ST JOHNS COLLEGE

Course Title: Gravity Racing

Year 11 **Curriculum Level(s): 6**

Focus-Technology Components

- Technological Products
- Construct a Resistant Materials Product
- Outcome Development and Evaluation – Prototype
- Planning for Practise
- Construct a Resistant Materials Product

COURSE DURATION

One year course, 32 weeks, 4 x 60 min periods per week.

COURSE DESCRIPTION

Students will design and construct a Gravity Powered Vehicle that they will race in an interschool challenge. A focus of the course will be on developing student knowledge of materials and processes and how their selection impacts on the performance of the vehicles.

This course has a strong focus on developing students:

- abilities in outcome development and implementation
- understanding of how a materials composition and structure determines their suitability for use in products
- abilities to create high quality well crafted products.

COURSE STRUCTURE

Brief Development:

As this course does not specifically allow for the identification of an issue (this is given to the students), the students are not required to develop a brief from start to finish. The approach is rather to further refine an initial brief which is supplied by the teacher. An initial conceptual statement is supplied along with a list of specifications.

As research and development evolves, students will refine the given brief to personalise it and enable it to be used to assess the 'fitness for purpose' of their manufactured gravity powered vehicle.

Planning for Practise:

Students are encouraged to take responsibility for their own progress. This is achieved by introducing and using a selection of appropriate planning tools to achieve identified key stages.

Outcome Development and Implementation:

The major focus for this course is to develop a functional gravity powered racer (luge). This is achieved by developing an understanding of specific performance requirements of components that combine to make the luge. Students investigate and test materials, manipulation processes and component selection to achieve performance requirements.

Learning Outcomes:

Student will:

- Demonstrate understanding of how material composition and structure informs the selection and use of materials when developing a luge
- Follow a construction schedule/plan to skilfully and efficiently make a luge to an agreed set of specifications
- Develop sketches that effectively communicate the design features of a luge in order to test their initial and developing design ideas
- Make informed selections of materials, tools, equipment and techniques to develop and trial a luge designed to meet a brief.
- Evaluate the fitness for purpose of the final outcome against the specifications

COURSE OVERVIEW

Exploring the Concept of Gravity Racing:

Initial introduction to this course is carried out:

- Class discussion covering course and introduction to gravity racing. Look at previous year's competition.
- Year 12 students who participated in last year's competition visit classroom. Discuss issues they encountered the previous year covering design, performance, manufacturing etc.
- Techlink video of luge race day used to look at previous outcomes. Existing folders used to show layout, depth of information and presentation standard required.
- Research and record type of gravity racing (luge, street luge, soap box) to gain an understanding of how they work, materials and processes used etc.
- Engineers from *Industrial Tube Manufacturing* visit to discuss criteria for manufacturing and innovation section of the competition.

Planning:

Resources used: *Resistant Materials Technology, www.technologystudent.com.*

Planning is introduced and discussed.

- Year planner is introduced and negotiated with class to set milestones (teacher guidance is crucial at this stage). Students will become more independent at planning as the course evolves and students see the relevance of the planning undertaken.
- Planning is used to guide development stages, research, luge design, resources, material and process testing, construction, implementation and evaluation.

Stakeholder Identification:

Resources used: *Resistant Materials Technology, questioning techniques.*

The importance of identifying and using stakeholders is discussed:

- The development of a residential home is used as an example. Students identify possible stakeholders and explain their input.
- Stakeholders are identified and selected for their specific input into the course. Knowledge of gravity racing, previous participants, materials and construction knowledge. Parents' input (transportation, funding, authority to participate).
- Discuss and give students tools to gather and use information from stakeholders.

Ergonomic:

Resource used: *Resistant Materials Technology*

Ergonomic issues are identified and researched. What is anthropometric data and how can we use it to achieve an ergonomic design. Importance of anthropometric data is discussed in relation to the luge, pilot's height, trunk length, leg length, shoulder width.

Methods of recording and documenting ergonomic information is discussed and made available to students. Ergonomic information is used during development of the luge to inform the design of specific components, determine how weight will be distributed and determine steering geometry. Documented evidence of ergonomic considerations are applied and recorded in the final orthographic drawings of the luge.

Materials Knowledge and Testing:

Resources used: *GCSE Resistant Materials Technology for OCR, Skills in Resistant Technology. www.technologystudent.com*.

As materials are a major factor in optimising the function of the luge, it is important that students have sufficient materials knowledge to support the development of their luge:

- Initial introduction of terminology (composition, structure, formulation, tensile strength, yield strength, profiles).
- Introduction by manufacturing engineer covering mild steel (properties, profiles, tensile strengths, yield strength, manipulation, jointing and finishing techniques).
- Introduction to timber (composition, structure, grain, ply wood properties, lamination, tensile strength, yield strength). This is also the introduction to A/S 91049 (1.6).
- Testing a selection of materials is carried out in groups and results are shared. Timber, ply wood, EWSS, aluminium are tested for yield and tensile strength.
- Students are introduced to forming of materials and given examples. In groups students work with a selection of materials to form combinations with the intention of improving yield and tensile strengths. Results are recorded and shared. Students summarise their findings and this is used during their materials selection.

This type of testing allows for hands on activities while utilising time. Generally evidence is recorded using photographic evidence with student's personal summaries.

Materials Manipulation and Testing

At this stage students have been introduced to a range of processes used to manipulate the materials we have identified as suitable for luge construction. This has come from existing product research, information from the two technologists' visits and testing of materials.

- A class discussion is used to summarise the above information.
- Students document this information which is later used along with further testing information to select appropriate processes.
- In groups, students produce and test various manipulation and jointing processes (jointing of timber for frames, laminating and shaping ply wood for frames, bending and jointing EWSS , bending and jointing aluminium hollow section).
- Students also produce and test various gusset methods to reinforce joints.
- Testing of jointing methods is carried out using a hydraulic press. Joints are tested to destruction.
- Outcomes are shared.
- Discussion is generated covering selection aspects of materials, costs, availability, manipulation processes available at school, jointing processes available at school.
- Students document and summarise information which is used for final materials selection.

This type of testing allows for hands on activities while utilising time. Generally evidence is recorded using photographic evidence with students producing personal summaries.

Function Testing (Components, Weight, Steering)

This section introduces students to some of the scientific information that theoretically has an effect on the performance of their luge along with testing of specific components that will be purchased.

- Physics lesson delivered by science teacher covering effects of gravity, momentum, and friction on their luge. Photographic evidence used to record aspects of lesson along with notes, students summarising.
- Testing professionally manufactured components (trucks, wheels, bearings).
  Testing of weight vs speed etc. Testing carried out on school driveway.

Students encouraged to take photographic evidence and present these along with notes. Students summarise information.

Brief Refinement

From the above research and testing students produce a refined brief.

- New attributes are identified and added. These will be addressed during the development process.
- Specifications generated from the above research and testing are documented and incorporated in the development process.

Concept Ideas Produced that Will Address Students Refined Brief

A formal lesson introduces students to concept drawings and standards required at this level.

- Examples of previous work are shown. Discussion on what are and why we produce concept drawings.
- Important points such as layout, size, types of 3D drawings used, rendering methods are discussed and shown.
- Teacher demonstration is given covering the above.
- Teacher generated example is displayed in the class as a reference for students.
- Specific sketching resources and tools are introduced to the students (initial stationary list outlines specific equipment required).
- Students produce concept drawings
- Concept ideas are screened and a final conceptual idea is generated

Students are encouraged to hand generate a large percentage of the evidence required. This allows for students to produce a large amount of the work during class time with only tidying up required for home work.

Functional Aspects Developed

Students identify functional aspects to be developed (planning).

- Aspects such as folding mechanisms, specific components to be manufactured, and system for assembling components together are developed and tested.
- At this stage students are encouraged to produce full sized mock ups of components using cardboard. Full size profiles of chassis and frames to check anthropometric information are also produced.
- Information for orthographic drawings can be generated from these full size mock ups.

Materials and Dimensions are Determined

- Final materials selection is determined and documented.
- Lesson covering basic orthographic drawing conventions is delivered.
- Students produce working drawing. Students are given the opportunity to add extra information to their working drawings as construction progresses.
- Brief revisited and additional information added.
- Cutting list is produced.

Construction

Resources used: *GCSE Resistant Materials Technology for OCR, Skills in Resistant Technology. www.technologystudent.com*.

A formal lesson is delivered covering the following:

- Examples of construction schedules and how they work are shown.
- A construction planner is produced which allocates time and schedule construction phases.
- Skill tests are factored into construction schedule to ensure students have the necessary skills to construct their luge (Note: tests applied will vary depending on individual students designs).
- Recourses are allocated to coincide with appropriate construction phases.
- Students construct prototype.
- A specific component (e.g. wheel assemble, frame including board) is identified by students and teachers as being the item that will be the focus for assessment again AS 91057. Specifications for this item and techniques to be used are agreed prior to the students beginning construction and students assessed against the achievement standards achievement criteria to determine their grade of achievement.
- Construction planner is revised at regular stages during construction of the luge.

Implementation and Testing

On completion of construction a class discussion is generated covering testing of their prototype (hand-out supplied to students).

- Students produce a testing schedule which is carried out on race day, (durability, speed, manoeuvrability, appearance). Students receive feed-back from Industrial Tube Manufacturing Engineers who also attend race day (stakeholder feed-back).
- Students aiming for excellence for A/S 91047 seek stakeholder feed-back for specific aspects of their final prototype and from testing it on the luge track
- Students summarise testing and stakeholder feedback and produce a final evaluation.

This Unit Link to Achievement Standards

91045: Use planning tools to guide the technological development of an outcome to address a brief – 4 credits: Internal.

91047: Undertake development to make a prototype to address a brief – 6 credits: Internal.

91049: Demonstrate understanding of how materials enable technological product(s) to function – 4 credits: External.

91057: Implement basic procedures using resistant materials to make a specified product – 6 credits: Internal.

This Course Links to the following Technological Stands

Technological Practice Component

Planning for Practice
Level Six:

Critically analyse their own and others' past and current planning practices in order to make informed selection and effective use of planning tools. Use these to support and justify ongoing planning that will see the development of an outcome through to completion.

Outcome Development and Evaluation
Level Six
Critically analyse their own and others' outcomes to inform the development of ideas for feasible outcomes. Undertake ongoing experimentation and functional modelling, taking account of stakeholder feedback and trialling in the physical and social environments. Use the information gained to select, justify, and develop a final outcome. Evaluate this outcome's fitness for purpose against the brief and justify the evaluation using feedback from stakeholders

Technological Knowledge Component
Technological products
Level Six:

Understand how materials are formed, manipulated, and transformed in different ways, depending on their properties, and understand the role of material evaluation in determining suitability for use in product development.

Construction and Mechanical Technologies Component

Construct a resistant materials product

Implement basic procedures to make a resistant materials product.

Assessment resources used

Common assessment guide for Technology 91049 (1.6).

NZQA Technology – annotated exemplars Level one.

NZQA Technology - assessment resources level one.