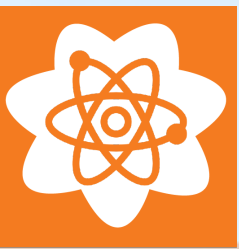
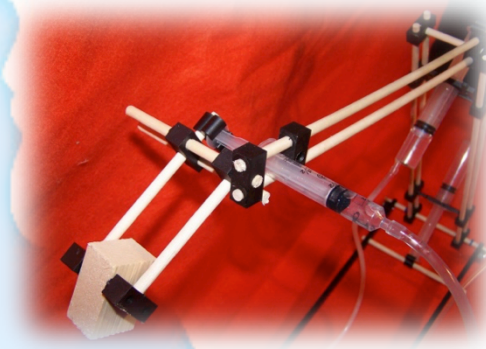


## Pneumatic Crane

Grade Level: ATHS G9

Cluster: Regular/ Advanced/ ASP

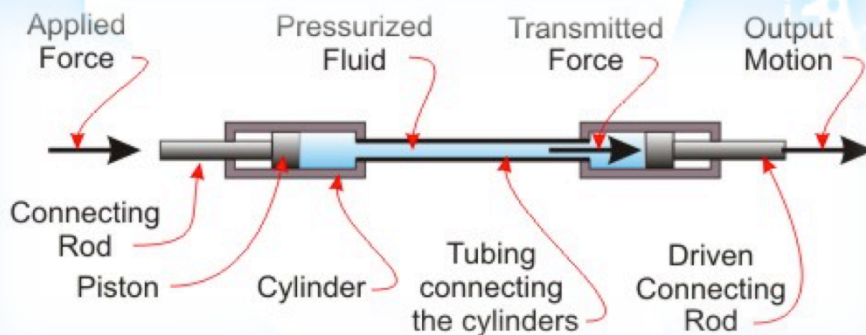


## Introduction

Pneumatic Systems (in Greek meaning "breath") is a branch of engineering based on the principles of physics. Mainly depend on the applications of using a pressurized gas, pressurized air and liquid.

Pneumatic systems used widely in industry are powered by compressed air, liquid or compressed gases. An electric compressor powers the cylinders, air motors, and other pneumatic devices.

Pneumatic systems are usually controlled manually or by means of automatic solenoid valves. They are widely used in mining, construction, excavation, dentistry, air brakes, jackhammer, pneumatic nail gun, and more.



Basic Principle of Pneumatic systems, Figure: [www.vektek.com](http://www.vektek.com)

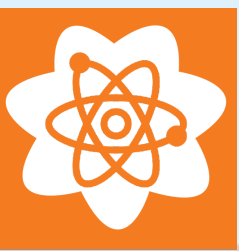


## Probing Questions

- ① Which construction materials should be used in the prototype?
- ① How many joints do we need?
- ① Prototype should be able to move in how many directions.
- ① How can we transfer pressure in the liquid to the prototype?
- ① How could your design be modified / changed to lift the load to twice the height or lift twice the mass?

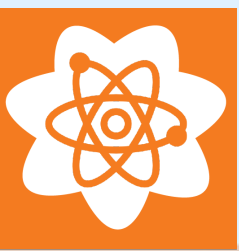
## The Challenge

- ✦ Your challenge is to create a crane capable of lifting up a full small water bottle (150 ml)



## Specification

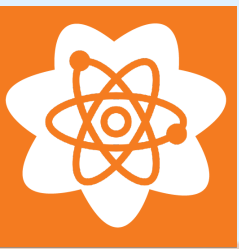
- ✧ The prototype may include different types wood, metal, syringe, plastic pipe, rubber band etc... as construction materials.
- ✧ The prototype must have a base allowing it to stand unassisted.
- ✧ It must include at least four syringes moving the prototype in different directions. You can use syringes with different size depending on the need.
- ✧ Different types of movements are accepted. However, extra credit will be granted for advanced movements.
- ✧ The crane should remain stable and not fall over when the load is applied.
- ✧ The Prototype should be able to lift a full water bottle successfully.



## Extra Resources

You may find the following resources useful for your project.

- [Spring Actuated Arm Mechanical Arm](#)
- [Hydraulic Robot](#)
- [Mechanical Arm](#)
- [Hydraulic Syringe](#)
- [Hydraulic Crane](#)
- [Pascal's Principle 1,](#)
- [Pascal's Principle 2,](#)
- [Pressure in Liquids,](#)
- [Pressure in Gases](#)



## Subject Specifications

### Physics:

Students to conduct research in the area of pressure in liquids, pressure in gases and Pascal's Principle. Then prepare a section in your report describing physical principles and its relation with the project.

### English:

If you were to include your crane in a catalogue you would need to design a page that will highlight all the features of your crane. Research different catalogue designs for construction machines and create your own page based on your creation.

### Business:

The students will produce a simple costing of their product which will be included in their report



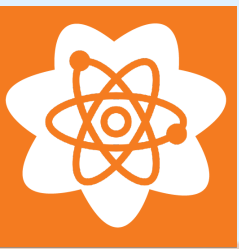
**Mathematics:**

What will be the minimum and maximum angles which can be attained between the crane hand and the horizontal surface. At which angle will the crane's hand exert the maximum power to lift the bottle of water. Write few lines about your observation in math part of your report.

**Engineering Design:**

Research how the use of appropriate levers and ways of linking the components of fluid systems can improve the performance of the system.

What are the most appropriate simple machines that can be used to produce the compound machine.



**Computer Science:**

Understanding all features of HopScotch App will be useful to employ all its capabilities to create the best animated clip. Explore the internet and get ideas of different projects around the world.

**Creative Design:**

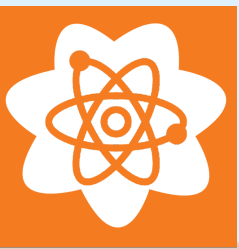
Research existing pneumatic devices as a starting point for your project. Depending on the materials you choose for your crane, sketch a range of ideas that will help to visualize your design. Consider form and aesthetic, as well as function, when creating your ideas





## Output/ Product

- ✧ A working prototype that meets the requirements.
- ✧ A report that contains the following:
  - ❖ Physics Principles
  - ❖ A costing of your prototype
  - ❖ Mathematical data collected and analyzed
  - ❖ Ways of improving the engineering design
  - ❖ Creative sketches of ideas that will help to visualize your design
- ✧ A catalogue.
- ✧ An animated clip using the of HopScotch App
- ✧ Your report will include Arabic part



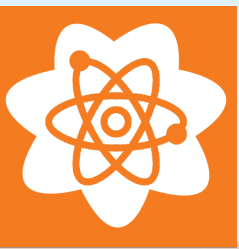
## Rubrics

	5	4	3	2	1
<b>Prototype</b>	A prototype that is capable of lifting the bottle successfully and consists of more than 4 syringe.	A prototype that is capable of lifting the bottle successfully and consists of exactly 4 syringe.	A prototype that is capable of lifting the bottle successfully and consists of less than 4 syringe.	A prototype that is not capable of lifting the bottle successfully and consists of less than 4 syringe.	A prototype that is not capable of lifting the bottle successfully and consists of less than 4 syringe.
<b>Math</b>	Accurate and precise measures of the minimum and maximum angles . Clear and correct narrative description of the relation between different angles and the power of the crane's hand.	Adequate measures of the minimum and maximum angles . partially Clear narrative description of the relation between different angles and the power of the crane's hand.	Adequate measures of the minimum and maximum angles . un clear narrative description of the relation between different angles and the power of the crane's hand.	angles are not measured properly, and description is not clearly defining the relation between the angles and the power of the crane's hand.	No angles were measured and no narrative description was provided.



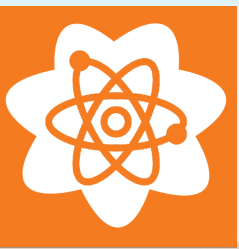
## Rubrics

	5	4	3	2	1
<b>Physics</b>	Physical principles are presented well and theory explained in details.	Physical principles are presented and theory is covered.	Physical principles are adequately presented and theory is adequately covered.	Physical principles are partially presented and theory is partially covered.	Physical principles are not presented clearly and theory is not covered.
<b>Engineering Design</b>	Gives complete and detailed explanation of how levers and fluid systems improve the performance of the system. Identifies pneumatics concepts involved correctly and with clarity.	Gives nearly complete explanation of how levers and fluid systems improve the performance of the system Correctly identifies most concepts involved.	Gives partial explanation of how levers and fluid systems improve the performance of the system Correctly identifies some concepts involved.	Gives simple explanation of how levers and fluid systems improve the performance of the system Uses limited concepts.	Gives no explanation of how levers and fluid systems improve the performance of the system Uses incorrect concepts.



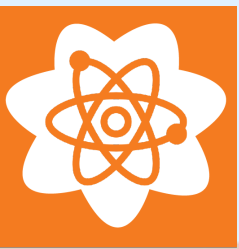
## Rubrics

	5	4	3	2	1
<b>Computer</b>	<p>Problem solving opportunities are all over the place. The model is moving freely. The animation allows the student student take on a new identity or role, and/or influence the model environment.</p>	<p>Presents multiple opportunities to problem solving. The student has more control over the movement of eth model. The animation has the option for students to create their own world by using different design elements or choosing an avatar.</p>	<p>Presents limited opportunities to problem solving. The student has control over the movement of the model. The animation has the option for students to create their own world by using different design elements, but the choices for different attributes or design techniques may be limited.</p>	<p>Presents almost no opportunities to problem solving. The student has control over the movement of the model. Limited design elements are used to animate the object.</p>	<p><i>Animation uses no problem-solving situations and is not connected to the real world.† The student has no control over the movement of the model. The animation doesn't allow for student customization of avatar or the environment.</i></p>



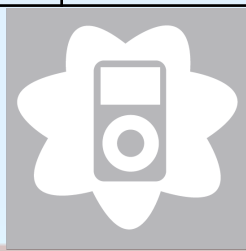
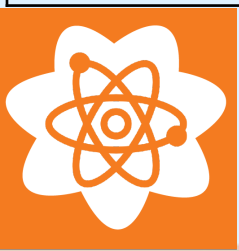
## Rubrics

	5	4	3	2	1
<b>Creative Design</b>	The project shows excellent research and creativity in design. Student has excellently relayed visualised prototype thoroughly detailed drawings	The project shows moderate research and creativity in design. Student has visualised prototype through detailed drawings	The project shows adequate research and creativity in design. Student has visualised prototype through some detailed drawings	The project shows little research and creativity in design. Student has visualised prototype through basic drawings	The project shows no research and creativity in design. Student has inadequately visualised prototype through drawings
<b>Costing</b>	The calculations include all necessary elements. They are neat, organized, and accurate.	The calculations are included. They are legible, but may lack organization and accuracy.	All necessary calculations are included. They are difficult to follow and contain significant errors.	The calculations do not include all necessary elements. They are difficult to follow and contain significant errors.	The calculations of the solution were not included. Only an estimate (if that) was provided.



## English Rubrics to evaluate the catalogue page

Score	4	3	2	1
<b>Attractiveness &amp; Organization</b>	The catalogue page has exceptionally attractive formatting and well-organized information.	The catalogue page has attractive formatting and well-organized information.	The catalogue page has well-organized information.	The catalogue page formatting and organization of material are confusing to the reader.
<b>Content - Accuracy</b>	The catalogue page has all of the required information and some additional information	The catalogue page has all of the required information	The catalogue page has most of the required information	The catalogue page has little of the required information
<b>Writing - Mechanics</b>	Writing is grammatically correct. Capitalization, punctuation and spelling are correct throughout the catalogue page.	Writing is mostly grammatically correct. Capitalization, punctuation and spelling are mostly correct throughout the catalogue page.	Some Writing is grammatically correct. Some of the capitalization, punctuation and spelling are correct throughout the catalogue page.	Most of the writing is not grammatically correct. Most of the capitalization, punctuation and spelling are not correct throughout the catalogue page.
<b>Graphics/Pictures</b>	The graphics go well with the text and there is a good mix of text and graphics.	The graphics go well with the text, but there are so many that they distract from the text.	The graphics go well with the text, but there are too few.	The graphics do not go with the accompanying text or appear to be randomly chosen.



## Sample of Catalogue Page

### MULTIFUNCTIONAL Lifting System for INDUSTRIAL / AUTOMOTIVE

Arc Lifting  
Standard Crane  
for Lifting  
OVER  
# 5200



More than just a crane, The Lift System can be dressed with options and setup to perform a wide variety of lift applications. Power Arm with accessories for multifunctional jobs

Special crown tread wheels with dust bearings provide High Mobility for ease of movement and positioning.

Flow through base allows legs to be telescoped backwards,

Dual Control: Air / Manual Hydraulics with upgraded lever release for absolute hydraulic control

5 1/2" Wheel  
Height Clearance



### Quick change to POWER ARM FLIP-OVER Tool holder

Parallel lift for  
OVER / UNDER  
applications



67" High  
24" Low

**POWER ARM:** An extra arm for the operator with a lifting range of: 67" High - 24" Low



Special Application Horizontal Boom adapter for high-low configuration

# 5200

For loads up to 5000 lbs for most applications

### Accessories / Options

Available counterbalance provides the ability to lift where the lift point is extended past the front wheels

#### Skid Spreader Option

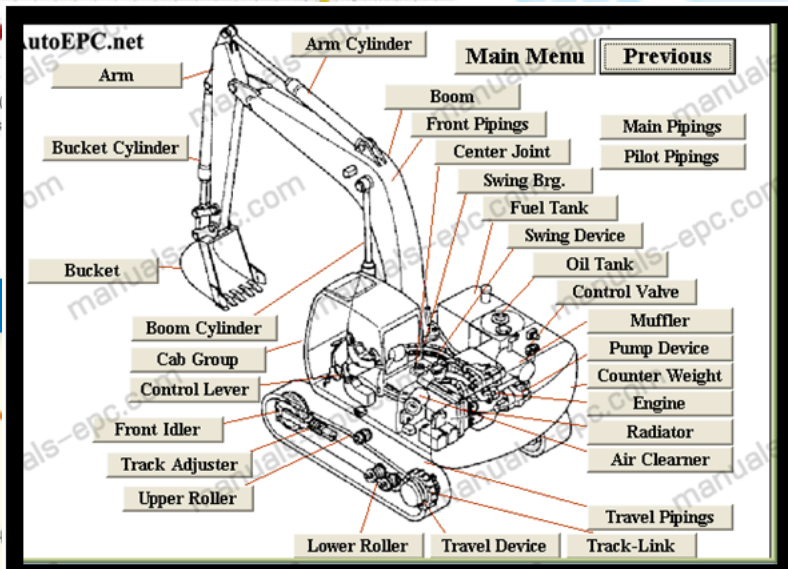


# 5280

# 3200 SSL

Available as a single counterbalance unit or stack 2 for more weight

Skid Spreader reduces all capacity



اللغة العربية

## الرافعة الهوائية





## توصيف المشروع العربي:

يُكلف الطالبُ بترجمة المشروع الذي قدمه في الإنجليزية إلى العربية، على أن يُراعي في العمل الجوانبَ التي تُتمّي مهارات الطالب اللغوية والأسلوبية، ونجدُ في آخر العرض، قائمةً من المعايير المستعملة لتقييم عمل الطلاب في المشروع، وخطّة لتوزيع الدرجات على جميع المكونات.



## محتويات المشروع:

يتألف المشروع من خمس شرائح تتكون  
مُحتوياتها على النحو التالي:

- الشريحة الأولى: العنوان باللغة العربية،  
وأسماء أعضاء المجموعة، والصف  
والشعبة، والمعلم المشرف وشعار  
المدرستين.
- الشريحة الثانية: المقدمة
- الشريحة الثالثة والرابعة: الموضوع
- الشريحة الخامسة: الخاتمة



### قائمة معايير التقييم

1	3-2	4	المعيار/العلامة
يفتقر إلى التفاصيل	يذكر معظم المعلومات	يذكر المعلومات كافة (عنوان المشروع - بيانات الطلاب - اسم المشرف - الشعار)	التوثيق في الشريحة الأولى
يعرض أفكاراً ضعيفة الصلة بالموضوع	يعرض أفكاراً واضحة ومتسلسلة غالباً	يعرض أفكاراً غنية ومتسلسلة وواضحة	مضمون المهمة البحثية
لا يُراعي الصّحة اللغويّة	يكتب مراعيًا الصّحة اللغويّة غالبًا	يكتب مراعيًا الصحة اللغوية دون أخطاء	السلامة اللغوية
يفتقر عرضه إلى التنظيم والإخراج السليم	يشمل عرضه معظم الشرائح المطلوبة	يتكوّن عرضه من شريحة المعلومات، وشريحة المقدمة، وشرائح الموضوع، وشريحة الخاتمة	الإخراج والتنظيم
نادرًا ما يراعي اللغة السليمة والطلاقة ولغة الجسد	يُناقش المهمة البحثية بلغة سليمة غالبًا وطلاقة متوسطة وكفاءة أقل	يُناقش المهمة البحثية بطلاقة ولغة سليمة موظفًا لغة الجسد بكفاءة	العرض الشفهي
20 درجة			المجموع:



## Mark Allocation

GRADE	PROJECT	SUBJECT	OUTPUT	MARK ALLOCATION
9 ATHS	Pneumatic Crane	Engineering	Prototype and Engineering Design	AE or Physics
		Physics	Report on the physical Principles and its application into the project	Physics
		Chemistry	None	None
		Biology	None	None
		Math	An observation sheet about different measures of angles, the minimum and maximum angles which can be attained between the crane hand and the horizontal.	Math
		Computer	Animated clip using the HopScotch App	CS
		Business	Cosing of the project- Report	Business or Math
		CMP	Research and creativity in design	CMP or CS
		English	A catalogue	English
		Arabic	Presentation	Arabic

