TEMPLATE for BEST PRACTICE EXAMPLES

1. **Name of the project:**
   Electric power plant

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

3. **Target group (age range and size of the group):**
   13-16 y.o.

4. **Duration of the activity:**
   2-3 h

5. **Key words:**
   Electricity, electromagnetic induction, generator, turbine

6. **Key sentence describing context of the activity, followed by short description (200 words):**
   Students build an electric power plant using a ready made electric motor.
   The power plant consists of an electric motor used as a generator and a self made turbine. The generated electricity is measured and used on an electric device. The power of the power plants is calculated and optimized by manufacturing a better turbine and possibly a gearing mechanism.

7. **Description of the activity environment, including the list of materials and tools needed:**
   Materials: Electric motors, materials for the turbine (e.g. cardboard, ready made turbine from for example a cooling fan or a 3D printed turbine), pressurized air to test the turbine, electrical cord, lamps or other electrical devices, voltage and current meters.

8. **Step by step, detailed description of the activity, including teaching and learning strategies:**
   Students are divided into groups.
   Students should already know the basics of electricity and the concept of electromagnetic induction.
   1. Understanding the principle
   Students use the electric motor to get the lamp to illuminate. At this point they only use their fingers to turn the axle of the motor.
   2. The working principle of a power plant
   Teacher teaches the simplified working principle of a power plant.
   3. Manufacturing the turbine
   Students should start with the wind turbine, since it is the simplest. Pieces of cardboard tilted at an angle and connected to the axle of the motor should work decently. The

turbine can be turned by blowing on it or using pressurized air for a bigger blow. A lamp is connected to the generator to give a visible proof of the generated electricity.

4. Measuring the power

The voltage and current produced by the generator is measured, and the corresponding power calculated.

5. Fine tuning the generator

Students now have the power readings generated by the simple power plant. Now they are tasked to improve the power for example to illuminate more light bulbs or a bigger light bulb. The idea is to mainly get the turbine to work better. Students can play with different turbine blade shapes, tilts and sized. For a bigger effect the turbine can be swapped for example to a ready made cooling fan or the students can make their own turbine with a 3D printer. It is also possible to make it a hydroelectric power plant by using water from a faucet. The turbine can also be used with steam simply with a bunsen burner and an Erlenmeyer flask and a (small diameter) tube directing the steam to the turbine. It's also possible to manufacture some sort of gearing (for example from Legos) to better match the turbine speed to the optimum speed of the motor.
Again the power from the improved power plant is also calculated.

9. Learning objectives/competencies:

Learning and exploring electricity and electromagnetic induction related concepts, manufacturing and optimizing a product, using a digital (3D) model in a real world application, strengthening competence in basic electricity calculcations

10. Evaluation/Assessment guidelines:

If evaluated, the grading should take into account at least the power generated, structural integrity of the power plant and engineering ingenuity.

11. Lessons learned:

Motors have limits on how much power they can handle. Students should also know these limits not to accidentally burn the motor. The motor and the load (e.g. lamps) should be matched so that the motor is able to illuminate the lamps, and on the other not to burn the lamps. For example fans meant for computer cooling make for a good turbine.

12. Additional information/Links:

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13. Contact person:

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