FLUID POWER ACTION CHALLENGE:

NOTES FOR TEACHERS & ADVISORS

1. FOR SCHOOLS PARTICIPATING IN THE VIRTUAL TSA CHALLENGE AT FLORIDA STATE IN 2021

If your team is participating in **Florida State TSA virtual event** you will receive 1 X Workshop Kit that contains kits for classroom introduction to fluid power (Lifter & Rotating Platform kits) and materials for each team of 4 to design a prototype device. In addition, you will receive 1 X Challenge Kit and 1 hard layout board that is used on the virtual Challenge day. The Workshop Kit contains a paper layout to practice on.

Purchase these kits for approximately $195 (including shipping) from Mechanical Kits Ltd.
https://www.fluidpowerkits.com/product/tsa-fl-challenge-1-team-kit/

If your school is holding a **school-based challenge** to select the team to represent the school-chapter then you will order from Mechanical Kits Ltd. at
www.fluidpowerkits.com/product/fl-state-school-kit/
1 X FL State Challenge Event Kit @ $450 + shipping.
This contains: 7 Workshop Kits that contain smaller kits for a classroom introduction to fluid power (Lifter & Rotating Platform kits) and materials for each team of 4 to design a prototype device

1 X Selected Team Kit to enable the selected team to re-design their solution prior to the Challenge Event (in case the group mix is different)

1 X Challenge Kit to enable the school team to build their final device on the

Also available:

The Layout Board will be needed for the event, or multiple boards if required. The 2021 Layout board is $30 + shipping. An extra board is not needed for the 2021 virtual event

A Mini Tool Kit is available that contains a cutting (miter) board, ruler, scissors, handsaw and 4 pairs of safety glasses. The components of the kits are pre-drilled; however, cutting wood to length as well as drilling holes in wooden strips will be required

A "Facilitators' Kit" is available that contains extra materials, one of each Lifter and Rotating Platform kits, a mini glue-gun and a supply of glue sticks

2. PRIOR TO THE EVENT:

Download and review the Introducing the Challenge PowerPoint Presentation and the files below from the Resource Center on the NFPA website: https://nfpahub.com/fpc/technology-student-association-resources/

Print and review the following for "virtual" in-school event: *20-21 In-School FPAC Procedures; Notes-for-Teacher-Advisors - virtual-TSA -2021 and 21-20 In-School Score Sheet*.

Print the following:

One Copy for Each Team	
Lifter Instructions	*Rotating Platform Instructions*
Judges Rubric	*TSA Event Rules*
20-21 Cube Instructions (legal)	*Process Cube Sides (legal)*
Portfolio Notebook Checklist	*Portfolio Notebook Template*
Iso-Ortho Views Explained	*Design Process Diagram*

Two Copies for Each Team	
20-21 Action Challenge Scenario	*20-21 Challenge Rubric*
Hints for Device Design & Construction (which illustrates use of components in the Fluid Power Kits)	

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

3. PRE-COMPETITION ACTIVITIES

It is recommended that the selected team follow the activities below including the "Introducing the Challenge" video

Students will:

1. Watch a 10-minute video about fluid power, if available
2. Explore the materials using the kit and the Student Hints & Tips
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-Notebook 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 Event or the next step

2A. INTRODUCTION TO FLUID POWER – VIDEO PRESENTATION

http://www.tpt.org/fluid-power-a-force-for-change/video/tpt-documentaries-fluid-power-force-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!)

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.

2C. POSSIBLE SEQUENCE OF ACTIVITIES:

If you are a teacher-advisor, it is useful to have the two models pre-made to show how the Lifter and the Rotating Platform work.

The instructions for building the kits are *PowerPoint* files and although the instructions will display on cellphones, iPads or similar tablets 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. 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 cube can also be used in the construction of the Workshop Lifter.

2E. BUILDING THE WORKSHOP DEVICES

Students open the Nat'l 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.

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

Open the two kits. 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 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 enough 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 kits.

2F. INTRODUCING THE CHALLENGE:

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 Portfolio-Notebook following the items found in the *Portfolio Notebook Checklist* and *Portfolio Notebook Template*

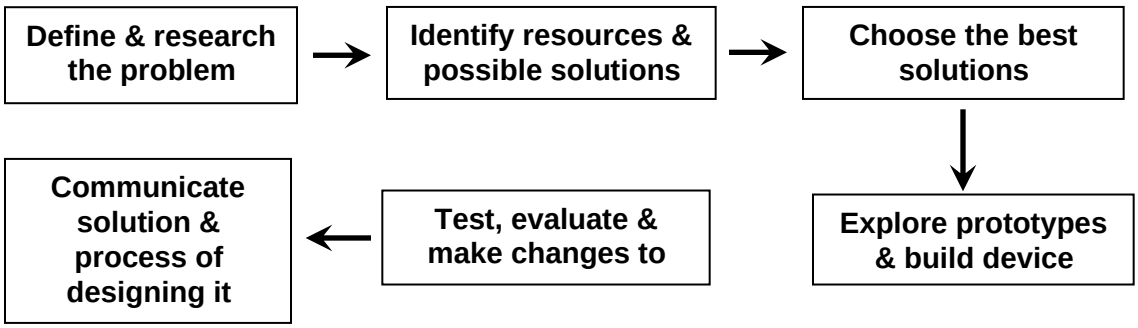
The teacher-advisor will need to refer to the Challenge Layout Board dimensions (*20-21 Challenge Board Assembly*) and the "*Introducing the Challenge*" PowerPoint presentation.

In addition, there is "*Fluid Power Fundamentals*" document that covers standard curriculum content: Pascal's Principle, Force, Pressure, Area, mechanical advantage plus advantages of Fluid Power and other useful information

Once all this material has been distributed:

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* which will tell the students how their efforts will be graded.
5. Stress the importance of the portfolio and refer to the *Portfolio Checklist*, *Portfolio-Notebook Template* and the *Iso-Ortho Views Explained.*
6. Emphasize the need to explore different designs! Usually the first idea is **not** the best!

The following chart explains the Design Process. It includes the text from the *Design Process Cube Sides*.



2F. USING THE DETAILED RUBRIC TO SCORE POINTS IN THE PORTFOLIO:

The detailed judging 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 e.g.:

"Our team decide 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" (1 point)

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

2G. PROCEDURE FOR SCHOOL-BASED CHALLENGES:

28 students, in teams of 4, will use their materials to design a solution to the Challenge recording their process in their team's Portfolio-Notebook.

From the 7 teams, one (1) team is selected to represent the school. The "selected team" kit contains materials for the selected team to work together to provide another prototype and portfolio-notebook. It is this version that is used for the Challenge Event.

A "Select-a-Team" rubric is available to judge teams

(An alternative format is to have a school-based competition with more than one team omitting the "selected team" phase. For example, if there are 4 teams in the Challenge Event then more Challenge Kits will be required. The winning team becomes the "selected team" and uses the Selected Team Kit to develop their new Notebook-Inventors' Log for the Challenge Event).

When a single team is selected to represent the school-chapter in a TSA event then that team will submit a copy of the team's final Inventors' Log at the Challenge Event

3. THE CHALLENGE EVENT:

3A. INTRODUCTION TO THE CHALLENGE:

A team will:

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

A Challenge Event takes approx. 3-3½ 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.

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 IN-SCHOOL CHALLENGE EVENT:

A team will bring only its Portfolio-Inventors' Log and their toolbox to the Challenge.

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 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.

The *Judges Rubric* is used to evaluate the team's performance. Attached to the Judges rubric are these interview questions and it is useful to invite an expert to judge the team's work on the day:

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?