Hydraulic System

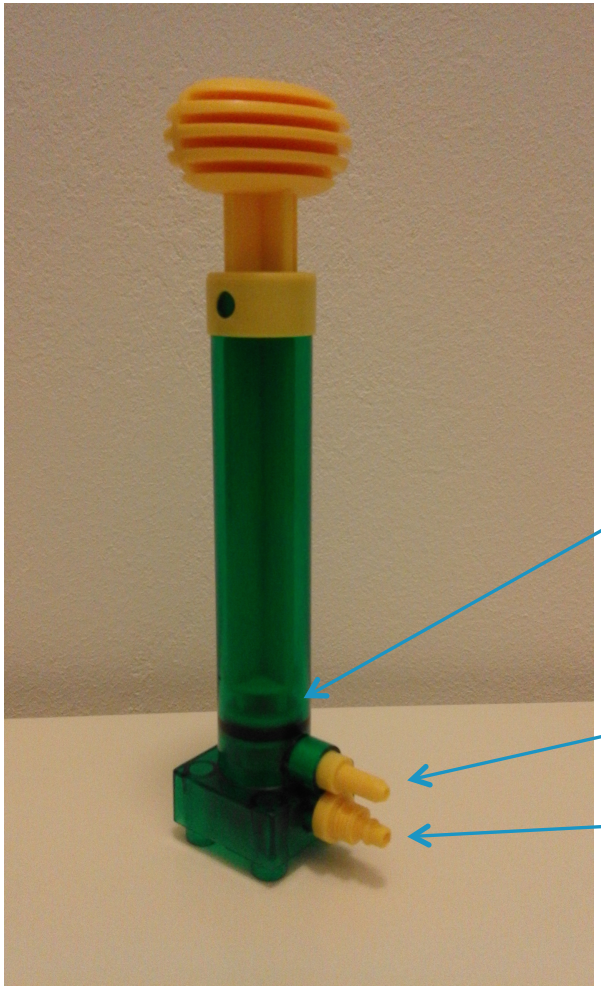
force magnification

Our aim(=Ziel).....

We want to raise up a heavy book, but to use only a fourth of the weight force of the book.

¼ of the force

Hydraulic Pump



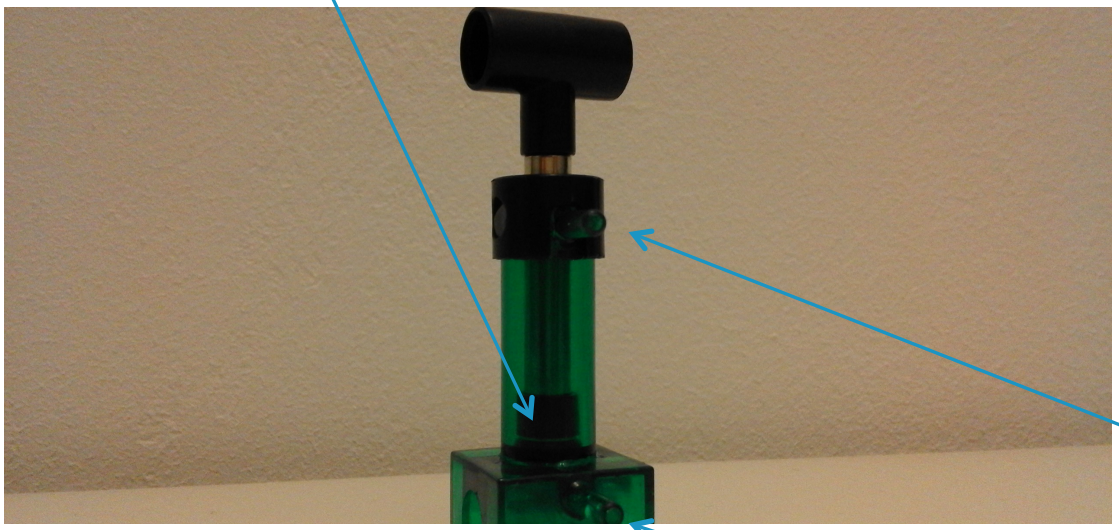
Piston (=Kolben), moved by air/water

Valve (=Ventil) for air/water going IN

Valve for air/water going OUT

Hydraulic Cylinder

Piston moved by water/air



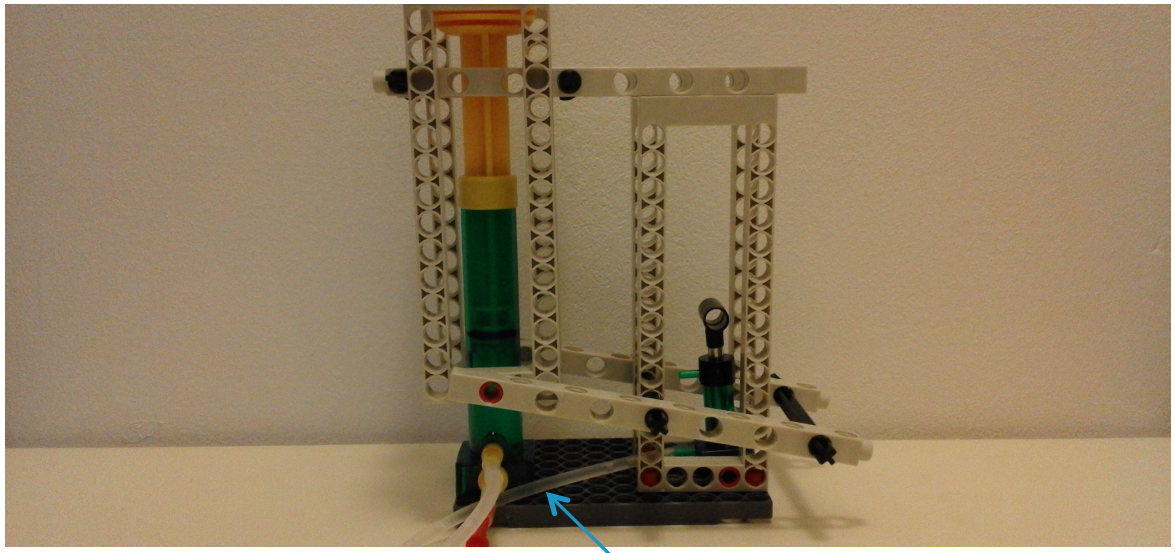
Valve for air/water going IN/OUT

Valve for air/water going OUT/IN

Physical background

- Pressure in ideal (non-viscous) fluids (e.g. water)
- Neglection of fluid weight

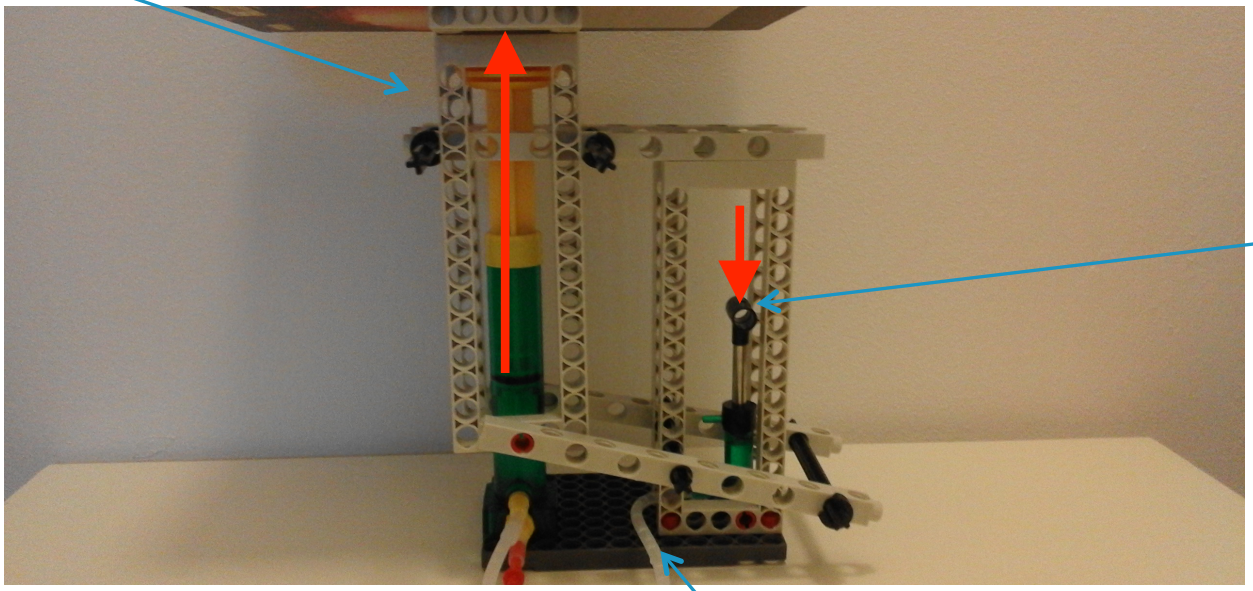
→ Pressure p is the *same* in pump, cylinder and hose (=Schlauch)!



Pump and cylinder are conected

Let‘s go!!

3.Book is raised up by the pump



1.press

2.Water flows through the hose

What is the secret behind the experiment?

Pressure p = const.

* Force F = pressure p * area A
* Force on piston (=Kolben) $F_{piston} = p * A_{piston}$
* $A_{piston,pump} = 4 * A_{piston,cylinder}$

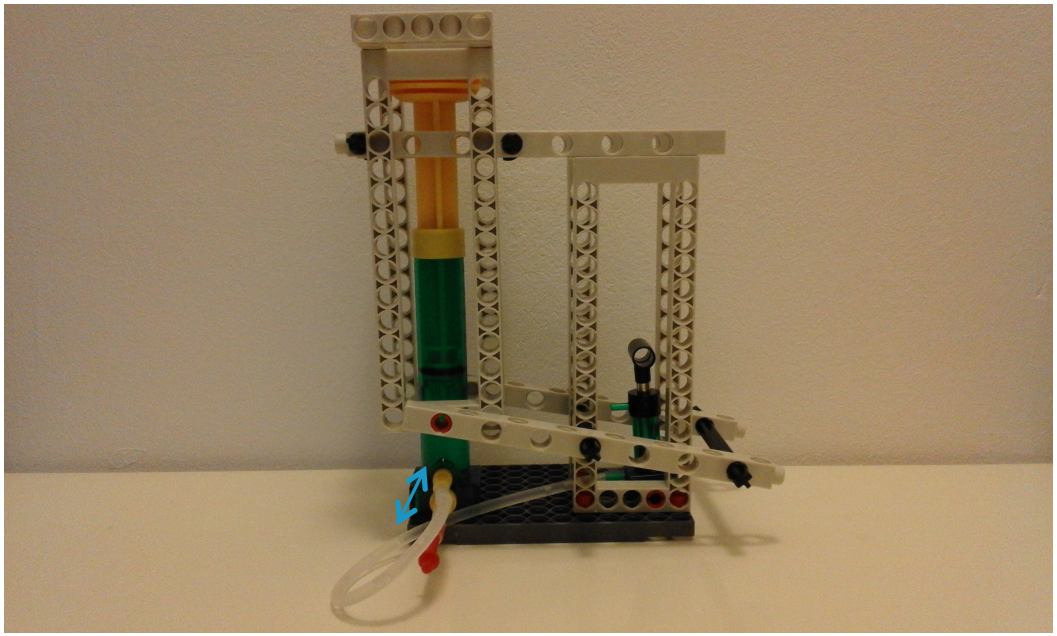
→ $F_{piston,pump} = 4 * F_{piston,cylinder}$ (the force is magnified ***four times***)

Work = Force times path = F * s = const.

* $F_{piston,pump} * s_{piston,pump} = F_{piston,cylinder} * s_{piston,cylinder}$
* $s_{piston,cylinder} = (F_{piston,pump} / F_{piston,cylinder}) * s_{piston,pump} = 4 * s_{piston,pump}$
* (but the cylinder needs to be moved ***four times more*** than the pump is moving)

How to do the experiment again

If you want to repead the experiment you have to change the two hoses.



Thank you for your attention!!!!!!