



## NOTES FOR TEACHERS (& FACILITATORS) 2020-21 VIRTUAL CHALLENGE

### ***PRIOR TO BEGINNING ACTIVITIES WITH STUDENTS***

A “Virtual” Fluid Power Action Challenge is when students work together, remotely from home, to participate in this design and build competition. Much will depend on the efficiency of the information technology students have access to, their willingness to work on their own and share their ideas and work with their team members and to responsibly meet critical deadlines.

Depending on local circumstances, the Host will assist in setting up the necessary IT. It is likely that different schools and School Districts will have protocols in place for virtual lessons.

It is suggested for this Virtual Challenge that the teams of four students take specific roles:

- **Builder** – Responsible for construction of the competing machine. Receives a full kit of materials to support the prototype and build process. Submits video of the working prototype device.
- **Designer** – Responsible for researching structural strength and stability and presenting 3 ideas for the overall design of the prototype. Receives Rotational Platform kit.
- **Illustrator** – Creates all diagrams and drawings in the portfolio including the orthographic and isometric drawings.
- **Team leader and Writer** – creates a detailed timeline of each team member’s role and participation in the production of the portfolio and planned production of the device. Team member is responsible for the final version of the portfolio. A detailed timeline includes:

Team members will have access to a supervised shared folder into which files will be uploaded and using this method, will develop the required documentation and working prototype of the team’s design. *It will be advisable to also have an alternative inter-system to communicate between members e.g. a school-sanctioned social media channel, group e-mail chain or a project management website. Sites like ClickUp.com and Discord.com offer a free interface for students to collaborate on projects.*

Digital access to Resources: Access will be need for the team, teacher, and Host.

Host Input: Likely to vary according to local circumstances. Host/Teacher will set up shared folder and follow the “*Virtual Fluid Power Action Challenge Procedures*” that outlines expected outcomes for each participant at different stages of the process. In the past, sometimes Hosts have an edited version of the Introducing the Challenge PowerPoint.

Target Dates: Due to the nature of the virtual experience keeping to agreed deadlines will play a critical part in the success of the Challenge. It is expected that the following deadlines will set:

*Individual team member’s contributions to the design a prototype device*

*Individual team member’s contributions to the portfolio*

*Demonstration of version 1 of device from Builder*

*Receipt of version 1 of the Design Portfolio from Writer*

*Written responses to the Interview Questions documented in the portfolio*

## ***1. INTRODUCING THE CHALLENGE & AVAILABLE RESOURCES:***

Resources are available on the NFPA website: ([link required](#)) There are many other files for coordinating a Fluid Power Action Challenge, for example: Photo-Video Student consent form.

Download and review the Introducing the Challenge PowerPoint Presentation (after input from Host if appropriate). This is intended for all participants in the Challenge. In virtual settings students will view all the content – it can be broken down into three segments: slides 1 thru 14; 15 thru 32 that includes a lesson on isometric drawing; 33 to the end. It covers safety and building, the portfolio and ideas for construction and organizing available resources including time.

All team members, no matter what role they play, will view the files below including those of other team members. In that way they will know what they contribute to the whole and what they are responsible for.

### **All Team Members**

|  |  |
|--|--|
| <i>2020-21 Introducing the Challenge</i>   | <i>2020-21 Virtual Action Challenge Scenario</i> |
| <i>2020-21 Challenge Board Assembly</i>    | <i>Virtual Challenge Rules</i>                   |
| <i>Virtual Challenge Rubric</i>            | <i>Judges Rubric</i>                             |
| <i>Portfolio Checklist</i>                 | <i>Fluid Power Fundamentals</i>                  |
| <i>Virtual Action Challenge Procedures</i> | <i>Pre and Post Surveys (1 per student)</i>      |

### **Builder**

|                                      |   |
|--------------------------------------|---|
| <i>2020-21 Cube Instructions</i>     | <i>Hints for Device Design and Construction</i> |
| <i>Workshop Lifter Step by Step.</i> |   |

### **Designer**

|   |  |
|---|--|
| <i>Workshop Rotational Platform Step by Step</i>  | <i>YouTube Search: Fluid Power Challenge</i> |
| <i><a href="#">Fluid Power: A Force for Change</a> (Research 3 actions of a robot arm – lift, turn, grab)</i> |  |

### **Illustrator**

|   |                                  |
|---|----------------------------------|
| <i>2020-21 Challenge Board Assembly</i> | <i>Iso-Ortho Views Explained</i> |
| <i>MS Sample Portfolio</i>              |                                  |

### **Writer**

|                            |                           |
|----------------------------|---------------------------|
| <i>MS Sample Portfolio</i> | <i>Portfolio Template</i> |
|----------------------------|---------------------------|

Students will:

1. Be introduced to the Challenge (*above*)
2. Know roles and deliverables the team will have throughout the project
3. Builder will explore the cutting tools following the introductory activity, and make the Lifter kit; Designer will build the Rotating Platform kit; Writer and Illustrator test shared folder and inter-team systems and begin timeline for deliverables by role
4. Be made aware of the importance of the Portfolio and the process of design
5. Seek clarification of the Challenge through questions & answers
6. Understand what and is required of them and when
7. Know how to contribute to the shared folder system

## **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. BUILDER: DISPENSING WOOD GLUE**

In the Workshop kit, there are two small plastic cups. These are used to hold a small amount of wood glue. Use the bottle of wood glue and stirring sticks to apply the glue to the wood and cardboard when assembling a device. It should be emphasized that only a small amount of glue is required to secure the pieces.

## **2C. BUILDER: INTRODUCING THE USE OF TOOLS**

### **SAFETY RULES: THE STUDENT WHO IS THE BUILDER MUST BE SUPERVISED WHEN CUTTING AND ASSISTED WHEN DRILLING**

The Builder makes a square with external dimensions of 4" using one long piece taken from the Workshop Kit box. Do not tell the student 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 3/4") or (4 X 3 5/8") 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 3/4" 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.*

The Builder will drill a hole in the plunger of a 20ml syringe using the miter box for support. This should be done with assistance, as it is best to have 2 pairs of hands available for this operation. This task is for when builder explores a prototype and needs to attach syringes as actuators.

## **2D. BUILDING THE INTRODUCTORY DEVICES**

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

The instructions for building the kits are PowerPoint files. They will display best on tablets or notebook or desktop computers.

When the Builder opens the Workshop Kit and pulls out the Lifter kit, additional materials (wood, dowels, and bags of parts for later use) may spill out.

Notice that the parts in these two kits are cut to size and drilled where needed. 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 complex 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 kit.

## ***2E. 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.

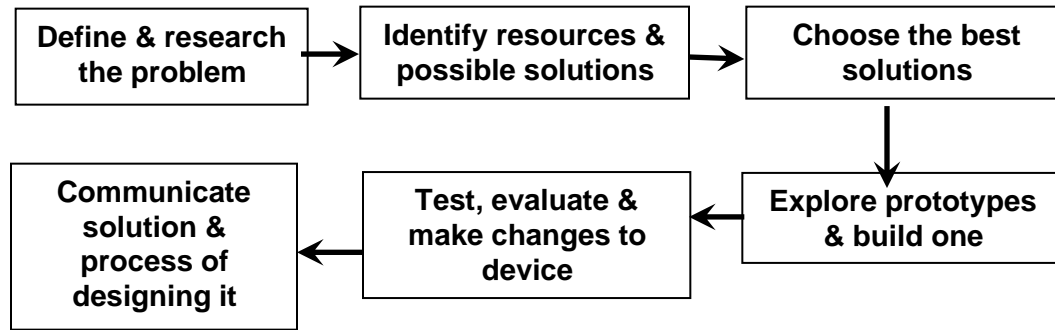
The Writer and Illustrator will test shared folder and inter-team systems. Teams will combine the sub-systems to make a prototype device and record their work in the shared team folder so that they Writer can begin assembling the portfolio. Writer will begin working on the detailed timeline deliverable and the Illustrator will research Isometric and Orthographic drawings.

## ***2F. IMPORTANCE OF THE PORTFOLIO AND PROCESS OF DESIGN:***

Once the shared folder is setup and tested:

1. Read through the *Virtual Challenge Scenario* and review the Layout Board with the students using the *2020-21 Challenge Board Assembly*.
2. Go over the *Virtual Challenge Rules*, emphasizing safety requirements.
3. Go through the *Virtual 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 the device be clamped to the footprint wall?”
4. Go through the *Virtual 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 *Virtual Judges Rubric*
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 following chart explains the Design Process. It includes the text from the *Design Process Cube Sides*.



### 3. CHALLENGE EVENT AND EVALUATING THE TEAMS

Teams will submit the final version of Portfolio and video of working device to the shared folder for the teacher to review. Teachers will evaluate student’s work using Part B of the *Virtual Team scoresheet*. After receiving scores for Part B from the teacher as well as completed portfolios and a 2-minute video of the operating device, Hosts will evaluate Parts A, C & D and select the winners of each category.

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, for example:

“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. Each team member is responsible for answering one of the below questions:

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

The team will produce a portfolio that documents their design process. They will use the shared team folder to submit their contributions to the portfolio and the process of designing and making a prototype.

The Builder will build, test and fine-tune a prototype of the device and demonstrate it for a period of two minutes so that the “moving object” score can be determined, while recording the demonstration on video.

- **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.**