TEMPLATE for BEST PRACTICE EXAMPLES

1. **Name of the project:**
   Hydraulic jack

2. **Subjects covered from STEAM areas:**
   Science, engineering, mathematics

3. **Target group (age range and size of the group):**
   11-16 y.o.

4. **Duration of the activity:**
   1-2h

5. **Key words:**
   Hydraulics, force, pressure

6. **Key sentence describing context of the activity, followed by short description (200 words):**
   Make a jack and measure its lifting capability.
   Students use syringes to make a jack. The force of the jack is measured with either a force meter or by lifting a set of weights with it. The target is to make a jack that has a high lifting capability. The theoretical force of the jack is compared to the measured force.

7. **Description of the activity environment, including the list of materials and tools needed:**
   Materials: Syringes (different sizes) and hoses to connect the syringes. A frame for the jack (e.g. wooden frame with connection points for the syringes connected with cable ties for example). Hose splitters to connect more than two syringes. Force meter or a set of weights to measure the force of the jack.

8. **Step by step, detailed description of the activity, including teaching and learning strategies:**
   Students are divided into groups. The students should already be familiar with the concept of pressure.
   1. The basics with two syringes
   Students are given two different size syringes connected with a hose. The task is to try how much force they can get out of the two syringe setup. With some trial and error the students realize that the bigger syringe should be the one that lifts the weight.
   2. Connection with pressure
   Why is it easier to push the smaller syringe and lift with the bigger one? Teacher explains the connection with pressure.
   3. Making the jack

Students are tasked with making the frame of the jack. The important thing is to have enough space inside the jack to attach the syringe(s). Students design the hydraulics so that the jack can produce a high force. Students need many syringes and hose splitters to divide the fluid into many syringes.

4. Measuring the force of the jack

Students measure the force of their jack with a power meter or by lifting a set of weights with it. Students can also measure the force with which the syringe is pushed. Is it possible to lift a person with the jack?

5. Calculating the force of the jack

By calculating the surface areas of the syringe that is pushed and the syringes that lift the weights students can calculate how many times bigger the jack makes the applied force. This can be compared to the measured pushing and lifting forces.

9. Learning objectives/competencies:

Learning about force and basic hydraulics concepts, manufacturing a frame for the lift that can handle the forces, learning about the relation of force and distance: if the jack increases force, also the working distance increases.

10. Evaluation/Assessment guidelines:

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11. Lessons learned:

The limiting factor for the jack can easily be the structural strength of the jack frame and the syringe attachments. The syringe that is pushed should be reasonably long so that the jack can lift the weight a reasonable distance. The hose connections should be secured so that they don’t fail and wet everyone around.

12. Additional information/Links:

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13. Contact person:

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