centre de développement pédagogique
pour la formation générale en science et technologie

Working document

Overview of the task « AST »

The electric hydroplane

Target audience:	2nd cycle of secondary school (4th year) **AST**
Team work:	2 people
Time required in class:	15 - 75 minute periods

Pedagogical intention:

The first aim of this LES is to design a part to regulate a Reed switch motor (RSM). To do so, the student has to carry out several learning activities related to the scientific and technological concepts associated with electric motors. An analysis of the RSM allows the student to understand the scientific and technological principles of the missing part. While testing the RSM, the student will control its operation.

The second aim of the LES is to design a propeller that will propel the hydroplane. To do so, the student will carry out two learning activities related to the concepts associated to Archimedes' flotation principle and Bernoulli's principle of fluid dynamics. When testing the hydroplane, the student will control its operation with the objective of participating in a race to be held later.

NOTE: This LES was designed within the framework of training sessions. It will require adaptation before being used with students

Targeted disciplinary competencies:

C_d-1 *Seeks answers or solutions to scientific or technological problems*

- The student must develop a design process allowing him to make the part that regulates the RSM and the propeller.

C_d-2 *Makes the most of his/her knowledge of science and technology*

- The motor and the propeller constitute two of the applications which the student may study. His full understanding of the scientific and technological principles involved will allow him to control their operation.

Targeted cross-curricular competencies: C_t-4 Uses creativity

Broad area of learning	**Personal and Career Planning** Focus of development: • Self-knowledge and awareness of his/her potential and how to fulfill it (recognition of his/her talents, strengths, interests and personal and career aspirations).

Worlds and concepts that may be involved N. B. The concepts written in italics are broached in the optional AST (ES) course	**Material World:** Electricity • Ohm's Law • Electrical circuits • Relationship between power and electrical energy Electromagnetism • The forces of attraction and repulsion ▪ Magnetic poles of permanent magnets ▪ The force of attraction and repulsion between two magnets • Magnetic field of a solenoid ▪ Intensity of the field in relation to the number of whorls ▪ Intensity of the field in relation to the current ▪ Intensity of the field in relation to the type of core used ▪ The right hand rule ▪ The force of attraction and repulsion between a magnet and a solenoid Transformation of energy • Law of conservation of energy • Energetic output • *Relation between potential energy, mass, acceleration and displacement* • *(optional course)* • *Relation between kinetic energy, mass and speed (optional course)* Fluids • Archimedes' principle • Bernoulli's principle Forces and movements • Relation between constant speed, distance and time **Technological world:** Language of lines • Multi-view orthogonal projection (overall drawing) • Functional dimensioning • Standards and representations (diagrams, symbols) Mechanical engineering (implicitly during design stages) • Adherence and friction between parts • Linkage of mechanical parts (degree of liberty of a part) • Guiding function Electrical engineering • Supply function • Conduction, insulation and protection function • Command function (magnetic switch) • Transformation of energy function (electrical to mechanical, thermal, etc.)Fabrication • Drilling • Measurement and control (form and position, angle)

Techniques	**Technology:** Graphical language • Using instruments to carry out a graphical representation (e.g.: multi-view orthogonal projection) • Choosing the most explicit view of the technical object to be described Fabrication • Using machine tools safely (e.g. band saw, press drill, disc sander) • Making the part while respecting the steps of the following machining processes: stripping, splicing, soldering • Sanding the faces or de-burring the edges of each part after fabrication (propeller) • Choosing the appropriate tools for assembly • In the case of electrical circuits, identify and gather the electrical components. • Connect the components using wire, connectors or solder • Evaluate the dimensions of a part using a ruler or a calliper during and after fabrication • Compare the actual dimensions of a part to the specifications (draft, plan, technical file etc.) • Proceed with making the part, applying the appropriate techniques **Science:** • Adequate use of measurement instruments (e.g.: ampere meter, voltmeter)
Community resources	There has long since been, in our surroundings, a culture of inventiveness. You need only think of Bombardier and its dazzling development. This company is the fruit of the passion of a single man, Joseph-Armand Bombardier. This company is now a multinational corporation that makes us all proud.
Possible evaluation: You will find trails corresponding to the evaluation criteria in the student booklet, though an actual evaluation grid is not supplied.	
Global context: This LES puts the student in the context of a friendly competition. The situation will end with a hydroplane race (at the school pool if possible or in class in a more modest basin). To do so, the student will have to: • Study the operating principles of the RSM; • Make the RSM and design a regulatory part; • Test the RSM and control its operation; • Design a propeller that will be installed on the RSM; • Test the hydroplane and control its operation; • Be measured against other prototypes during a race; • Carry out an integration and reinvestment synthesis activity.	