

Grade 8 Hydraulics & Pneumatics Challenge

Challenge Situation:

Society is becoming more and more aware of its responsibilities to help physically challenged individuals operate in an independent manner. To do this, those who have physical disabilities will need to rely on devices that help them to overcome their physical challenges.

One of the major challenges for people with physical disabilities is difficulty picking up materials that they wish to use or that they have dropped. You have been asked to help with this by designing and constructing a model of a device that would aid in picking up different objects and materials.

Your device must meet the following design specifications:

- Must be operated by using hydraulic or pneumatic principles
- Must have accompany calculations showing the MA (mechanical advantage) or the lack thereof of your device
- Must be made out of the materials provided
- As part of your final product you will be required to give a sales pitch to a company that will potentially purchase your device for mass production

Project Criteria:

- You will be working in teams of 2
- 1 copy of the written report & drawings must be handed in for each group
- Every student is required to complete & submit a project learning log with their final written report
- Hand in your copy of the rubric with your final project

Due Date:

Group Members: _____
Class: _____

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S.P.I.C.E

S - Statement of Problem:

P - Possible Solutions: (Sketch 3 numbered sketches)

E - Evaluate: To be completed when your prototype is completed

The good things (strengths) of this model are:

If I were to do this again, I would improve or change the following things about my model:

Hydraulic & Pneumatic Information

- Hydraulics and pneumatics involve the transfer of force through a fluid
- Hydraulics transfers force through as liquid
- Pneumatics transfers force through as gas
- Both systems use pistons as the means to transferring the force
- The piston that is pushed is called the **driver** and the piston that reacts is called the **follower**
- When a force is applied to a piston or syringe the force is exerted equally against every cc (cubic centimeter) in the syringe. As the force is pushed through the tube to the follower syringe the force is also applied against every cc in the follower.
- If the follower syringe is large and has more cc's than the driver the same force pushing against a greater number of cc's and is therefore larger and you get an increase in force (Pascal's Law)

Example: In a hydraulic system that has a 30cc follower and a 10cc driver, the force in the driver is pushing against 10cc while the follower it is pushing against 30cc. Since the follower is 3 times as large, the increase in force from the driver to the follower is 3 times which means a MA of 3.

If the volume of the follower was 50 times more than that of the driver you get 50 times as much force and a MA of 50.

Note: Although you get more force the piston in the follower does not move as far or as fast as the piston on the driver. You lose distance and speed to gain an increase in force

Group Members: _____
 Class: _____

Criteria	Level 1	Level 2	Level 3	Level 4
Design Process	<ul style="list-style-type: none"> • develops a plan with assistance • demonstrates little use of the design process (SPICE) 	<ul style="list-style-type: none"> • develops a plan with limited assistance • demonstrates some use of the design process (SPICE) 	<ul style="list-style-type: none"> • develops a workable plan • uses the design process (SPICE) 	<ul style="list-style-type: none"> • develops a workable plan & modifies plan when necessary • effectively uses the design process (SPICE)
Model Design & Construction	<ul style="list-style-type: none"> • translates design plans into working model with assistance • creates model that may not perform intended function 	<ul style="list-style-type: none"> • translates design plans into working model with limited assistance • creates model with some intended function 	<ul style="list-style-type: none"> • successfully translates design plans into working model based on criteria required • creates model that functions successfully according to specifications 	<ul style="list-style-type: none"> • successfully translates design plans into working model based on criteria required • creates model that functions beyond expectations
Use of Tools & Equipment	<ul style="list-style-type: none"> • uses tools, materials with little regard to safety 	<ul style="list-style-type: none"> • uses tools, materials with limited regard to safety 	<ul style="list-style-type: none"> • uses tools, materials safely 	<ul style="list-style-type: none"> • uses tools, materials safely & appropriately
Group Work	<ul style="list-style-type: none"> • displays difficulty working toward group goals 	<ul style="list-style-type: none"> • demonstrates commitment to group goals: requires assistance to carry out specific roles 	<ul style="list-style-type: none"> • demonstrates commitment to group goals: carries out specific roles 	<ul style="list-style-type: none"> • actively identifies group goals and fulfills a variety of roles in group

<p>Communication With group & Written Report</p>	<ul style="list-style-type: none"> • report lacks clarity • communicates understanding of few of the basic concepts 	<ul style="list-style-type: none"> • communicates with some clarity • communicates understanding of some of the basic concepts 	<ul style="list-style-type: none"> • communicates clearly & precisely through all stages of task • communicates understanding of most of the basic concepts 	<ul style="list-style-type: none"> • communicates clearly & precisely & insightfully • communicates understanding of all of the basic concepts
<p>Learning Log</p>	<ul style="list-style-type: none"> • makes limited reflection • sets goals and describes steps needed to achieve goals, with assistance 	<ul style="list-style-type: none"> • reflects on results but makes few changes • sets a few goals and describes some of the steps needed to achieve goals 	<ul style="list-style-type: none"> • reflects on results in order to make necessary changes • sets clear goals, describes each step 	<ul style="list-style-type: none"> • uses sophisticated reflection to record results, and makes changes • sets clear goals, describes each step needed to achieve goals, adjust as necessary

Comments: