Fluids

Station #1
Pneumatics vs. Hydraulics

Task

Determine what system, pneumatics (using compressed air) or hydraulics (using compressed liquids) is best suited for controlling a robotic arm that is used in robotic surgery.

Day #1

1. Follow the instructions found at the station and gather the data required showing understanding of pneumatics and hydraulics.
2. Read the article about robotic surgery.
3. Read the article comparing hydraulics and pneumatics.
4. Use a highlighter to mark advantages and disadvantages for both systems.
5. Fill out the comparison chart with what you know from the experiment and your reading.

Day #2

6. Using the following website to learn more about pneumatics and hydraulics. You will also find it in your science folder on your desktop. http://www.wisc-online.com/objects/index_tj.asp?objID=HYP4307
7. Complete the comparison chart of pneumatics and hydraulics.
8. Write a report that explains your recommendation for which system to be used in robotic surgery. Make sure you back up your decision with facts that you've discovered.
    a. You must use the proper writing process.
        i. Brain storming - this is your comparison chart
        ii. Rough copy
        iii. Revising
        iv. Final draft
    b. You must also make a R.A.F.T. before you begin by filling out the chart provided.

Information to read

From "How Stuff Works" Website

Advantages of Robotic Surgery

In today's operating rooms, you'll find two or three surgeons, an anaesthesiologist (person that sedates the patient) and several nurses, all needed for even the simplest of surgeries. Most surgeries require nearly a dozen people in the room. As with all automation, surgical robots will eventually eliminate the need for some of those personnel. Taking a glimpse into the future, surgery may require only one surgeon, an anaesthesiologist and one or two nurses. In this nearly empty operating room, the doctor will sit at a computer console, either in or outside the operating room, using the surgical robot to accomplish what it once took a crowd of people to perform.

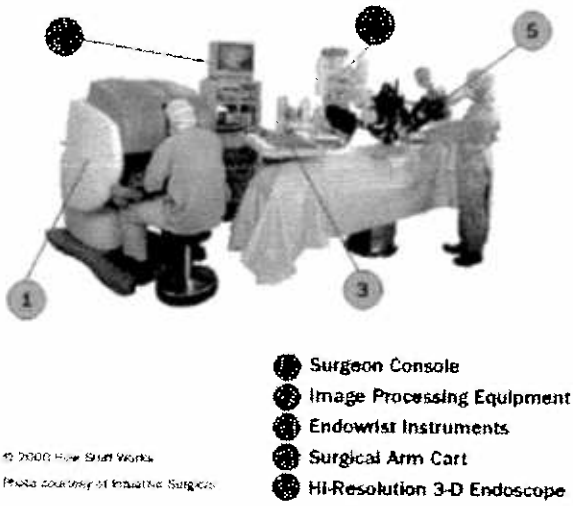

Photo courtesy of Intuitive Surgical

The use of a computer console to perform operations from a distance opens up the idea of **tele-surgery**, which would involve a doctor performing delicate surgery miles away from the patient. If the doctor doesn't have to stand over the patient to perform the surgery, and can remotely control the robotic arms at a computer station a few feet from the patient, the next step would be performing surgery from locations that are even farther away. If it were possible to use the computer console to move the robotic arms in **real-time**, then it would be possible for a doctor in California to operate on a patient in New York. A major obstacle in tele-surgery has been the time delay between the doctor moving his or her hands to the robotic arms responding to those movements. Currently, the doctor must be in the room with the patient for robotic systems to react instantly to the doctor's hand movements.

Having fewer personnel in the operating room and allowing doctors the ability to operate on a patient long-distance could lower the cost of health care. In addition to cost efficiency, robotic surgery has several other advantages over conventional surgery, including enhanced precision and reduced trauma to the patient. For instance, heart bypass surgery now requires that the patient's chest be "cracked" open by way of a 1-foot (30.48-cm) long incision. However, with the da Vinci or ZEUS systems, it is possible to operate on the heart by making three small incisions in the chest, each only about 1 centimeter in diameter. Because the surgeon would make these smaller incisions instead of one long one down the length of the chest, the patient would experience less pain and less bleeding, which means a faster recovery.

Robotics also decreases the fatigue that doctors experience during surgeries that can last several hours. Surgeons can become exhausted during those long surgeries, and can experience hand tremors as a result. Even the steadiest of human hands cannot match those of a surgical robot. The da Vinci system has been programmed to compensate for tremors, so if the doctor's hand shakes the computer ignores it and keeps the mechanical arm steady.

While surgical robots offer some advantages over the human hand, we are still a long way from the day when autonomous robots will operate on people without human interaction. But, with advances in computer power and artificial intelligence, it could be that in this century a robot will be designed that can locate abnormalities in the human body, analyze them and operate to correct those abnormalities without any human guidance.

How stuff works website

(Highlight advantages and disadvantages in this paragraph.)

Tradeoffs between hydraulic vs. pneumatic power

Though hydraulic and pneumatic power shares many characteristics in common, there are some key differences. For example, because hydraulic fluid is much less compressible than a gas, hydraulic power is preferred over pneumatic when precise position control is required. On the other hand, pneumatic power has an edge in applications where the presence of hydraulic oil could cause problems (e.g. in food processing machines). Pneumatic systems are also typically less expensive to build than hydraulic.

Data Collection Sheet

Table #1

Volume of fluid drawn in	Volume of air in jack (ml)
4ml or cc	
8ml	
12ml	

Table #2

Volume of fluid drawn in	Volume of air in jack with books (ml)
4ml or cc	
8ml	
12ml	

During the pull stroke describe the movement of the fluid.

During the push stroke describe the movement of the fluid.

Table #3

Volume of fluid drawn in	Volume of water in jack (ml)
4ml or cc	
8ml	
12ml	

Table #4

Volume of fluid drawn in	Volume of water in jack with books (ml)
4ml or cc	
8ml	
12ml	

What did you notice about the amount of force you needed to use to push in the syringe as compared to how much force you would have needed to use to lift the textbooks with your hands.

What happened to the load of books when you opened the valve?

Explain which fluid is compressible, liquid or gas.

NAME:

Comparison Chart of Hydraulics and Pneumatics

Hydraulics	Pneumatics
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.

R.A.F.T.

Role of Writer (Who are you as the writer?)	
Audience (Whom are you writing this for?)	
Format (What kind of writing is this? Speech, a letter, poem...	
Topic and strong verb (What is the subject or the purpose of this?)	