



International Council of Associations for Science Education

Introducing the International Council of Associations for Science Education



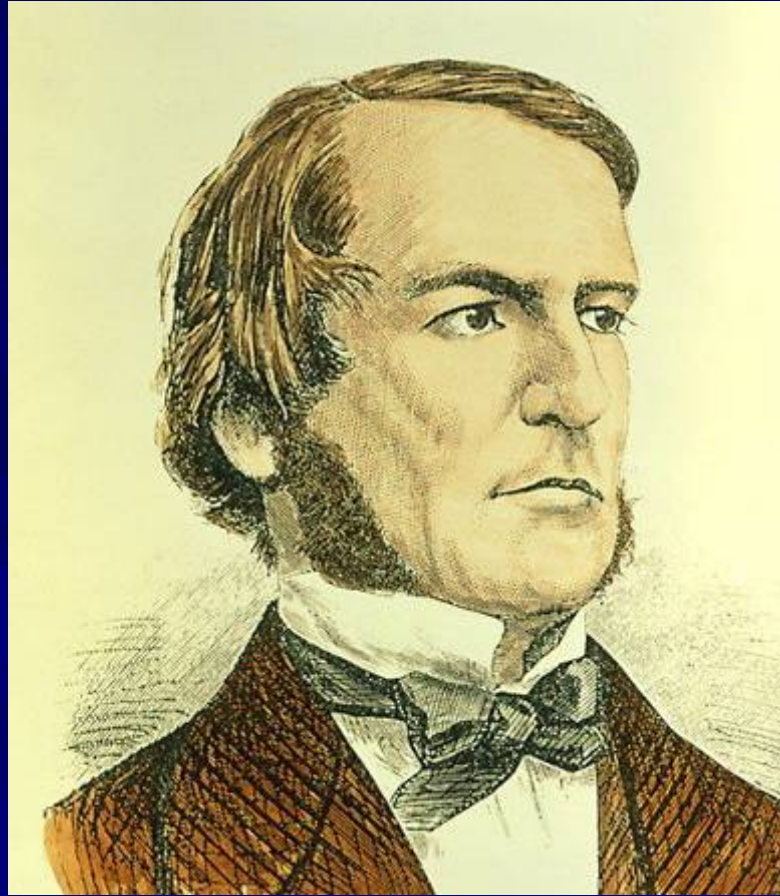
**Hands-on Science Network Conference
18th July 2021**

**Dr Declan Kennedy,
Department of Education,
University College Cork,
Ireland.**



COBH





George Boole (1815 - 1864)
First Professor of Mathematics in UCC



- The International Council of Associations for Science Education (ICASE) was created in 1973 by the United Nations Educational, Scientific and Cultural Organization (UNESCO) to extend and improve science education throughout the world.
- ICASE is a vast network of science teacher associations, institutions, foundations and companies, working together to promote science and technology education around the world.
- ICASE facilitates communication and cooperation at national, regional, and international levels.

Objectives of ICASE

1. To extend and enhance the quality of formal and non-formal science and technology education for all, with particular reference to the children and youth of the world.
2. To provide and support activities and opportunities that will enhance formal and non-formal science and technology education throughout the world.
3. To assist and support all members and other organisations throughout the world that are involved in formal and non-formal science and technology education.
4. To establish and maintain an international communication network for member organisations and their members involved in formal and non-formal science and technology education.
5. To encourage and support the establishment and development of professional science and technology organisations, especially teacher organisations in all countries.

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ICASE
 International Council of Associations for Science Education

**WORLD
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5th World Conference on Science and Technology Education

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Scientific Programme and Abstracts

Edited by
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About Journal



Science Education International

Science Education International is the quarterly journal of the International Council of Associations for Science Education (ICASE). ICASE was established in 1973 to extend and improve education in science for all children and youth by assisting member associations throughout the world.

This journal provides a means for associations, institutions, centres, foundations, companies, and individuals concerned with science education to share perspectives, concerns, ideas, and information that will foster cooperative efforts to improve science education, and which will serve as a chronicle of the advancement of science education throughout the world

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REVIEW ARTICLE

Didactic Strategy for Learning and Teaching of Functional Groups in High School Chemistry

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REVIEW ARTICLE

School Gardening in Early Childhood Education in Oman: A pilot project with Grade 2 Students

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ORIGINAL ARTICLE

An Assessment of Availability and Utilization of Laboratory Facilities for Teaching Science at Secondary Level

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ABSTRACT

The present study aimed to explore the availability and utilization of a science laboratory for the teaching and learning of science. This study was a joint collaboration with India's Ministry of Human Resource Development, the Government of India, and the National Council of Educational Research and Training. The study adopted descriptive survey methodology and random sampling. The instruments used for the study were questionnaires for principals, teachers, and students. The study's findings revealed in most participating schools; there were no separate science laboratories. It was also found that many teachers faced difficulties when conducting science activities due to the large number of students in each class as well as inadequate equipment and materials. The findings highlight that as there was no assessment of science laboratory practical activities, these activities did not contribute directly to the measurement of students' academic performance in science. The study suggested that governments should support laboratory practical activities in science as a part of assessment and specifically for this study's context takes immediate steps to set up science laboratories in all schools for the effective teaching and learning of science.

ICASE brings teachers together!



UCC / ICASE PROFILES MODULES

1. Does it give you wings?

This module allow pupils to work as a team in an investigative setting to examine the use of energy drinks in sports and exercise. Pupils investigate the current popularity of both legal and illegal performance-enhancing aids and use this information to evaluate energy drinks available and design their own drink based on the information they have gathered.

2. Enzymes are they really needed?

In this module students research different enzymes and to test their functions in different environments. Students also investigate the consequences of an enzyme deficiency to discover whether enzymes are really needed.

3. Getting things moving.

This module involves pupils carrying out investigations to study the underlying principles of the physical transportation of goods, people and services. In addition, students study the challenges of solving transportation problems in the future with particular reference to how we produce and use energy.

4. Grip it or slip it.

This module contains a series of activities to allow pupils to join an investigative team which will examine the factors that cause a car tyre to slip on the road.

5. Mouthwash – does alcohol really make a difference?

This series of tasks allows students to form an investigative team to examine whether mouthwash containing alcohol is more effective at killing bacteria than mouthwash that doesn't contain alcohol.

6. Organ donation – opt in or opt out?

The aim of this module is to give students an opportunity to investigate issues relating to organ donation and to promote analytical skills, attitudes and values that enable students to play a constructive, participative and responsible role in society.

7. Sweaty Betty – Which is the best deodorant?

In this module students are given the opportunity to investigate deodorants as part of a research team to develop a homemade version of a deodorant.

8. That makes me sick?

This series of activities allows students to research the different types of microorganism, devise procedures to examine the microorganisms in their immediate environment, determine the best disinfectant to use and the most effective hand washing technique.

9. Which antacid remedy is the most effective in dealing with excess stomach acid?

This set of activities allows students to work together as part of a team to design and carry out laboratory activities to determine which is the most effective antacid remedy, to analyse their results and put forward a scientific argument to justify their choice.


10. Body at War

In this module students are invited to investigate how the body defends itself against disease and how vaccines and antibiotics help the body's immune system. Students are presented with various Case Studies and as a group they will try to find out the disease associated with each case study and propose a treatment. Using antibiotic discs they also investigate the zone of inhibition on bacterial agar plates.

All modules free to download at:

<http://chemweb.ucc.ie/Pro2/PROFILES-ucc.htm>

ucc.ie/en/chemistry/projects/profiles/

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The [PROFILES project](#) has received funding from the European Community's Seventh Framework Programme under grant agreement number 266589.

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Does it really give you Wings?

Outcomes

Investigate food groups and discuss their requirements for exercise and activity.

Compare the daily energy requirement of a sedentary versus an active individual.

Research the range of sports drinks on the Irish market. Categorise these as isotonic, hypertonic and hypotonic. Evaluate and design a sports drink.

Design and conduct an experiment to examine electrolyte content of a number of drinks.



Results

After completing this inquiry-based module, it is clear that over 50% of the students thought that this topic did relate to their own live. The majority of the students reacted positively to the problem-based approach to a new topic compared to their previous experiences of introductory lessons.

It was noted however that students may find an inquiry-based approach difficult to engage in immediately so a more structured form may be best to introduce students to it.

It was clear that the students felt more active and part of the lesson compared with previous types of lessons.

Curriculum content

Bonding, solutions, atomic structure, use of scientific apparatus, concept of current and charge

Student activities

The concept of the inquiry-based module was explained by the teacher. The students were divided into three groups and all were given the scenario to read and discuss.

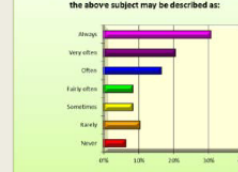
The tasks undertaken by each group:

Group 1 – Researched and designed a poster based on the link between nutrition and athletic performance. They examined food groups, benefits of sports drinks, importance of hydration and types of sports drinks available.

Group 2 – Researched the best types of sports drinks available and the benefits of each one. They designed their own sports drink from their findings.

Group 3 – Planned and conducted an experiment to examine which type of drink contained a suitable amount of electrolytes to be considered to have a positive impact on dehydration and performance.

14. The degree to which I participate in lessons of the above subject may be described as:



7. The level of importance to my everyday life of the topics I study in my lessons in the above subject may be described as:



Evaluation

- The topic was clear and relevant to the everyday lives of the students.
- It was not gender based and was equally attractive to girls and boys.
- It included Chemistry that was part of the Leaving Certificate curriculum.
- It engaged the students through tasks and problem solving activities.
- The students' tasks were open to adaptation by the students or the teacher.

Learning objectives

Give students an appreciation of the importance of each food type for the body.

Give students sufficient factual knowledge to allow them to investigate the daily energy requirements of a sedentary individual compared to an athlete in training.

Give students an understanding of the different types of energy drinks commonly available.

Does it really give you wings? The power of sports drinks

Info on food pyramid

What are they called?	What do they do for you?	Where do they fit in?
Carbohydrates	They give you energy	Top
Protein	They help you build your muscles and repair them	Middle
Fats	They provide energy and help insulating	Bottom
Starch	It helps you digest your food	Bottom
Minerals	They are good for the blood. Sodium is good for your bones. It helps to give you energy and strength	Side and Bottom
Vitamins A, B, C, D, E	They are good for your skin, bones and teeth	Side products

Types of energy drinks

There are three main types:

Type	Contents	Example
Isotonic	Fluid, electrolytes and 5-10% carbohydrates	Lucozade
Hypotonic	Fluid, electrolytes and low level of carbohydrates	Sport, Citrus
Hypertonic	High level of carbohydrates	Real juice

Water v sports drinks

- Health body to keep you healthy hydrated.
- Sports drinks contain carbohydrates to improve energy levels.
- Sports drinks contain electrolytes like Ca, Mg.
- Water causes bloating.
- Water replaces thirst so you drink less.

Homemade sports drinks

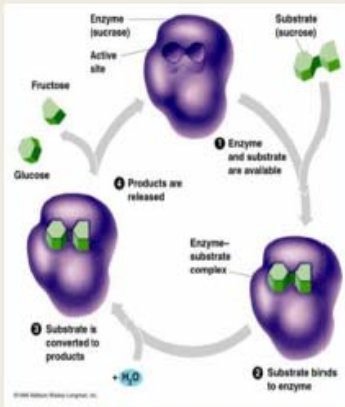
- Isotonic - 220ml of orange squash (concentrate and orange), 1 litre of water and a pinch of salt (a).
- Hypotonic - 100ml of orange squash (concentrate orange), 2 litre of water and a pinch of salt (a).
- Hypertonic - 400ml of orange squash (concentrate orange), 2 litre of water and a pinch of salt (a).

Conclusion

It was clear that an inquiry-based resource has the ability to nurture a creative and stimulating environment for the students. Based on student responses, the author discovered that students are mainly passive learners in the classroom and become disillusioned with science as a result. Consequently students are opting out of Senior Cycle Sciences and reducing their opportunities at tertiary level.

This study highlighted that inquiry-based learning can be a workable alternative to the current pedagogical settings of science in the classroom to engage students.

Enzymes – are they really needed?



Learning Outcomes:

The students could:

- Explain how enzymes work and devise a demonstration model to illustrate the activity and specificity of enzymes.
- Carry out experiments that investigate the activity of the enzymes under different conditions (pH, temperature).
- Interpret the information collected from the experiment and compare it with the information obtained from research to see if the results correlate with regard to the optimum pH and temperature of the enzymes. If the two sets of data do not agree, the students will be able to assess the reasons why.
- Discuss whether they think enzymes are needed/not needed, each side giving reasons for their opinions.
- Evaluate the socio-scientific use of enzymes and select the most recent research into enzymes to discuss with the class.

References:
 O'Callaghan, M. Leaving Cert Biology (Revised Ed.)

www.gate2biotech.com

www.enzymesuff.com

www.scienceaid.net

(Wenning & Khan, 2011).

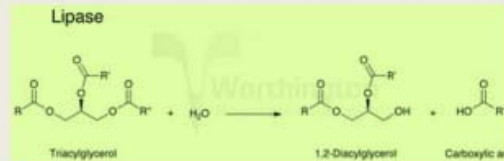
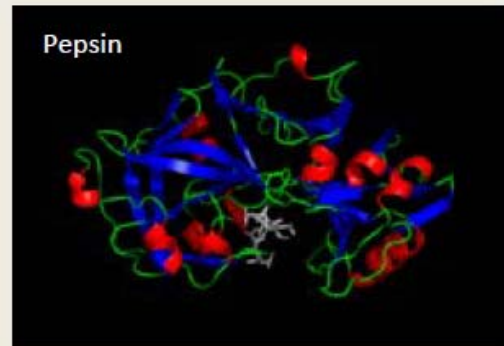
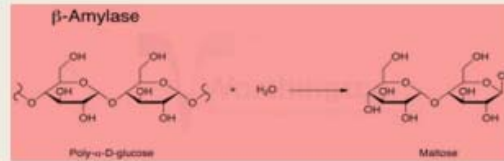
www.physorg.com

www.scienceaily.com

www.sciencearticle.com

Objectives:

- To encourage students to question the function and importance of enzymes.
- To give students an understanding of how enzymes function and what factors affect enzyme action.
- To strengthen the students' inquiry based technique by allowing them to design experiments to test enzyme action.
- To improve the students' overall understanding of enzymes.
- To enhance the students' interest in enzymes by relating enzymes to real-life applications.



Activities:

The material that was covered in the lessons includes an understanding of what enzymes are and what they do. How they are used in digestion but also how useful they are in both domestic and industrial situations which allow a socio-scientific connection to be made.

Results:

- Students became 'active inquirers rather than passive receivers' (Wenning & Khan, 2011).
- Participation increased especially among weaker students in the technology phase of the module.
- Students were taking responsibility for their own learning and had a folder of the information they had collected.
- Communication and co-operation had increased among the students in the class.
- Confidence in their scientific literacy had developed.
- The link with science and society was established.
- Students had the opportunity to see how scientists develop their ideas and strategies of the scientific method.
- The module was not a 'cook-book' affirmation of scientific knowledge but rather an experience of scientific processes.



Evaluation:

- Different learning and teaching strategy which is beneficial to both students and teachers.
- Teachers may need practice in order to improve the effectiveness of the incorporation of IBSE into their classrooms.
- All students had a job to do so inclusion was paramount, interpersonal and intrapersonal skills were being improved. This leads to an increased confidence.
- There were definite changes of attitude. The different learning strategies using different skills painted the sciences in a brighter more accessible and achievable nature.

Conclusions:

- Students and teacher found the teaching and learning experience more enjoyable.
- It is a more natural approach as to how we function as humans, being thinking creatures naturally; this facilitates that aspect of our nature.
- Inclusion and accountability in the learning process increased students' necessity to participate.
- It is a non-threatening environment as it is acceptable not to know everything but essential to question.
- IBSE is a process that is inter-connected to other learning strategies that are important in how people come to understand new knowledge. It is intrinsically linked to multiple intelligences and achievement of the aims of Blooms taxonomy can be facilitated



Keeping society moving – how will transport work in the future?



Objectives:

Identify key means of transport in our society, how they work, why they are important, and problems they will face in the future.

Identify that friction and gravity are the two major forces affecting moving objects.

To improve understanding of these forces using practical work devised by the students.

To gain experience with new laboratory equipment (air track).

To use this equipment in novel ways to examine what factors affect moving objects.

Learning Outcomes:

On successful completion of this module students will be able to:

Summarise modes of transportation vital to modern society, and the power sources by which each works.

Recall that friction and gravity determine how objects move.

Design practical tasks to investigate the effect of friction and gravity on falling and moving objects.

Predict and justify the probable behaviour of objects placed in a force field..

Curriculum Content

Friction and gravity and their effects on moving objects. Speed, acceleration and velocity. Current and future energy sources used by vehicles in society.

Student activities

Concept maps were produced by each group to summarise the students' prior knowledge of forces and modes of transport.

Simple experiments were designed to show the effects of forces on falling objects, and moving objects such as cars and trolleys.

After demonstration of the apparatus, the students then used the air track to control the forces on a moving trolley, and finally used the apparatus in novel ways to examine how the movement of objects was affected.

*Results:

*After completing this inquiry-based module, there was a significant increase in the number of participants who felt that the topic was important and relevant to their everyday lives and society.

*The majority of the students reacted positively to the problem-based approach to a new topic, compared to their previous experiences. There was also a favourable reaction to the scenario used to introduce the topic.

*It was noted however that students found an inquiry-based approach difficult to engage in immediately, in spite of their previous experience with coursework tasks, and the structured introductory tasks provided in this intervention module.



Evaluation:

The topic was clear and relevant to the everyday lives of the students. It was not gender based and was equally attractive to both boys and girls. This was in contrast to how previous lessons had been viewed.

It introduced Physics experiments and equipment normally reserved for the Leaving Certificate curriculum.

Literature and Internet sources

Department of Education and Science. Leaving Certificate Physics Syllabus: Ordinary and Higher Level. Stationary Office: Dublin. O'Regan, Dan. (2004). Real World Physics. Folens, Dublin.

Rocard Report: European Commission, Community Research. (2007). Science Education Now: A renewed pedagogy for the future of Europe. http://ec.europa.eu/research/science-society/document_library/pdf_06/report-rocard-on-science-education_en.pdf



Learning Outcomes

- Design a mind-map showing the factors that affect friction.
- Design and plan an investigation into one of the factors affecting friction.
- Carry out an investigation, record data and analyse the results.
- Draw conclusions.
- Report and discuss the findings.

Curriculum Content

Forces, friction, application of friction, lubrication, use of data logging sensors, IT and the analysis of quantitative data.

References

- Anderson, R. D. (2002) Reforming science teaching: what research says about inquiry. *Journal of Science Teacher Education*, 13(1):1-12.
- Kennedy, D. (2012). Practical work in Ireland: A time of reform and debate. *Eurasia Journal of Mathematics, Science & Technology Education*, 2012, 8(1), 21-34
- Wenning, C. J. (2010) Why the resistance to inquiry oriented science teaching? *Journal of Physics Teacher Education Online*, 5(3), December 2010

GRIP IT OR SLIP IT

Objective

To allow students gain an understanding of the factors that affect friction by conducting a series of investigation.

Activities

1. As a group students had to try to identify with the aid of a mind map all the factors that contribute to a bus tyre gripping or slipping the road.
2. Each group then had to chose a single factor to investigate. They designed an experiment to see if their chosen factor did affect the tyre's ability to grip the road.
3. Each group then carried out their investigation.
4. They then discussed their findings and gave a short presentation to their fellow class mates.



Results

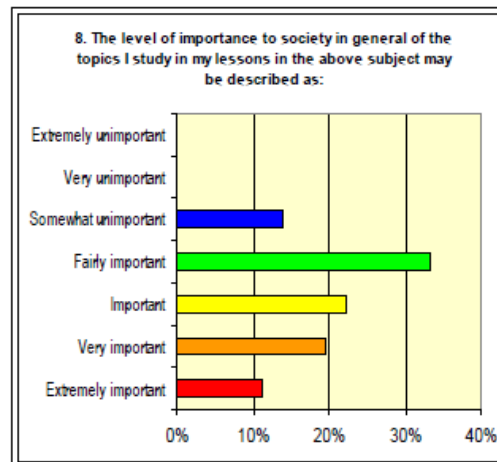
- Analysis of student accounts of the investigations shows that they engaged in a significant amount of IBSE during lessons.
- Feedback from students showed that the module had a positive impact on student motivation.
- Students found that the lessons were relevant for society.

Evaluation

- The module placed a strong emphasis on group work.
- Students worked independently of the teacher.
- The module was successful in presenting students with a scientific problem they had to solve.
- The scenario was not as effective as had been hoped in initially motivating students.

Conclusions

- The module was effective in promoting IBSE.
- The scenario and title were only partly effective in motivating students.



Mouthwash – Does alcohol really make a difference?

Learning Outcomes of Module

On completion of this module students should be able to:

- Investigate the structure of the mouth.
- Identify the functions of the various parts to the mouth.
- Design and conduct an experiment to examine whether alcohol based mouthwash is better at killing bacteria than non alcohol based mouthwash.
- Analyse the results of the experiment and suggest some reasons for these results.
- Present their findings to fellow students and teachers of the school in a short presentation.

Curriculum content:

- Physical digestion
- Microbiology (growing cultures on agar plates)

Activities

Students performed a number of inquiry based activities as part of the module. These activities included:

- Researching the internet on the structure of the mouth
- Devising and implementing their own experiment to decide if non alcohol based mouthwash is better at killing bacteria than alcohol based mouthwash.
- Analysing results from their experiment
- Presenting their research to the class in a PowerPoint presentation



Activities

Each activity was designed to last one double class (80 minutes).

At the beginning of each activity students were given a task sheet assisting them on what they need to do to complete the task successfully. They kept a record of each task in a folder and this was submitted at the end of the module for assessment by the teacher.

Assessment

For assessment students and teachers contributed to the grade that each student received.

Student grades of the module were based on a number of items including:

- Student self assessment form
- Teacher evaluation form
- Small test based on module content
- Student presentation on their research of whether alcohol based mouthwash is better at killing bacteria than non alcohol based mouthwash.

Results



Student opinion was divided amongst the class as results from the experiment varied greatly.

From the results in the picture above, the students in this group were able to conclude that the non alcohol based mouthwash was better at killing bacteria than the alcohol based mouthwash as there were a higher percentage of microorganisms killed after a student rinsed with the non alcohol mouthwash.



Conclusions

Students enjoyed taking part in this module. One student mentioned that the module made 'me feel smarter cause I had to make up my own experiment'.

All students concluded that both types of mouthwash kills bacteria.

References

- www.sbs.ie
- <http://tami-port.suite101.com/prokaryotes-class-experiment-collecting-data-276608>

Organ Donation - Opt in or Opt out????



Learning Outcomes:

The students were able to:

- ✓ Discuss the ethical issues surrounding organ donation and transplantation.
- ✓ Describe what organs are donated, their structure, function and the illnesses they are used to treat.
- ✓ Carry out a role play effectively.
- ✓ Prepare and present a report on their views on the potential impact of an opt out system of organ donation in Ireland.
- ✓ Carry out a data search, process the information, select and analyse data.
- ✓ Construct and present an argument for or against the introduction of an opt out system of organ donation in Ireland.
- ✓ Apply their scientific knowledge to and be empowered to make informed choices about organ donation.

Objectives:

- To encourage in students an attitude of scientific inquiry, curiosity & discovery through working individually & within teams.
- To develop an understanding of organ donation & knowledge about the structure & function of organs which are donated & illnesses they are used to treat.
- To give students an understanding and experience of role play.
- To enable students to become familiar with searching for information on the internet, interpreting & analysing the information they select to best answer their questions.
- To enable students to experience group work.
- To give students an opportunity to defend their ideas, discuss other ideas/ arguments & develop their ability to make informed decisions about contemporary issues.
- To give students an appreciation of the complex issues involved & the challenge of trying to reach a general consensus on the issue.
- To provide students with the experience of presenting their decisions and their arguments orally & in written format.

Background:



In order to develop science literacy, teachers need to develop teaching strategies where students can critically discuss & debate contemporary issues in science and their applications. The topic of organ donation was selected as it is a current, controversial, socio-scientific issue being mirrored in authentic media. In an effort to improve Irish donation rates, the government has pledged to replace the current opt in system – whereby a person decides to donate his/her organs – with an opt out system where consent is presumed. This teaching module enables students to join an investigative team to assess the potential impact of an opt-out system for organ donation in Ireland and report on their findings.

Activities:

The students are given a scenario highlighting the topical issue of organ donation & are invited to investigate the issue further.

- Investigate what organs are donated & the illnesses they are used to treat.
- Role Play.



- Data search and analysis (ICT skills).
- Critical & creative thinking.
- Presentations (ICT skills).



Results:

- Results from the study indicate the module was both highly interesting & motivational for students and teachers alike. The overall view of the teachers on the success of the teaching module was very positive, reporting that the module was well received by students, who showed high levels of interest and motivation. The module stimulated intrinsically motivated learning.
- The inquiry approach was valued by students who enjoyed the opportunity to be involved in role-play, decision-making, communication and collaboration-related activities. Such activities aroused their interest and participation. The results suggest that the majority of students feel comfortable with the change of the traditional approach to teaching & that the inquiry approach stimulates positive attitudes towards learning science

Evaluation:

- The relevance of the module to society & the students' everyday life increased enjoyment & interest in the subject which stimulated intrinsic motivation in the students.
- The teachers believe that the module reinforced learning in competency domains, enabling students to acquire knowledge, new skills & abilities.
- Teachers perceive the approach as valuable but identify two major obstacles to implementing inquiry in their lessons. The considerable amount of time required to plan and implement inquiry lessons is seen as a potential barrier and the issue of assessment also is an important factor. The traditional assessment system does not assess many of the competences and learning attributes which incorporate the PROFILES approach.
- This study highlights the important role that teachers play in increasing students' engagement which is evident in similar studies. Teachers have a key role to play in the development of science education and need support, direction and guidance if inquiry-based science education is to be implemented effectively.
- Adapting to IBL can be challenging for both teachers & students. Due consideration should be given to their training needs.



Useful Websites

The following websites contain information on organ donation issues. They were used by both students and teachers to prepare and implement this task.

- <http://www.organdonation.ie/>
- The Irish Donor Network:
<http://www.alpha1.ie/index.php/organ-donation-and-transplant/57-irish-donor-network>
- The Irish Kidney Association - www.ika.ie
- Report on Public Consultation on Consent for Organ Donation:
http://www.dohc.ie/issues/human_tissue_bill/consent_su_bmissions_overview.pdf?direct=1
- <http://www.beaumont.ie/index.jsp?p=454&n=467>
- <http://www.transplantireland.ie/>



Sweaty Betty – Which is the best antiperspirant/deodorant?



Learning Outcomes

Students are expected to
Differentiate between deodorants and antiperspirants show a basic knowledge how each works.
Research the health risks of the products and discard unreliable information.
Examine the ingredients of different brands of deodorants and antiperspirants.
Produce a homemade deodorant.
Investigate the functions of the deodorant ingredients.
Create a name and advertising concept for the product.
Design an experiment to test known brands against one another.
Compare results.
Suggest how the experiment could be improved.
Present the project and findings in a PowerPoint presentation to the class.

Curriculum Content

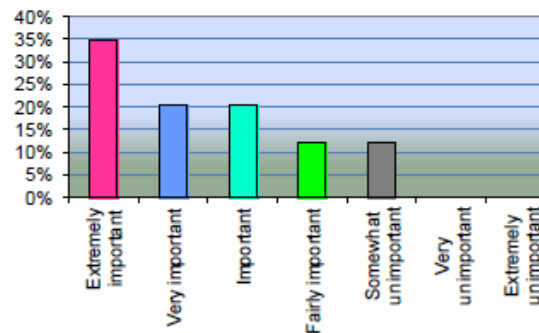
Sweating- excretion in Biology
Aluminium materials in Chemistry
Pharmaceutical Science.

Activities

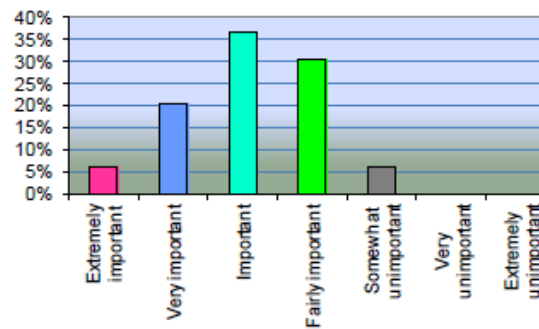
Researching the topic
Working as part of a team
Designing an experiment
Producing a home-made deodorant
Creating an advertisement concept
Designing a PowerPoint presentation

Results

7. For me, lessons of the above subject should be useful in my everyday life.



8. For me, lessons of the above subject should be relevant to society in general.



Conclusions

Student Attitudes

Students would prefer to be content with the subject matter than not. In their past lessons they have not experienced this.
The results show that students would like everyday topics to be included in their syllabus in the future.
They believe that the curriculum does not cater for this to date.
Students did not rate a link to society strongly.
The data highlights that wait times to questions should be increased and students should have the opportunity to give suggestions to the teacher regarding the subject matter of the lessons.
Students prefer having the entire class involved rather than just one or two answering and participating.

Teacher Attitudes

The author remains convinced that an IBL or IBSE approach is beneficial to students.
However for the practitioner with it comes unknown territory and pitfalls. Practice is required to refine the technique and become comfortable or to raise the "self efficacy" of the teacher as PROFILES intends.
The type of inquiry can be structured, guided gently or totally open ended. Structured and guided are the two forms the author feels most confident with.
This could be an evolving process with open ended inquiry the final triumph.

Recommendations

Hopefully the author will continue to practice and endorse IBSE. The author has been very fortunate to encounter IBSE whilst doing a Masters programme. There have been advisors on hand throughout the year. The hope is that without this framework IBSE will be continued.

References

PARSEL website <http://www.parsel.uni-kiel.de/cms/>
PROFILES website <http://www.profiles-project.eu/>

That Makes Me Sick!



Learning Outcomes:

- Students discuss the different types of microorganisms that exist.
- Design and conduct an experiment to examine the presence of microorganisms on everyday objects in their school.
- Investigate the best disinfectant to use to reduce the growth of harmful microorganisms.
- Explain the best method of hand washing and its necessity.

Curriculum content:

Distribution of microorganisms in nature, common illnesses caused by microorganisms, precautions needed when working with microorganisms, methods of reducing harmful microorganisms and the technique for inoculating an agar plate.

Objective of Module:

To give students the chance to work like scientists to investigate the microorganisms we encounter as part of our everyday lives, to understand that there are some harmful and some not so helpful microorganisms and encourage them to investigate the best methods to reduce the harmful ones.

Kind of activities:

- Research and information processing.
- Communicating
- Planning and carrying out laboratory tests
- Comparing results and drawing conclusions

Results:

- The students response to the module was very positive and they enjoyed being able to conduct the research and experiments
- The majority of students were able to conduct their work in an inquiry based manner and enjoyed the experience.
- The results that the students found and the conclusions that they were able to draw were very good.

Student Opinions:

'I really enjoyed doing this project. I enjoyed getting to work as a group to solve a problem.' Claire

'I really enjoyed this. I loved learning this way because it actually lets you think for yourself and I feel I learn things much better than just reading it from a book.' Stephanie

'I thought it was really interesting and more fun than just reading how to do everything from a book.' Fiona

'I enjoyed the freedom that we had to make up the experiments ourselves and research it. I also really enjoyed the fact that we were out of the classroom and actually doing the experiment hands-on, ourselves. I liked our ideas being used instead of being told what to do.' Olivia

Evaluation and Conclusions:

- Overall, the students enjoyed the module as it was hands-on, motivating, interesting and student centred.
- The majority of students were able to design and conduct the procedures with very little guidance from the teachers.
- It was evident that the students displayed no major issues in conducting the procedure, however when it came to drawing their conclusions they displayed some signs of struggle
- The students as part of this module were very capable of conducting the lessons through inquiry with the teacher as a mentor and facilitator



References:

- Websites Used:
www.earthskids.com
www.google.com/images
www.hse.ie
www.keepingitkleen.com
www.pei.ie
www.sciencecompany.com

Acknowledgments:

Thank you to the staff, management and especially the transition year students in St. Mary's High School, Midleton, Co. Cork

Which Antacid Remedy Is the Most Effective In Dealing with Excess Stomach Acid?

LEARNING OUTCOMES:

This project enables students to learn about
The purpose of antacid remedies.
To discuss and put forward suggestions as to how best to carry out the experimental work.
To identify variables and controls and put them in place so that their experimental work produces valid results.
Design and write up the procedure for each experiment.
Working as part of a team.
Analysis results based on scientific and experimental evidence.

Your task:
Design experiments to measure the effectiveness of different antacids.



Use technology where at all possible

CURRICULUM CONTENT:

Neutralisation (consolidation of concept), titrations, use of pH sensors and data logging, quantitative analysis of results.



Did you know?

- Amount of stomach acid varies with time of day and with meal time.
- On average there is roughly 100 ml of acid in the stomach at any one time.
- The acute effects of excess stomach acid (heartburn) occur when all the acid in your stomach is neutralised.



OBJECTIVES

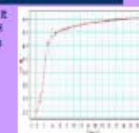
- This set of activities allows students to work together as a team to investigate which antacid remedy is the most effective in treating excess stomach acid.
- It involves researching what the word effective means in the context of antacid remedies, is it the fastest acting remedy, is it the one which neutralises the most acid? Or is it the remedy which results in the greatest pH change?
- It allows students to design and carry out experiments to determine which the most effective antacid remedy is.
- Students get the opportunity to compile and analysis their results and then put forward a scientific argument to justify their choice.
- To reinforce the role that acids and bases play in our everyday lives and shows that by knowing the Chemistry of a common medical problem it becomes easier to deal with.

Time factor Graph

Product	Final pH	Time taken to reach final pH
Milk of Magnesia	9.7	13 seconds
Gaviscon liquid	6.6	4 seconds
Gaviscon tablet	6.4	10 seconds
Rennie	5.6	20 seconds

Rennie pH scale

- It took 20 seconds for it to reach its highest pH
- As shown in the graph



Double tablets results table

Product	Acid neutralized with minimum dosage	Acid neutralized with double dosage
Milk of Magnesia	28.0ml	55.8ml
Gaviscon tablet	6.9ml	13.5ml
Gaviscon liquid	6.2ml	12.3ml
Rennie	32.5ml	64.8ml

Results of pH range

Product	Starting pH	pH after Minimum dosage	pH after Maximum dosage
Gaviscon liquid	3.3	7	7.3
Milk of Magnesia	3.3	9.4	9.8
Rennie	3.3	6.4	6.4
Gaviscon tablets	3.3	4.3	7.3

Part A

Measure the pH vs. Time when the minimum dosage is added to stomach conditions.



Does doubling the dosage half the time required for neutralisation?

What is the final pH at the end point?

Part B

Measure the volume of the acid neutralised by the minimum dosage.



Does doubling the dosage neutralise double the acid?

The Body at War!

Learning Outcomes

- Define and give examples of the General Defence system and Specific Defence system of the human body.
- Define the term vaccination, immunisation, antibiotic.
- Create bacterial agar plates using aseptic technique.
- Present information to the class and defend opinions on the newspaper article given.
- It is hoped that this module will enable students to make informed decisions about contemporary biological issues by:
 - Constructing scientific knowledge in an organised manner.
 - Collaborating with their peers to arrive at informed decisions.
 - Developing their cognitive and reasoning competences.
 - Being open to express their attitudes to the ethical issues that present themselves in science.



Curriculum Content:

The content of the lessons come from the Leaving Certificate Biology Syllabus aimed at students of 15-18 years of age.

- Difference between the specific and general defence systems.
- The role of White blood cells to include monocytes and lymphocytes.
- Applications of antibiotics, vaccines and immunisation and their role in modern society, medicine and industries.
- Basic Microbiology – factors required for the growth of bacteria and aseptic techniques.

References:

Second Level Support Services - www.slss.ie
 National Council for Curriculum and Assessment - <http://www.ncca.ie/>
 State Examinations Commission - [http://www.seamr.ie/01010101/](http://www.seamr.ie/010101/)
 Irish Science Teachers Association - www.ista.ie
 Biology Syllabus - http://www.curriculum.ie/en/Uploads/Files/FD011c_biology_lv.pdf
 PROFILES - <http://www.arcf.ie/project/en/>
<http://www.irishteachers.com/>
<http://www.irishteachers.com/news/2014/04/01/2014-04-01-01/>
<http://www.irishteachers.com/article.html?id=15853>
<http://www.youtube.com/watch?v=udmwa05wM0c>
<http://www.youtube.com/watch?v=Uw005f8qj>

Objectives

- to understand the role of vaccinations, antibiotics and immunisation techniques.
- to see how antibiotics are chosen for various infections using methods that mimic that of real scientists.
- to create a presentation and improve presentation skills.
- to discuss ethical issues

Activities

Task 1: Brainstorming – students discuss ways that the body protects itself against infection

Task 2: Authentic inquiry-based activity – students read the diaries of people suffering from an infection. The students must match the symptoms of the people to the bacteria or virus that they have.

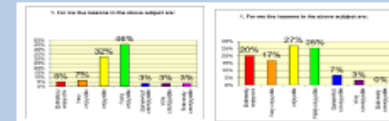
Task 3: Students grow bacteria on nutrient agar plates. Antibiotic discs are then added and the students can see the effect of antibiotics on the growth of bacteria.

Task 4: Students create a PowerPoint presentation on the information learned throughout the module and discuss their opinions on a newspaper article which discusses the possibility of drug companies making money from creating viruses.

The following shows an example of a part of a presentation created by one group of students.

Results:

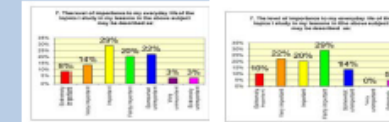
- Over one quarter of the students found that the module taught here was more enjoyable than previous teaching modules.



Questionnaire prior module

Questionnaire post module

- The students felt that the topics covered were relevant to their everyday lives and to society. This creates a purpose for learning for the students.



Questionnaire prior module

Questionnaire post module

- On observation the students seemed to be hugely engaged in each task and participated well in all aspects of each task.
- Oral feedback from the students shows that they particularly enjoyed the discussions and voicing their opinions.

Evaluation:

- Each of the lessons were easy to prepare and easy to implement.
- Time constraints inhibited more discussion time.
- The students thoroughly enjoyed the activities but would like more time to ask questions during the process.

Conclusion:

- Participation levels were high in all tasks.
- Students enjoy inquiry-based activities more than traditional teaching methods.
- Students feel that Biology lessons are very relevant in their everyday lives.

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