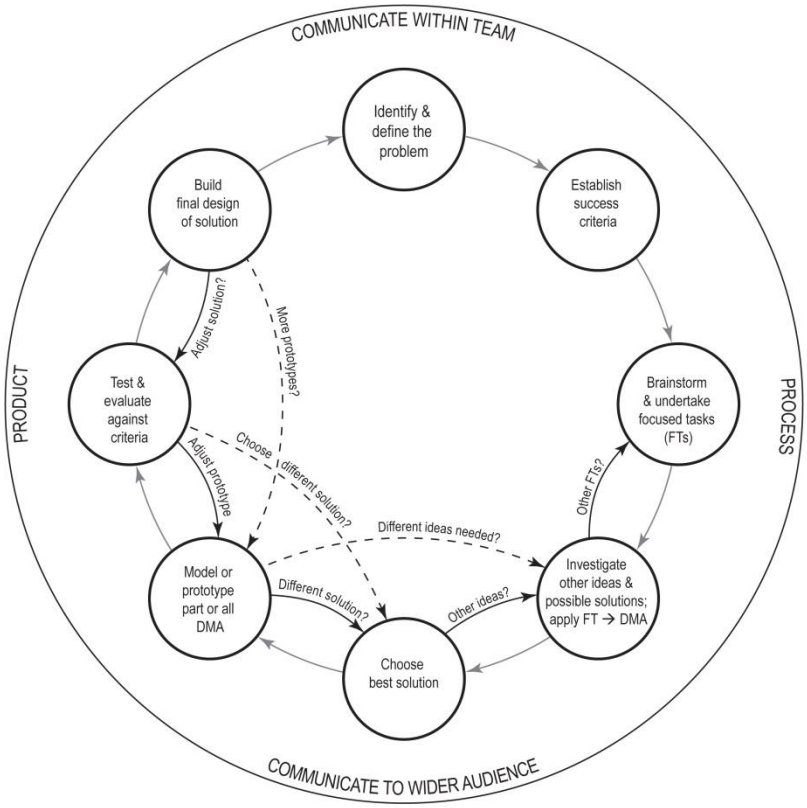
The workshop facilitator will need to refer to the *Challenge Layout Board* and distribute the materials for the teams (*See Section 1)*

1. Read through the *Challenge Scenario* and show the *Layout Board* to 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 3A.)*
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 (short version)* which will tell the students how their efforts will be graded.
5. Stress the importance of the portfolio and refer to the *Portfolio Checklist* and *Portfolio Review Template* and the *Iso-Ortho Diagram.* The Portfolio Review Template is the minimum requirement for the portfolio
6. Emphasize the need to explore different designs! Usually the first idea is **not** the best!

The diagram of a detailed *Design Process* below illustrates the iterative procedures involved with an advanced design process. It is provided here as information for the facilitator. The short version is the six sides of the design process cube the students have made.

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) is the overall design and making of the prototype device.



3. THE CHALLENGE EVENT:

Completing the Post-Test

At this point, all students are asked to complete the Challenge Post-Test.

3A. INTRODUCTION TO THE CHALLENGE:

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 "Challenge Day" conditions

On average it takes 3½ hours for a team to build their device and a further 15 minutes to organize and two minutes operate it in the competition so that the "moving object" score can be determined.

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 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 its Design Portfolio and their tools to the Challenge event as well as an additional copy for the judges.

At the start the Challenge Kit is handed to the team. It contains the materials that the team will use to build their device. Only these materials will be used and the team must build their device from scratch using their portfolio work to guide them.

The *Judges Rubric* is used to evaluate the team's performance. Attached to the Judges rubric are these interview questions:

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?

HAVE A GREAT CHALLENGE!