Detailed Unit Plan: **Year 10 STEM Electric Cars**

AVE MARIA COLLEGE
A Catholic College for Young Women

Length of unit	15 lessons ≈ 6 weeks

UNIT OVERVIEW

Students design and construct electric cars. Parts must be studied, including motor, battery holder, wires, wheels, axels, sleeves and gears. Gear options are available and 2 must be chosen based on the need to balance top speed versus the power available to potentially achieve that speed, so an understanding of the relationship between the ratio of teeth on 2 gears, engine rotation speed, wheel radius and car top speed is explored. A prototype is built using a corflute chasis with sticky tape and 2 sided foam tape being the major binding agents. Careful measurements are made from the prototype. Students sketch using SketchUp, convert to STL, examine in Cura and 3D print a chasis that is based on the prototype but designed to hold all pieces in place without sticky tape or other connecting agents. Special emphasis is on minimising weight, printing time and filament use while still providing sufficient strength and rigidity. Students build the new car with the 3D printed chasis. Cars are raced against the creations of other students under class designed race conditions.

ESSENTIAL QUESTIONS *(no more than 5 "big" questions for the Unit)*

1. How does a DC electric engine work?
2. What is the relationship between the number of teeth on gears, the acceleration and the speed of a vehicle?
3. Can we 3D print a car chasis to connect engine, battery holder, wires, wheels, axels and gears using no glue or tape?

LEARNING OUTCOMES *(there should be 4-6 items in each section, depending on the number of essential questions and unit duration)*

What students **should *know*** by the end of the unit

- You create 3D objects using SketchUp by adding and subtracting 3D figures, extended from 2D shapes.
- Objects print much quicker with different rotations, but some rotations will not print successfully.
- The larger the ratio of teeth of spur pear to pinion gear, the larger the acceleration but the slower the top speed.
- How a switch works
- There is more than 1 correct way to build the dragster car.

What students **should be able *to do*** by the end of the unit

- Build an electric car from the Dragster kit and a student created body
- Design a 3D objct using SketchUp
- Transform a SketchUp file to STL format
- Examine a 3D object in CURA to see if it will print
- Rotate a 3D object in CURA
- Print a 3D object

GLOSSARY OF TERMS

SketchUp	CURA	3D printer	Units mm	Rotate
Scale	Push/Pull tool	Measuring tool	Rectangle tool	Circle tool
Line tool	Arc tool	Print bed	Extruder	Filament
Gantry	Belt	Laminated layers	Extension Warehouse	STL file
Zoom	Pan	View	Spur gear	Pinion gear
Engine	Switch	Positive wire (red)	Negative wire (black)	RPM
Radius	Circumference	Diameter	Acceleration	Plan view
Side View	End View			

LEARNING CAPABILITIES *(there should be 3-6 items in this section, depending on the Domain and subject focus*

Numeracy Focus

- ✓ Measure in mm, convert other units to mm.
- ✓ Apply gear ratios to 1000 rpm engine speed, apply wheel circumference to calculate theoretical top speed.

Literacy Focus

- ✓ Students to keep a glossary of symbols and language associated with the electric dragster and 3D printing

General Capability Focus – Critical and Creative Thinking

- ✓ Build an electric dragster
- ✓ Inquiring – identifying solution requirements
- ✓ ICT – download required software. Create SketchUp. Use CURA. Use 3D printer.

VCE preparation Focus

The process of analysing a problem, designing a solution, creating the solution and evaluating it is consistent with requirements of VCE Computing.

Indicators:

- *ability to identify a problem and design a solution*
- *ability to print a 3D object*

ASSESSMENT

Formative / ungraded	Summative / Graded (on the report)	%	weighting

• King Arthur Problem • Gear ratios, wheel circumference, engine rpm, theoretical top speed worksheet	• Dragster Assessment Task	100%	

ALTERNATIVE LEARNING OUTCOMES:	
For developing students	For extending students
- Teacher may assist more with building Dragster. - Teacher may assist more with using SketchUp. - Teacher or IT may print the student's object.	- Students may work in more than 2 gears. - Students may select a real life problem, imagine, design and print a solution.

Detailed Unit Plan – Work Program

Essential Question: What is the relationship between the number of teeth on gears, the acceleration and the speed of a vehicle?

Lesson(s)	Learning Intention	Success Criteria	Learning Concepts	Resources and activities
1	Reciprocal teaching and problem solving techniques.	Students work in a group to solve the King Arthur problem. Students self assess their efforts.	Groups work best when all members are actively involved. Problem solving can be assessed in many ways, therefore, there are many different worthwhile actions in problem solving.	King Arthur problem with … rubric
2	Students study the components required for building an electric car	Students understand all components of the dragster	Students gain a complete understanding of the Assessment task and how to build a dragster.	Dragster building instructions. 1 Scorpio dragster no solder kit per student. Dragster Assessment Task and Rubric.
3	Students understand how gear selection relates to car performance.	Students complete worksheet. Students can make an informed gear selection	Gear ratio = teeth on spur gear ÷ teeth on pinion gear.	Worksheet
4-6	Students build the dragster	A dragster is built that works	Choice of gears. Simple series electric circuit.	Dragster kit Coreflute Construction tools Stick tape and 2-sided foam tape
7	Which dragster is the fastest and why?	Students race their dragsters	Friction Acceleration / power relationship	Dragster Racing track Stopwatch

Essential Question: Can we 3D print a car chasis to connect engine, battery holder, wires, wheels, axels and gears using no glue or tape?

Lesson(s)	Learning Intention	Success Criteria	Learning Concepts	Resources and activities
8-9	Students can draw an object from 3 different directions.	Students draw a 1:1 scale drawing of their dragster, including plan	Plan view is from above. Accurate scale drawing essential for working 3D print	Graph paper Ruler

Lesson(s)	Learning Intention	Success Criteria	Learning Concepts	Resources and activities
		view, end view and side view, all with measurements shown.		
10-11	Student's learn how to use SketchUp	Students draw in SketchUp the chasis for their dragster	Using SketchUp, draw a 2D shape, then push or pull it into 3 dimensions.	Student PC SketchUp
12-14	Students organise the print of their chasis and put their car together	Dragster created with 3D body	Cura can check a print before it is printed.	Student PC CURA 3D Printer
15	Which dragster is the fastest and why?	Students race their dragsters	Friction Acceleration / power relationship	Dragster Racing track Stopwatch

Essential Question: *(taken from unit outline)*

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