

Area of Study

Taster (with link to Creativity, Work and Future)

Overview

Design and Discovery is a transition unit promoting a hands-on learning experience by encouraging students to identify creative solutions to everyday problems in the world of design and engineering. The unit focuses on basic scientific, design and engineering concepts, and students follow processes used by professionals to build prototypes of their ideas. It is not necessary for students to have a prior knowledge of science, or a high level of ability in mathematics.

(Design and Discovery Teacher Guide and Student Booklet may be downloaded from www.skool.ie – click on Teachers tab and select Engineering)

Related learning

The skills and knowledge developed have wide applicability across a variety of curriculum areas as well as in everyday life. The unit, however has close links with:

- Junior Certificate – Science, Mathematics and Technology
- Leaving Certificate – Physics, Physics and Chemistry, Mathematics, Engineering, Construction Studies, Technology, and Design and Communication Graphics.

Outline of the unit

The unit is organised into 15 sessions.

Part 1: Understanding the Design Process

Students are introduced to the designed world and then practise the design process that is revisited throughout the unit.

Session 1: Jump Into The Designed World 1

Students re-think and re-engineer everyday objects. These hands-on activities reinforce a ten-step design process that is used many times throughout the Design and Discovery unit.

Session 2: Jump Into The Designed World 2

Students learn that design opportunities are everywhere. This session builds their ability to analyse existing objects for improvements and helps students identify suitable problems to solve with design and engineering.

Session 3: Material Science

From spacecraft to ballpoint pens, materials make the difference in successful performance of a product. Students learn about four different classes of materials and test them to understand their properties. They apply selection criteria to determine the best materials for different applications, while learning to consider cost and environmental impact when choosing materials.

Part 2: Engineering Fundamentals

These sessions provide background in electrical and mechanical principles that students may need to incorporate in their designs.

Session 4: Electronic Engineering 1

Circuits are the building blocks of all electrical appliances. In this session, students explore simple circuitry with bulbs, batteries, wires, and breadboards.

Session 5: Electronic Engineering 2

Students continue to learn about simple circuitry. They use reed switches, LEDs and motors and begin to think about their application in the world around them.

Session 6: Making Machines and Observing Functionality

Students study mechanics and motion. They build simple mechanical devices such as a rolling toy and a crankshaft. This session also introduces students to motors and explains how motors can be used to produce motion.

Session 7: Robotics

This session will expand the students' knowledge of the world of robotics. Students will identify many of the different types of robot in general use and will carry out activities that illustrates some of the issues that arise in the programming of these devices.

Part 3: Thinking Creatively about Problems and Solutions

In these sessions, students identify interesting problems and develop ideas for solutions.

Session 8: The 3 Rs of Problem Identification

The 3 R's of problem identification invites students to revisit, refine, and research design opportunities for a project of their own. Using a variety of techniques, students narrow down their list of design opportunities.

Session 9: A Solution Taking Shape

Preparing a design brief helps students to focus their understanding of a problem and propose a solution. Students delve deeper into their proposed design solution as they research patents for similar ideas and consider the necessary parts to get from 'think' to 'thing'.

Part 4: Making, Modelling and Materialising

Students turn their thinking into things and begin several cycles of building trials and testing their ideas.

Session 10: Project Analysis and Planning for Models

Students begin this session by reviewing their solution before proceeding to the next steps. They make sketches of their design in their design notebooks and list the materials that they need to make their model.

Session 11: Making It! Models, Trials, and Tests

Let the construction begin! Pieces, parts, and connections become trials and models of a system, a component, or the product itself.

Part 5: Prototype and Final Presentations

In these sessions, students refine their project into a working prototype and learn how to display and present their projects.

Session 12: Prototype Practicalities

Projects are taken to the next level as students plan how to develop their working prototypes. They consider the product specifications, materials and budget. Students begin to construct their prototype.

Session 13: Prototype Review

This work session gives students more time to work on their prototypes. They may need to make several prototypes as they conduct trials and tests of the product.

Session 14: Prototype Evaluation and Presentation

Having completed a number of trials and tests students now evaluate the feedback, and implement the changes to develop the final prototype. At the end of the session students are asked to think about their final display and presentation.

Session 15: Final Presentations

In this final session students begin to prepare for the end of year exhibition. Preparation involves planning the event and designing a display. Students practise their presentations and receive feedback from their peers. Following the event, they reflect on their Design and Discovery experience.

Breakdown of the unit

Class contact time: 30 hours - The unit is divided into 15 sessions. Each session is intended to be of two hours' duration (three forty-minute periods). It is preferable if two of these periods are available as a double period in order to facilitate the practical work. The teaching units of the module could then be covered in a 15-week period (1/2 year).

Note: Sessions 3, 4, 5, 6, and 7, are stand alone sessions. Depending on the project chosen and the time available, the teacher may decide to consider one or more of these sessions to be optional.

Independent research and work on project: 10 hours, weighted towards work on the project

Fieldtrip: 4-5 hours – see Teacher Guide for ideas. (www.skool.ie > Teachers Tab > Engineering Documents > Teacher's Guide, page 7-9)

Aims

This transition unit aims to:

- improve the students' problem-solving, analytical, and inquiry skills and promote independent learning, communication and teamwork
- develop students' understanding of the role of engineering and design in producing effective solutions to real world problems
- introduce students to the decision-making process of material selection in design, based on material properties and economics
- provide students with a background in electrical and mechanical engineering principles develop students' skills using hand tools to construct a prototype of an engineering design
- raise students' awareness of the many and varied career opportunities in engineering in Ireland today thus enabling them to make informed choices about Leaving Certificate subjects.

Learning Outcomes

On completion of this unit students should be able to:

- recognise design opportunities in their everyday lives
- describe a 10 step design process used by engineers
- explain the principles of simple mechanics identify different mechanical components and outline the function of those components
- build a simple mechanical toy
- explain the principles of simple electronics
- identify different components and outline the function of those components
- build simple electronic circuits and be aware of the practical applications of these circuits
- discuss the economics of material selection and differentiate between materials based on their properties
- explain the concepts of systems, components and parts
- demonstrate methods of representing design solutions through sketching and orthographic drawing
- plan and prepare a display for an event
- present a design solution and communicate engineering and design expertise.

Key skills

How evidenced

information processing	Assessing information from a number of sources. Evaluating the information on the basis of reliability of source, relevance, and scientific validity. Recording, analysing and evaluating results from investigations.
critical and creative thinking	Investigating a range of materials and according to their properties determining the best materials for different applications. Identifying suitable problems to solve by analysing existing objects for improvements. Understanding the 10 step design process used by engineers and using this understanding to turn ideas into reality. Revisiting, refining and researching a design idea.
communicating	Communicating and listening to other members of the group. Practising presentations and receiving feedback from peers. Presenting a project on Transition Year Evening, at SciFest or at the BT Young Scientist & Technology Exhibition.
working with others	Working in small groups or pairs (students rotate through different groups or pairings to encourage students to work with different people). Possibly working with a mentor from industry or a third level institution.
being personally effective	Undertaking research and working on a project outside of class time. Having an overall plan and meeting deadlines. Receiving and responding to feedback. Improving presentation skills

Learning approaches

A wide range of teaching and learning methodologies will be used.

- practical work
- research
- pair/group work
- teacher demonstrations
- project work
- classroom discussions
- use of videotapes
- field Trip

Assessment approaches

- **Oral Presentation**
Students make a short presentation to their teacher and peers
- **Visual Presentation**
Visual display
- **Design Notebook**
The design notebook is a diary of the progress of an idea. It is a place to record ideas, inspirations, discoveries, sketches and notes. (Can be downloaded from Teacher's Guide website www.skool.ie)

Evaluation methods

The following three evaluation sheets can be downloaded from the Design and Discovery resource.

- Design and Discovery Pre-Survey
- Design and Discovery Post Survey
- Project Reflection Session 13

End of unit student evaluation questions

1. What part of the Unit did you most enjoy? _____
Why? _____
2. What part of the Unit did you find most beneficial? _____
Why? _____
3. What part of the Unit did you least enjoy? _____
Why? _____
4. If this unit was being taught again what changes would you suggest to make it better?

Resources

Materials

The Design and Discovery Teacher Guide and Student Booklet may be downloaded from www.skool.ie – Click on Teachers tab and select Engineering

There are a number of suggested weblinks, videos, presentations and software available from www.skool.ie – Click on Teachers tab and select Engineering

Suppliers

- There is an overall 'Supply Shopping List' at the beginning of the unit. There is also a Supplies List at the beginning of each session and a short list before each activity
- Specially commissioned Design and Discovery electronic kits are available from William Cooney, Cooney Electronics, 15 Windsor Avenue, Dublin 3. Phone 01 8334703
- <http://www.maplin.co.uk> (Maplin Electronics – takes orders on line)
- Robots may be purchased from iBOTZ (Ireland) Ltd, Unit 2, Johnston Business Park, Athlone Road.

Tel. 043 36685

Email: sales@ibotz.com

Useful Websites

- <http://www.intel.com/cd/corporate/education/emea/eng/ireland/index.htm>
- <http://www.scifest.ie>
- <http://www.iei.ie/steps>
- <http://www.btyoungscientist.ie>
- <http://www.skool.ie>
- http://skool.ie/design_discovery.asp

Books

- Design & Discovery – Teacher Guide (Downloadable from website - http://skool.ie/design_discovery.asp)
- Design & Discovery – Student Booklet (Downloadable from website - http://skool.ie/design_discovery.asp)
- Speakers Directory – Produced by the Discover Science and Engineering Programme in 2004. This directory contains the names and contact details of people from a range of industries nationwide that are prepared to talk in schools about their job, their science or engineering career path, and the range of prospective jobs within their chosen industry.
- Adventures with Electronics by Tom Duncan

Teacher Training

The website, http://skool.ie/design_discovery.asp, is divided into 3 sections:

1. Documents - downloadable Teacher Guide and Student Booklet
2. Support Resources – There are many resources to be found in this section. All areas of the unit are covered. These resources include PowerPoint presentations of the teacher training days 1-4, instructional videos and other informative PowerPoint presentations.
3. Teachers' Forum