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• 2013 Primary Science Conference – highlighting science in the classroom

• Making stoichiometry engaging: a cheap, simple investigation to analyse exhaled breath for oxygen content
ANATOMY & PHYSIOLOGY

This workbook explores the essentials of human structure and function through engaging, generously illustrated write-on activities. Using key examples, students are encouraged to explore each of the 11 body systems within the contexts of disease, medicine and technology, ageing, and exercise. An ideal resource to support Units 2A and 3A of the WACE Human Biological Science programme.

Questions? Contact our friendly Sales Team: PHONE (07) 5535 4896  EMAIL sales@biozone.com.au
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Editorial

The editorial committee and I have put together a really practical issue for you this quarter.

Two excellent practical investigations are included, two opportunities for engaging excursions and a report on the successful Primary Science Conference. All other important information usually included is present, the final presidents report from our current president Bernie Hunneybun, report from chief executive officer John Clarke, and information from the Sci Network.

Making Stoichiometry Engaging is an efficient investigation, well researched and tested by Dr Leon Harris of Living Waters Lutheran College in Warnbro. It makes use of simple equipment available in all science laboratories to enable students to experience a practical application for stoichiometric analysis. Worksheets are included so this activity is all ready for your class.

Investigating Enzyme Activity is a practical activity which is aimed at year 11 and 12 Biology or Human Biology classes and demonstrates the factors effecting enzyme function. Prepared by the Primary Industry Centre for Science Education, this practical activity is fully supported with notes for you and student worksheets ready to go for your class.

The opportunities for excursions are presented by the WA Institute for Medical Research, which is providing an opportunity for teachers and students in the form of the new BioDiscovery Lab located in the Queen Elizabeth II Medical Centre in Nedlands, and the Gnarloo Turtle Conservation Project located on Gnarloo Pastoral Station 150 km north of Carnarvon. The aims and work of each of these facilities is described well in the articles located in this issue.

Don't miss out on the upcoming Future Science Conference at the University of Western Australia advertised on the back of this issue.

Thank you to all contributors and committee members for making this issue possible. If you have any requests, comments or ideas for future issues please contact me, we would love to share them with the rest of the science teaching community.

Happy reading
Fiona Lorkiewicz

President's Report

The School Curriculum and Standards Authority listened to our concerns regarding the ATAR Chemistry course and allowed a small working party of five to address these. We spent the long weekend re-writing parts of the course before it went back to the extended CAC panel and then went out to the briefing sessions where it was well received.

CONASTA 62 in Melbourne July 7-10 was great, we monitored everything very carefully in order to apply relevant strategies to the successful running of CONASTA 64 in Perth July 5-9 2015. The organisation for this event has commenced but if anyone would like to assist please contact me. We are now looking for sponsors and accommodation options due to Perth’s expensive hotel costs and constant high occupancy rates so if you have any suggestions please get in contact.

The STAWA publications will be available in ebook format from late September so they can be placed on booklists for 2014. The books will be complete ebook versions of our current books. You will be able to download sample sections to check them out or see me for demos of more complete versions. We are in the process of re-writing our current books to conform to the new courses in time for 2015 commencement date. These will be released in September 2014. Please contact us if there is something you would like to see included in the new versions.

Science Talent Search was again very successful this year. Thank you to all teachers and students for working so hard on entries, there was a record number of inventions this year. Regional competitions were again held and the best of these have been included in the metro competition. The award ceremony will be held on September 18 at Scitech. Thank you to all the teachers that helped judge the competition.

Future Science will be held on November 29 at UWA, a call for Presenters has gone out. It promises to be an exciting and varied program.

I was very sad to hear about the passing of Brian Sheperdson on Sunday August 4. Brian’s contribution to science and physics in particular has been considerable, he was a great mentor to many and his down to earth manner endeared him to all that worked with him. Rest In Peace, Brian.

This will be my final SCIOS report as President, I look forward to handing over to Geoff Lewis in September.

Bernie Hunneybun

SCIOS Deadlines for 2013-2014

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Chief Executive Officers’ Report

The 2013 STAWA EXXONMOBIL WA PRIMARY SCHOOL SCIENCE PROJECT has been a great success. School principals, primary science teachers and students have been very appreciative of these science resources. Funding through the ExxonMobil Community Contributions Program has made this project possible. Science packs containing student activities on electricity and energy, and equipment to support the activities were distributed to 30 Western Australian primary schools in 2013 and 41 in 2012. A total of 71 Western Australian primary schools have each been provided with $400 worth of science equipment to support their science programs. Thank you ExxonMobil.

As part of this program I was able to attend school assemblies to present, both the kits to the principals and prizes to students who won prizes in the design a science sticker competition run in conjunction with this program. The first presentation and launch of the 2013 project was carried out at South Ballajura Primary School. Chief Scientist, Professor Lyn Beazley, was our special guest at this event along with Mr Luke Musgrave, ExxonMobil Vice-President LNG. (Photograph 1)

This project engaged 120 primary science teachers in professional learning workshops. The teachers involved teach across a variety of primary years, sectors of education and included Perth metropolitan schools, The Great Southern and Bunbury regional schools. Workshops were held at South Ballajura Primary School, Curtin University, Armadale Primary School, Albany Senior High School and Ocean Forest Lutheran College.

Participant feedback demonstrates this was an excellent professional learning experience. Many teachers expressed how good it was to have been given the opportunity to see and discuss lesson and assessment samples with other staff. Importantly staff also found it very informative to be provided with the latest cross sectoral work on assessment.

On behalf of STAWA I would like to thank our presenters; Julie Belohlawek, Natalie Birrell, Mady Colquhoun, Sue Doncon, Erin Burns, Fiona Mayne, Glenda Leslie, Jeffrey Medcalf and Helena Stoakley. Thanks you to Louise Nielsen, Peter Watts and Stewart King who provided support and backup to the presenters. The professional learning workshops were funded through Western Australian Government Australian Curriculum Cross Sectoral Coordination and SCSA.

Important Dates:
AGM Thursday 12 September 5:00pm Curtin Resources and Chemistry Precinct, Bentley
STS: Awards night Wednesday 18 September 4:30pm for 5:30 pm start at Scitech
Physics Day @ Adventure World Thursday 26 September
ScienceIQ Online Quizzes Term 4, Years 5 and 8 Monday 11 November
Future Science Friday 29 November

Finally don’t forget to renew your membership. I also encourage you to extend the invitation of STAWA membership to your science-teaching colleagues.

Your Chief Executive Officer
John Clarke
What a marvellous species we are, so capable of making meaning from our world. Our minds are embodied in our brains, and are more powerful and sophisticated information processing machines than any which we could conceive of. Yet this great power comes at a cost: more than 20% of your bodies energy consumption, and the oxygen needed to unleash that energy from your food is needed to feed your brain. Worse, in just three short minutes without breathing, your brain starts to die and your personality begins to dissolve.

Our heavy oxygen demand is both a bane and a kindness: cockroaches, which are cold blooded, can live for up to 5 days without their heads, in a ghastly lingering death. The heads of eels that have been decapitated and left on ice have been known to bite their tormentor 10 hours later. For us, our vast oxygen requirements can save us from a lingering death. I would not want to be cold-blooded.

Our lungs are a critical system that sustains us. Have you ever wondered about how quickly your lungs can remove oxygen from the air? How would you test that, using your knowledge of chemistry.

I'll give you a clue: you have the following equipment:

- 2 syringes, 10ml each
- copper powder
- glass tube with pipe that fits onto syringes
- bunsen burner
- matches
- balloon (you could collect your breath in this)
- Tube of silica gel with tubing attached to it (silica gel is used to remove water from air – when dry it is blue, but turns pink when it has absorbed water. You can remove the water by heating it and blowing air over it until it turns blue again).

Your task is to design an experiment to measure the amount of oxygen in the air you exhale. You will need to estimate the amount of copper you will need (assume for the calculation that air is 100% oxygen, which it is not) and then overestimate the copper to be safe.

Experiment Planning – ramblings and points to ponder.

Hmm, how many grams of that copper powder will I need?

Where is my equation?

Now how much (in moles) of oxygen could there be in 10ml of air (maximum value)?

How many grams of copper would I need to react with that?

Let’s be safe and use 2-5 times as much (you pick).

Hmm, what about all that extra water in the air I breathe out? I’m going to have to think of a cunning plan!

How should I carry out the reaction? What can I do to make the copper react quickly, so I am not still waiting when I am 90?

But wait, won’t that affect my volume? What do I need to do to make it a fair test? (Hint: think how long).

How can I collect enough results to make sense of this? Should I pool with my classmates? Who will do the control experiment to calculate the oxygen composition of un-breathed air in the classroom?

Have I done my safety review? Maybe I should think of some risks that I will need to control in case that horrible Harris pings me!
**Oxygen Content of Exhaled Air Prelab Worksheet**

Dr Harris

The purpose of this worksheet is to assemble all the tools that you will need for this class investigation. You may use the internet to carry out the research, or you can answer from your memory or text. It shouldn't take longer than about 10 minutes to complete, so stay focussed!

What gases are present in air? Fill in the table below.

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What is the relationship between the number of moles of a gas and its volume?

Name 3 factors that can affect the volume of a gas

When copper is heated in the air, it forms copper (II) oxide, which is black. Write a balanced chemical equation for this reaction.

Name 3 factors that affect the rate of a chemical reaction
Reward your science stars!

Register your school to participate in the Woodside Scitech Science Awards and receive prize packs to recognise and reward graduating primary school students who demonstrate passion and enthusiasm for science.

Schools enrolled in the Woodside Scitech Science Awards will receive two free award packs to be awarded to the foremost graduating primary male and female science students. The award winners will be determined by the relevant teachers and school representatives.

“The awards are given to two graduating primary school students from each participating school. The awards are an opportunity to recognise students who have shown a curiosity about the world around them and a desire to experiment and investigate in the field of science,” said Scitech event coordinator, Vanessa Baker.

Through continued support by Woodside since the annual awards program was developed in 2007, the program has reached approximately 85% of all primary schools in Western Australia.

In 2012 prize packs were awarded to more than 1,500 graduating students.

Woodside and Scitech designed the awards as an opportunity to support science growth and interest in the community by providing a greater awareness of the critical role it plays in today's society.

“We hope that through this award, students will be encouraged to continue studying science in secondary school and go on to achieve great things,” said Vanessa.

Each award recipient will receive a book about science, certificate of participation, a family day pass to Scitech and Horizon – the Planetarium and a discounted membership to the CSIRO Double Helix Science Club.

Register your school for the Woodside Scitech Science Awards or find out more information through the Scitech website (www.scitech.org.au).
The Gnaraloo Turtle Conservation Program

Karen Hattingh, Environmental Advisor, Gnaraloo, + 61 (0)8 9840 1556; and Danica Illich, Scientific intern, GTCP Field team 2012/13.

Gnaraloo is a wilderness tourism business and working pastoral station on the Ningaloo Coast in North Western Australia, about 150 km north of Carnarvon, next to the Ningaloo Marine Park and the Ningaloo Coast World Heritage Area. Gnaraloo abuts 60 km of coastline, including southern parts of the Ningaloo Reef and four marine sanctuary zones. The Indian Ocean borders Gnaraloo to the west (refer to the map).

There are seven sea turtle species worldwide, all of which are at threat of extinction. The Gnaraloo Station Trust commenced the scientific Gnaraloo Turtle Conservation Program (GTCP) in 2005 to identify, monitor and protect key coastal nesting rookeries of endangered sea turtles on Gnaraloo beaches, namely of loggerhead Caretta caretta, green Chelonia mydas and hawksbill Eretmochelys imbricata sea turtles. Internationally, loggerhead and green sea turtles are listed as endangered, while hawksbill sea turtles are critically endangered (IUCN Red List).

The Australian loggerhead sea turtle populations are linked to, and support global loggerhead sea turtle populations, as loggerhead sea turtles are migratory and move vast distances across oceans to mature, mate, feed and rest. To reproduce, female sea turtles come ashore in various countries to dig their nests and lay eggs. Australia has two genetically distinct loggerhead populations, one in eastern Australia and the other in Western Australia (WA). Intermixing does not occur between the Queensland and WA breeding loggerhead sea turtle aggregations. The WA loggerhead sea turtle population is the largest population in Australia, one of only four populations in the Indian Ocean and, when all nesting activity in WA is combined, represents the third largest population in the world according to most recent research.

The GTCP and the separate protective Gnaraloo Feral Animal Control Program (GFACP) also initiated by the Gnaraloo Station Trust target matters of national environmental significance under the Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth), namely: (1) nationally significant species in the form of threatened fauna, in the category of endangered and vulnerable reptiles, and (2) key threatening processes, namely feral predation of turtle eggs and hatchlings by European red foxes Vulpes vulpes, feral cats and wild dogs. The GTCP has a number of objectives, including: to collect baseline scientific data on sea turtle nesting activities along the Gnaraloo coastline each year to identify significance, trends and required management activity to protect these endangered marine species and critical-
University based researchers, Honours and PhD students also conduct their own research projects on sea turtles and other subjects in the Gnaraloo rookeries. There are currently two monitored areas, the Gnaraloo Bay Rookery (7 km) and the Gnaraloo Cape Farquhar Rookery (14 km), which are both located in the southern section of the Ningaloo Marine Park. These survey areas contain predominantly nesting loggerhead sea turtles.

Research by the GTCP includes: (1) daily turtle track monitoring for species identification and turtle nesting activity determination ie. nests, unsuccessful nesting attempts, U-Tracks and unidentified nesting activities; (2) counts of nests versus unsuccessful nesting attempts; (3) data collection on turtle nest locations to determine turtle nest density and distribution within the monitored areas; (4) data collection on turtle nest disturbance and predation by native and feral predators and nest loss due to environmental factors; (5) monitoring of feral animal tracks to report on the presence of threats in the monitored rookeries for adaptive management activity; and (6) data management, analysis and scientific reporting. To ensure data accuracy, the GTCP also conducts night surveys to confirm the accuracy of its turtle species identification and nesting activity determination from tracks only and to identify the margin of error.

The annual scientific report by the GTCP of each season's work is provided to Government agencies, universities, sea turtle experts and made publicly available on the Gnaraloo website. To view the reports, see www.gnaraloo.com/main/scientific-data/

The GTCP will be in its sixth season of on-ground operation during 2013/14. The program addresses and makes valuable contributions to a previous knowledge vacuum on the Ningaloo Coast concerning critical coastal nesting rookeries on Gnaraloo of three migratory marine species listed in Australia as nationally significant and internationally as endangered. The Gnaraloo Station Trust actively monitors, manages and protects the significant sea turtle nesting rookeries on the Gnaraloo coastline and provides adaptive and effective management in real time to minimize threats to the rookeries.

Findings to date

The Gnaraloo Bay Rookery, together with the Gnaraloo Cape Farquhar Rookery, support and contribute to the third largest loggerhead turtle population in the world.
The Gnaraloo Bay Rookery is one of the two most significant mainland (as opposed to island) breeding rookeries for loggerhead sea turtles in WA (the other being in Cape Range National Park, Exmouth). The Gnaraloo loggerhead sea turtle rookeries are the most significant loggerhead rookeries in the Ningaloo Marine Park and the Ningaloo Coast World Heritage Area. The on-ground research by the GTCP since 2008 to monitor such rookeries constitutes the baseline on loggerheads for the Ningaloo Marine Park.

The GTCP has recorded the following number of nests of loggerhead, green and hawksbill sea turtles in the Gnaraloo Bay Rookery during seasonal monitoring periods since 2008/09:

- Season 2008/09 = 368
- Season 2009/10 = 522
- Season 2010/11 = 426
- Season 2011/12 = 346
- Season 2012/13 = 313

On-ground reconnaissance surveys of the Gnaraloo Cape Farquhar Rookery were first undertaken during 2011/12 after aerial surveys during 2009/10 and 2010/11. The on-ground surveys recorded the majority of nesting activities in the Farquhar rookery as loggerhead sea turtles, but green sea turtles were also recorded to use the rookery for nesting purposes. Sea turtles identified as greens (juvenile and adult) and smaller unidentified individuals were frequently observed swimming alongshore the Farquhar rookery during the surveys, which indicates that the loggerhead sea turtle activities observed in the Farquhar rookery may not entirely describe the extent of sea turtle presence in the area by other species.

The most significant achievements in the Farquhar rookery to date are the identification, naming, delineation and mapping of this rookery and on-ground reconnaissance surveys of all of its sub-sections for sea turtle activities. However, the majority of research questions concerning the Farquhar rookery cannot yet be answered, including: (1) confirming all turtle species that use the rookery; (2) the seasonal number of turtle nests dug at the rookery; (3) sub-sections in the rookery with the highest turtle nesting activities; (4) the start, peak and end of the turtle nesting period at the rookery; and (5) the relationship, if any, between the Gnaraloo Bay Rookery and the Gnaraloo Cape Farquhar Rookery as it is possible that sea turtles use both locations for mating, nesting, foraging and/or resting purposes. Should this be the case, the recorded seasonal numbers of sea turtles at Gnaraloo may be an underestimation and the Gnaraloo rookeries may be more significant than previously known.

Sea turtle populations are declining worldwide. Gnaraloo’s conservation efforts help to support the third largest loggerhead sea turtle population in the world.

Schools can become involved!

Primary and secondary schools may share in the research of the GTCP through educational field excursions at Gnaraloo and educational presentations at schools during the annual turtle season.

School groups may participate with the Gnaraloo turtle program through educational field excursions at Gnaraloo from 1 December to 1 February each year. School groups will have the opportunity to learn about sea turtle biology, behaviour, threats and protective management action; to accompany the GTCP field research team during their daily scientific patrols; to assist with data collection during the patrols; to learn how to watch nesting female turtles without disturbing them and what steps to take to contribute to turtle and marine conservation in everyday life. Please note that Gnaraloo does not offer turtle contact, but interpret and work with tracks. When school groups are not participating with the GTCP, several recreational activities can be conducted on Gnaraloo at the discretion of the school.

School groups can participate with the GTCP beach patrols, including turtle and feral animal track monitoring and species identification; turtle nesting activity determination; data collection on turtle nest locations and turtle nest disturbance and predation by predators and environmental factors such as shifting dunes and tides.

During October and March each year, the GTCP offers schools in regional and metropolitan locations in WA the opportunity for an educational presentation about sea turtles, the Gnaraloo turtle research program and marine conservation.

Feedback by school groups about the GTCP:

‘Your presentation was pitched at the appropriate level and kept the children's interest. It was obvious that your deep concern and care penetrated the session and the students became involved too, asking some excellent questions’
‘I most enjoyed seeing the beach environment practically untouched by man. I liked learning how to identify turtle tracks. The researchers and the hands-on experience with them were really cool’

‘The GTCP research team seemed to have fun with their work and they told us a lot about turtles and answered all questions. It was fun!’

‘Very interesting, great experience’

‘I rate the overall experience as a participant with the program as 10/10, learning about the Gnaraloo turtles and the conservation work and would recommend participating with the program to others’

Contact information
For further information on how a school group may participate with the GTCP, please request a copy of the invitation flyer for community participants and schools from Karen Hattingh, Gnaraloo’s Environmental Advisor, on +61 (0) 8 9840 1556.
Visit www.gnaraloo.com.au for GTCP field diaries, photos, videos and reports from previous years.
BioDiscovery Lab Coming Soon!

The Western Australian Institute for Medical Research (WAIMR) is excited to let teachers and the science education community know that they are currently completing work on an innovative education laboratory centre called the BioDiscovery Lab. The BioDiscovery lab will be open for practical science excursions for secondary students at the beginning of 2014. The BioDiscovery Lab is part of the WAIMR’s Education Outreach program whose mission is to “Promote Community Awareness and Participation” by creating a greater understanding of the importance of medical research.

The BioDiscovery laboratory, located on the mezzanine floor of the new WAIMR building which is situated in the Queen Elizabeth II Medical Centre in Nedlands, will be fully equipped for hands-on inquiry based medical research activities.

Practical sessions will be led by young WAIMR medical researchers and it’s expected that most classes, at least initially, will be aimed at Year 10, 11 and 12 students, with content written to link to the Australian Science Curriculum.

Groups of 12 to 28 students will learn how to use a scientist’s tools of trade such as micropipettes, gel electrophoresis, Polymerase Chain Reaction (PCR) as well as sequencing equipment.

Other equipment in the BioDiscovery Lab will include:

- A research grade inverted compound microscope (for cancer and stem cell investigations) that will also be remotely accessible for follow up activities at school; and
- Human physiology monitoring equipment for students to record EEC (heart), EEG (brain) and EMG (muscle) function for analysis.

WAIMR’s Education Outreach Manager, Pauline Charman, says the educational activities in the BioDiscovery Lab will complement Year 10, 11 and 12 courses in the areas of advancements in genetics, cell biology, human physiology and molecular biology. The activities will highlight medical research currently being explored by WAIMR.

Some proposed activities include:

**Year 10 Australian Curriculum Biological Sciences Strand**
- An introduction to a molecular geneticist’s tool kit;
- Use of micropipettes, DNA sequencers, electrophoresis, PCR, diagnostic testing and experiencing how the genetic test for Huntington’s Disease is carried out; and
- Introduction to ethical issues surrounding genetic testing including talking about the difficult decisions.

**Year 11 Australian Curriculum Unit 2 Biology and Stage 2 Human Biological Science**
- DNA, how do we manipulate the molecule for medical research? What happens when things go wrong with DNA replication?
- Enzymes as molecular scissors (restriction enzymes);
- Stem Cells, what are they and their role in WAIMR’s cancer research;
- Microscopy, examining, measuring and observation of (real) cancer and stem cells with; and
- The Cardiac Cycle, record and analyse your own.

**Year 12 Australian Curriculum Unit 3 Biology and Stage 3 Human Biological Science**
- Gene expression, using DNA extraction, PCR, gel electrophoresis, Western Blotting;
- DNA bar-coding and International Barcode of Life Project;
- Bioinformatics activities using real data from the WAIMR DNA Repository for Type 1 Diabetes;
- Disruption of Homeostasis using current diabetes diagnostic tools available at WAIMR;
- Neuromuscular research involving measuring the performance of your own skeletal muscle and what happens when things go wrong; and
- Ethical considerations of new technologies in cancer treatment, stem cell use and animal testing.

Pauline says that teacher induction courses will be offered at the end of 2013 and it’s worth booking ahead to ensure that your classes can fit into the BioDiscovery program when it begins at the start of the school year in 2014.
The 33rd annual Primary Science Conference was held on the 23rd and 24th of March at The Vines Resort in the Swan Valley. The theme for this year’s conference was ‘Flowing forward with the Australian Curriculum.’ Eighty Primary and Early Childhood teachers attended the conference and experienced a diverse yet engaging range of presentations and trade exhibits, along with a wonderful array of spot prizes kindly donated by our many supporters and sponsors.

The conference started with the One World Centre presenting education simulation games to all participants. These activities are designed to raise students’ awareness of the importance of water in the environment, connections between environmental and social sustainability, and to help recognise the global nature of sustainability issues that affect people locally. After being allocated to a country, groups then had to act out a sustainability issue particular to that country. This created some interesting scenarios as competition for food and water were counter-balanced with local issues, political agendas and the military.

In the first workshop session participants could choose one of four workshops on offer. Jennifer Pearson, President of the Australian Association for Environmental Education, presented on ‘Illustrating educating for sustainability in the Australian Curriculum,’ illustrating how to incorporate sustainability as a cross-curriculum priority. Richard Rennie (Science Communicator from Fremantle Light and Sound) presented ‘Light and sound for Year 1,’ with demonstrations of a wide range of unusual and historical light and sound instruments to engage young children. Who could ever forget the nose flute! Yes, that’s right, you blow through your nose! Yvonne Hunt presented a session on ‘Discovering desal was presented by Warren Hays from Murdoch University. Participants learnt the science of desalination and its relationship with sustainability, climate change and renewable energy. They also discovered the Desal Discovery Centre.

The second session had another four fascinating workshops to choose from. Suzanne Dee, a primary teacher from Katanning, presented on ‘Stick insects inside the classroom.’ Suzanne demonstrated how to use stick insects for teaching values and personal development while also addressing many science concepts. She brought a large number of diverse stick insects with her, and allowed some to crawl over participant’s hands and heads! Glenda Leslie, from AISWA, presented on ‘Year 3 heat and change of state.’ Participant’s explored the topic of heat and how to integrate change of state into the curriculum. A Scientists in Schools project was presented by Kerrie Cogger (primary science specialist from St Emille’s Catholic primary School) and Dr Rowena Long (The University of Western Australia), highlighting how scientists and teachers can work effectively together to develop engaging activities and programs. Charlotte Vaughan and Michelle Martin (Kings Park Education) presented on ‘Meeting curriculum outcomes in the outdoor classroom.’ This presentation highlighted the importance of children connecting with nature, and finding out how outcomes relating to Science, Maths, English and History can be met in the outside classroom.

Session 3 saw more engaging presentations. Mady Colquhuon (Primary science specialist from Armadale primary School) presented on ‘Kulparti Calamity’. Mady challenged her Year 6 students to become Environmental Officers and develop a management plan for the local creek and put one of their ideas into action. This approach allowed Mady to cover both Biological Science and Science as a Human Endeavour within her teaching and learning. Michael Burke and Michael Burgess (Department of Fisheries) presented a session titled ‘Hot water: Juggling science, sustainability and sharks.’ They covered the science underpinning the sustainable management of fisheries and the place of education to ensuring there will be fish in the future.

Helena Nicholson (primary teacher from Dunsborough primary School) leads sustainability in her school, presented on ‘Finding the Australian Curriculum in the veggie garden.’ This session outlined an AuSSI program developed through practical gardening activities and its partnership with the local community. Many links were explored with Biological Sciences and other learning areas. John Cadogan from Perth Scientific presented ‘Sustainability and wind power.’ This session demonstrated various ways to cover forces, motion, energy conservation and alternative energies in relation to the Physical Sciences in Years 4-7. Participants used a kit to build their own wind energy machine, and explored how to develop investigations around this machine.

The conference dinner was a BBQ with a Hawaiian theme. Even though the weather turned cold, it was great to see so many participants embrace the theme and enjoy some time to socialise and network.

The keynote address on Sunday morning was presented by Professor Jorg Imberger, Director of the Centre for Water Research at The University of Western Australia. Jorg’s presentation, titled ‘Water for people, industry, agriculture and nature: Different perspectives have different needs,’ was intentionally controversial, encouraging participants to question their own beliefs about their own use of water.
The final session of Sunday saw three more engaging workshops. Hall Jackson (Keypad interactive) presented on Assessment for learning: Getting the data the easy way. Hall demonstrated data logging techniques to determine student’s knowledge and how these relate to feedback. Barbara Sing (primary science specialist) presented on Sensational sea shells, illustrating how shells can be used to cover Biological Science, Science as a Human Endeavour and Science Inquiry Skills. Mary Rowlands (Education Consultant) presented on Teaching the chemistry of water. Focussing on Years 5 to 7, Mary explored a range of engaging hands-on, role play and digital strategies for teaching water.

Based on feedback from the participants, the conference was considered a huge success. Participants considered the highlights of the conference to be the passionate presenters, the chance to network, the great planning of the conference, the variety of sessions, being around inspiring and motivating people, the wide range of ideas and information presented, and the real classroom application.

“Today has been a shot in the arm for me and so refreshing. Thank you for your broad array of possible choices for learning. I really have learned a lot.” Quote from attending teacher.

One of the reasons the conference was so successful was due to the outstanding Primary Science Committee. A second reason this conference was so successful was the large number of practicing classroom teachers who presented this year. This allowed the committee to program a wide range of presenters from science communicators to classroom teachers, and from theory to practice.

“This was the first time I’ve presented at a STAWA conference. The committee were most helpful on the day. All of the workshop sessions that I attended were relevant and worthwhile.” Quote from attending teacher.

So if you think you are doing something innovative in science in your classroom, please consider presenting it in the 2014 Primary Science Conference.

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GUIDELINES FOR AUTHORS

Introduction

These notes are a brief guide to contributors. Contributors should also refer to recent issues of the Journal and follow the presentation therein. Refereed articles are peer reviewed by the Editor and anonymously by at least two reviewers.

Feature articles

Feature articles should not normally exceed 3000 words plus figures, tables and references. Short concisely written articles are very welcome. Please use headings and sub-headings to give your article structure. We also welcome any other type of contribution. Reviewed articles are subject to peer review.

Send the following to the Editor:

Note: if you cannot send your contribution in the following recommended form, please send it to the Editor in any reasonable form.

For all contributions

1. Please send your document as a word the file as an email attachment.
2. Photographs and other images (e.g. diagrams) should be sent as separate files.
3. Photographs often increase the clarity and interest level of your work. Send your photographs as TIFF or highest quality JPEG files, with a resolution of at least 225-pixels per inch.
4. Copyright clearance for any part of your contribution that is the copyright of a third party.

Note to teachers: Parent permission slip must be obtained for any photographs to be included in SCIOS.

Innovations in the classroom

The editorial board members are keen to increase the number of articles in this section. We are always keen to review your ideas about experiments, demonstrations, teaching techniques, hints, safety notes, computer applications and anything else that could help classroom science teachers, especially beginning teachers.

Reference style

SCIOS reference style is based on the most recent edition of the Publication Manual of the American Psychological Association. Examples of the most common references are:

In-text referencing

In your text indicate references by author and date. For example: ‘Smith and Jones (1992) investigated … resulting in increased enrolments (Moriaty, Jacobs, & Murphy, 1989; Robinson, 1995), especially of girls (Andrews, 1994b).’

End-referencing

The reference list at the end of your article should provide the details of all the references you cited in the text of your article and no other references. For example: Smith, J. (1992). Physical Chemistry, (3rd ed.). Melbourne: Longman Cheshire.

Spelling

Use The Macquarie Dictionary. If it lists several alternative spellings, use the first. The only exception is in a citation, reference or quotation directly from a source that uses alternative spelling.

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Contact details: John Clarke, STAWA Email john@stawa.net
News
Making stoichiometry engaging: a cheap, simple investigation to analyse exhaled breath for oxygen content

Dr Leon Harris, Living Waters Lutheran College, Warnbro, Western Australia

Stoichiometry is mathematical analysis of chemical ratios, this article is related to year 11/12 chemistry courses.

Introduction
Stoichiometry can be a very dry subject. It has a reputation for discouraging students that are not strong in mathematics from the study of chemistry. Yet an understanding of stoichiometry is at the heart of analytical chemistry, and quite essential to using chemistry as an enabling science for other disciplines such as biology and sports science. In this paper, I describe an engaging experiment to measure the efficiency of human lungs at removing oxygen from inhaled air.

It has been my experience that students are particularly interested in the functioning of their own bodies. This gives us a strategy to engage them in aspects of chemistry which are traditionally seen as rather dry. One possible context for studying stoichiometry is to measure the oxygen content of air and compare it to that of exhaled breath. This can be easily done in the lab by exploiting the fact that oxygen readily reacts with heated copper, as follows:

Copper metal, when heated, reacts with oxygen gas to produce copper oxide. The precise nature of this reaction depends on the amount of oxygen present, as can be seen from the following two equations:

\[ 4Cu + O_2 \rightarrow 2Cu_2O \]  \hspace{1cm} (1)  
\[ 2Cu + O_2 \rightarrow 2CuO \]  \hspace{1cm} (2)

In situations in which oxygen is very limiting, reaction (1) predominates. Where there is an excess of oxygen, reaction (2) predominates.

These two reactions may be readily distinguished by the colour of the product: copper(I) oxide is pink, while copper(II) oxide is black.

Consequently the method presented here has the advantage that it is possible to tell when the copper is exhausted - all the copper turns black. It also allows for repeated use of a single column of copper. The significance of this last point is that, by using the same column throughout an experiment, differences in column volumes (and ‘dead volumes’) can be controlled.

A more traditional approach to measuring oxygen content is done by reacting iron, in the form of steel wool with oxygen in the presence of acetic acid which acts as a catalyst (Altig, 2011).

The technique described in the present paper has the advantage that there is no possibility of hydrogen gas interfering with the volume measurements, and that compensating for water vapour partial pressure is unnecessary.

Lesson aims and strategies
Science investigations often face two competing and sometimes contradictory needs. On the one hand, there is the overwhelming need for a ‘successful result’. On the other, the goal really has to be to get our students to construct meaning and understanding for themselves. Balancing these two needs can be quite a challenge. Too much emphasis on the successful result can lead to a cookbook approach to science, which stifles creativity and is not very stimulating. It has been suggested that Australian Science educators should try for more open-ended activities that investigate relevant science questions (Goodrum et al., 2001). This paper is geared towards the second need, but hopefully includes enough background to enable the students to achieve a sense of success with their results.

The goals of this practical are as follows:
1. To give students a context that allows them to engage in a scientific dialogue using stoichiometry.
2. To pique their curiosity and to engage their aesthetic sense in the practice of chemistry (a well-designed experiment is a very beautiful thing).
3. To explore and engage with the chemistry behind the reactions of copper and oxygen.
4. To give the students a feeling of success when applying chemical theory to solve a real problem of interest or relevance to them.

Structure of the lesson
I start this investigation by handing out a ”Project scope sheet” (Harris, 2013). This project sheet is included in the article "Oxygen content in exhaled air project scope" also contained in this issue of SCIOS. This sets the scene for the investigation, and ties the chemistry closely to the functions of the respiratory system. It also has an aesthetic element to it, and seeks to achieve the second of my goals.

Next I hand out a prelab worksheet; the worksheet contains some simple questions that give them the background to participate in discussions of the project (Harris, 2013). Because these answers
are simple concrete facts, they can be found quickly using the internet, and I allow only 15 minutes on this task.

The third part is more open-ended. The sequence followed is partly determined by the student answers. I start by drawing attention to the two equations for oxidising copper, and pose the following question:

**Which of the two reactions would it be better to try for if you wanted to measure oxygen?** (The answer I am looking for is reaction 1, because you could be sure that if pink copper oxide is formed that all of the oxygen would be removed from the air).

**How much copper do we need?**

Next, the students are then asked how much copper metal would be needed to measure the oxygen content in a 10ml sample of gas. After reminding them that one mole of gas at STP is 22.7 l in volume, and that the maximum amount of oxygen possible in their 10ml gas sample is 10ml, they are usually able to come up with an answer of 0.0005 moles. Using Equation 1, this means that 4 times as much copper is needed, or 0.11 grams.

A brief discussion about limiting reagents can then follow, and I get the students to see that it is good to have an excess of copper present.

**Moles and volume – the chemist’s Rosetta Stone**

At this stage in the investigation, I ask the students what the relationship between number of gas molecules and volume is. I am not looking for a PV=nRT type of answer here, simply the understanding that volume is proportional to the number of particles. It is an important point - this was the “Rosetta Stone” for the early chemists that allowed the whole concept of the mole to develop, because volume is the only simple physical property that you can directly relate to the number of particles of any substance (without first knowing about moles and molar mass).

**Questions for a scientific dialogue**

Once it is agreed that volume is directly proportional to moles, we then discuss how to design our experiment in earnest.

- **How could we measure oxygen content with this simple system to remove oxygen?** We can measure the volume of gas remaining after a 10ml sample is passed over heated copper.
- **Should we use a control, to measure the oxygen content of just air?** But we know that it is 21% from the textbook, so why would you do that? Is that true though, is oxygen always 21% at all regions of the earth?
- **What if there is a systemic error in our apparatus that stops us from exactly measuring 21% - aren’t we really interested in how efficiently our lungs remove oxygen?** If we are interested in the rate that our lungs remove oxygen, that means an amount per unit of time.
- **What is a reasonable time frame to hold your breath for to allow your lungs to remove some oxygen from the air?** My class decided 10 seconds, because it was easy to divide by 10, but other numbers may also be reasonable. Indeed, different breath hold times may affect the result - there is no guarantee that your lungs remove oxygen at a constant rate.

These questions form an important part of the investigation planning and is a good opportunity to allow students to think about making an informed scientific value judgement.

**Solving the water issue**

Water vapour is an important component of exhaled breath, and accounts for 6% of the volume of a saturated sample at body temperature (Weast & Astle, 1979). As water can change state and disrupt measurements, it is good to remove it from the breath samples. A column of silica gel (of the blue indicating variety) can be used to remove water from the breath passed over it, and as long as the gel is still blue at the end where the breath sample leaves the column, it will work. The way my class did this is shown in Figure 1.

**Data processing**

As part of the planning process, we look at how we can process the data that this experiment could give us. We are able to measure the difference in volume of an air sample, before and after being passed over heated copper. Knowing that, we can find the percentage of the sample that is oxygen.

\[
\text{Percentage oxygen} = \frac{\text{volume before heating over copper} - \text{volume after heating}}{\text{volume before heating over copper}} \times 100\% \quad (3)
\]

The aim of our investigation is to measure how efficient our lungs are at removing oxygen.

As this measurement is a rate, we also need to consider the time that we held our breath for.

So we need to measure a “control” sample of air - one that our lungs haven’t acted upon, and compare it to one that our lungs have.

\[
\text{Oxygen removal rate} = \frac{\text{\% Oxygen air} - \text{\% Oxygen exhaled}}{\text{Time breath held}} \quad (4)
\]

This gives us a measurement in terms of percentage oxygen removed per second. This is quite intuitive for students, but to make it more useful, we need to convert this to moles removed per seconds. To do this, we need to know the volume of air exhaled.

**Methods for measuring volume of air exhaled**

Measuring the volume of air can be done three ways:-

1) In its crudest form, you can do this by blowing up a balloon and measuring its diameter. Assuming that it is spherical, you can calculate the volume it holds by

\[
\text{Volume (ml)} = \frac{4}{3} \times \frac{(\text{circumference (cm)}^3)}{2\pi} \quad (5)
\]

2) By compare collecting the exhaled breath in a large measuring cylinder that is submerged in water, if done quickly to minimise the carbon dioxide from being dissolved in the water.

3) It is also possible to collect the gas over a solution of saturated sodium bicarbonate – the common ion effect, together with the tendency of bicarbonate to equilibrate with dissolved carbon dioxide should prevent changes in volume due to dissolution of carbon dioxide from the exhaled air sample.
Each of these three techniques has advantages and disadvantages, and it worthwhile encouraging students to evaluate their merits. The balloon technique is the easiest, and reasonably accurate (balloons aren’t perfect spheres), although requires calculations that students might be prone to make mistakes in. The submerged cylinder technique is the second easiest, but also the least accurate. It is also very visual, and will give students confidence in their results. Collecting the gas over saturated bicarbonate is the most complex, and expensive, but also the most accurate.

**From percentages to moles**

Once you have a value for the volume of gas that you inhale, and you know the percentage of oxygen (of the total gas volume) removed per second you can convert this to moles.

To do this, you first find the volume of pure oxygen removed per second.

\[
\text{Volume Oxygen gas removed per second} = \frac{\% \text{ removed per second}}{\text{volume exhaled}}
\]

From this you can convert to number of moles by rearranging the ideal gas equation.

\[
\frac{PV}{RT} = n
\]

Where \(P\) is pressure in atmospheres, \(V\) is volume of oxygen in litres, \(R\) is the universal gas constant (in these dimensions) \(0.08206 \text{ L·atm·mol}^{-1}\text{·K}^{-1}\) and \(T\) is the temperature in Kelvin.

In this case, I have given the ideal gas law in non-SI units. This makes it easier to do this math than to convert from millilitres to cubic metres.

**Setting the students loose**

Once all this theory has been covered, the students can be given the task of designing the experiment. The experimental setup that my students used is shown in Figure 2.

The equipment that we supplied them with was as follows:

- Glass tubing (8mm diameter and 12cm long)
- Copper turnings or short copper wire
- Glass wool to stopper the glass tubing with
- Silicone aquarium tubing to connect the syringes to the glass tubing
- Balance to weigh out the copper turnings
- Bunsen burner
- Matches
- 2 x 10ml syringes.
- Balloons
- String
- Meter rule
- Stopwatch

**Teacher tips to make the experiment work**

There are just a handful of things that a teacher should watch out for when conducting this experiment. These are:

- Make sure the copper is clean and has no volatile oils on it. We achieved this by washing our copper turnings in acetone.
- Make sure that you use temperature-resistant silicone and not polypropylene tubing. Polypropylene melts, and this will allow gas to escape, spoiling your students’ measurements.
• Remember to remove water from both the breath samples and the room atmosphere samples by drawing the gas over a silica gel column (made by filling a tube with silica gel then plugging both ends with glass wool. This is then connected to the syringe that you wish to receive your sample in).

• Students will need to pass the air samples over the heated copper repeatedly. We found that 10 passes were enough to react all of the oxygen.

• Be extremely careful of gas leaks in the syringes – these will ruin the accuracy of your experiments! If leaks are a problem, you can use tie wire and pliers to secure the tubing.

• Take all volume measurements when cold! This means waiting 5 minutes after you have finished heating the gas sample over the column.

• Don’t leave your exhaled breath samples in the balloon for longer than a few minutes - balloons are notoriously permeable to carbon dioxide. (I thank Don Collins from the catalyst discussion group for pointing this out to me)

• Try to avoid very old or worn syringes (ie ones with a high amount of friction). New ones seem to work better - the gas pressure equilibrates properly.

Conclusion

My students enjoyed this investigation. It is open-ended, and yet simple enough to get a satisfying result. It also allows them to put together a detailed set of steps to solve a real problem. You can compare the efficiency of your students’ lungs with the published results for resting metabolism, at 20°C (Anon, 2013). This equates to approximately 6% of the volume of the air breathed in. This is 0.014 moles of oxygen gas per minute.

Concluding extension

An interesting extension is to approximate your energy usage at rest by counting the number of breaths you take. If your students are interested, you can get them to approximate using the ‘activated’ form of the fatty acid palmitate:

\[
\text{Palmitoyl-CoA} + 23\text{O}_2 \rightarrow \text{CoA} + 16\text{CO}_2 + 15\text{H}_2\text{O}
\]

For every 23 moles of oxygen you absorb (equivalent to approximately 2750 litres of air at room temperature), you are consuming 259g of fat (as the free fatty acid)!

Palmitate is a reasonable choice because when fasting and at rest, and in the absence of hypoxia, our bodies preferentially consume fatty acid stores for energy. The above result of 0.014 moles of oxygen gas per minute, if used solely to metabolise fat, would account for a weight loss of 0.15g.

References

Altig, J. Determination of the Percentage Oxygen in Air. Available at: http://infohost.nmt.edu/~jaltig/Air.pdf [Accessed December 27, 2011].


Harris, L. Oxygen content of breath prelab worksheet and scope.doc Available at https://drive.google.com/folderview?id=0B8NyMDTl1ovXOG9iYUlXYllyUTQ6usp=sharing [Accessed July 16, 2013]


colour filler??
Investigating Enzyme Activity
Effect of Lactase on Lactose Concentration in Milk

Overview of Core Experiments and Variations
This activity is targeted at year 11 or 12 students completing a biological science course which focuses on the factors effecting enzyme function.

Prepared by: Dr Sue Low (Curtin University) and Mrs Kay Lembo (PICSE, University of Southern Queensland)
Synopsis of Core Experiment
Students will use the enzyme 'lactase' and investigate its impact on reducing lactose concentration in milk.

Curriculum Content Links:
Yr 10-ACSSU187;
Senior Biological Sciences and Agricultural Science

TEACHER’S NOTES
Preparation time required: 30 minutes
Lesson time required: 40 minutes
- 1% = 1g/100ml, w/v
- Use distilled or de-ionised water to make up solutions
- When preparing sodium alginate solution, use magnetic stirrer and slowly add powder. This will minimise the formation of lumps
- The alginate bead can be refrigerated but will only keep for a few days
- Some UHT milk may test positive for glucose as the heat treatment may hydrolyse some of the lactose.

Objectives for the Core Experiment:
At the end of this experiment, students will be able to:
Describe the role of an enzyme as a catalyst on a known substrate and relate the role of lactase to the issue of 'lactose intolerance'

Teacher Background:
Enzymes are proteins that act as biological catalysts i.e. they increase the rate of the chemical reactions that occur in the cells of living things. There are about 4 000 different enzymes in human cells and have varying degrees of specificity. Some act specifically with only one reactant (called a substrate), while others react with substrates with similar functional groups or side chains. The basic method by which enzymes catalyse chemical reactions begins with the binding of the substrate/s to the active site on the enzyme. The active site is the specific region of the enzyme which combines with the substrate. The binding of the substrate to the enzyme causes changes in the chemical bonds of the substrate. This process facilitates the reactions that lead to the formation of products.

Enzyme action (the ability to speed up a reaction) can be affected by the environmental conditions that surround it. The molecular structures of enzymes are sensitive to pH and temperature. Not surprisingly, most enzymes in humans work best at normal body temperature, around 37°C. Enzyme activity can also be affected by the concentration of both enzyme and/or substrate as well as the presence of inhibitors.

This experiment involves using the enzyme 'lactase' which is involved in the biochemical reaction that hydrolyses lactose, a sugar in milk and milk products. Lactase (beta-galactosidase) catalyses the hydrolysis of lactose to glucose and galactose (see figure 1).

Both of these sugars taste sweeter and are more readily digestible than lactose.

The sodium alginate substrate used to encapsulate the enzyme is derived from seaweed, it is commonly used as a food thickener and is a popular “molecular gastronomy” ingredient. Alginate is a polymer which is extracted from the cells walls of brown algae, when added to water it forms a viscous substrate known as a hydrocolloid. A hydrocolloid can simply be defined as a substance that forms a gel in contact with water. Such substances include both polysaccharides and proteins which are capable of: thickening and gelling aqueous solutions, stabilizing foams, emulsions and dispersions and preventing crystallization of saturated water or sugar solutions.

The formation of the ‘spheres’ in this experiment is due to the reaction between sodium alginate and the calcium ions in the calcium chloride. Sodium alginate is a salt containing polysaccharide (a long chain of sugar molecules) and has a negative charge when dissolved in water. When it meets the positively charged calcium ion, it immediately forms a gel as the calcium ions bind the alginate chains together tightly. The outside layer can become firm enough to hold the droplet's shape, as well as acting as a barrier to keep additional calcium away from the liquid at the centre of the sphere. At this stage of formation, it is often referred to as ‘sodium alginate caviar’. The spheres can completely solidify by increasing the exposure time with the calcium ions.

Additional References:
Investigating Enzyme Activity

**Effect of Lactase on Lactose Concentration in Milk**

Materials:

You will need the following for each group of students:

- Small piece of nylon gauze
- 10 ml plastic syringe (without needle)
- 4 mm plastic tubing to fit syringe nozzle (approx 7 cm)
- Tube clamp for plastic tubing
- Retort stand and clamp
- 3 x 250 mL beaker
- 2 x 50 mL beaker
- 10 mL measuring cylinder
- 100 mL measuring cylinder
- Strainer (fine)
- 6 x Glucose test strips
- Glass Stirring rod
- Lactase enzyme - Commercial preparation “Lacteeze”
- 100 mL Milk
- 20 mL sodium alginate solution (2%)
- 150 mL calcium chloride solution (1.5%)
- Distilled water

Procedure:

1. Make 20 mL of a 2% solution of sodium alginate by slowly adding 0.4 g sodium alginate to 20 mL of warm distilled water.
2. Pour 10 mL of the 2% sodium alginate into a beaker using a 10 mL syringe.
3. Add 6 drops of the lactase solution ‘Lacteeze’ into the sodium alginate solution.
4. Mix well and then draw all the solution (10 mL) back into the syringe.
5. Using a measuring cylinder, add 100 mL of 1.5% calcium chloride to a clean 250 mL beaker.
6. Holding the syringe above the beaker containing the calcium chloride, add the alginate-enzyme mixture 1 drop at a time until the syringe is empty.
7. Allow the beads that form to harden (approx 2 minutes).
8. Attach a short plastic tube to the end of the syringe.
9. Remove the barrel of the syringe and place a a nylon gauze disc into the syringe (this will prevent the bead blocking the nozzle) - do not replace the barrel.
10. Clamp the syringe in the retort stand and attach the tube clip.
11. Pour the calcium chloride solution containing the beads through the strainer.
12. Carefully add the beads to the syringe.
13. Place about 10 ml milk into a 50 mL beaker – test for glucose using the glucose test strips.
14. Record the colour of the glucose stick and the concentration of glucose (as per the code).
15. Place the milk into the syringe and then place the beaker under the tubing.
16. Open the clip and allow the milk to run through.
17. Collect the milk and test again for glucose – recording colour and concentration.
18. Repeat steps 14-16 four more times. You should now have 6 glucose readings.

Results:

Tabulate and graph your results:
Results:

1. Tabulate and graph your results:

<table>
<thead>
<tr>
<th>Reading</th>
<th>Glucose strip colour</th>
<th>Glucose level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
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<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
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<tr>
<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
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</tbody>
</table>

Discussion:

1. Explain the changes in the sugar content in the milk:

_________________________________________________________________________________
_________________________________________________________________________________
_________________________________________________________________________________
_________________________________________________________________________________

2. How did your results compare to others in your class? Explain a possible reason for the differences.

_________________________________________________________________________________
_________________________________________________________________________________
_________________________________________________________________________________
_________________________________________________________________________________
_________________________________________________________________________________

3. Suggest ways to minimise the variations in results.

_________________________________________________________________________________
_________________________________________________________________________________
_________________________________________________________________________________
_________________________________________________________________________________
_________________________________________________________________________________

Primary Industry Centre for Science Education (PICSE)
Extension:

1. Some people may not produce enough lactase and therefore have trouble digesting the sugar lactose, found in milk and are said to have “lactase deficiency” or are referred to as being “lactose intolerant.”
This can happen naturally as people get older, (only one-third of all people retaining the ability to digest lactose into adulthood) and this is often an inherited trait.
The exact number of people with lactose intolerance in Australia is not known. Certain people are more affected by it, according to a CSIRO report, *Lactose: A Review of Intakes and of Importance to Health of Australians and New Zealanders*, (1994).

What are the common symptoms of this disease in humans?
_________________________________________________________________________________
_________________________________________________________________________________
_________________________________________________________________________________

2. The process used in this practical is a commercial process called ‘enzyme immobilisation’ and is used to produce lactose free milk for human food products, as well as cats and marsupials.

What are the outcomes if kittens or marsupials are fed ‘normal’ milk in significant amounts?
_________________________________________________________________________________
_________________________________________________________________________________
_________________________________________________________________________________

3. For the following enzymes, state where they are found, what substrate they hydrolysis and at what pH do they operate.

<table>
<thead>
<tr>
<th>Enzyme</th>
<th>pH</th>
<th>Substrate</th>
<th>Where found</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactase</td>
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<tr>
<td>Catalase</td>
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<td>Amylase</td>
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<td>Trypsin</td>
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<tr>
<td>Pepsin</td>
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<td>Cellulase</td>
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</table>
Lung model makes headway for aerosol drug delivery
By Louisa Frew, ScienceNetwork WA

THE first computational lung model with true-to-life moving airway walls is holding promise for the optimisation of aerosol drug delivery and improved lung surgery outcomes for patients with respiratory diseases.

Funded by the Asthma Foundation WA, the model forms the foundation of an ongoing project by Curtin University’s Health Innovation and Fluid Dynamic research groups, in collaboration with the Telethon Institute for Child Health Research.

Lead researcher Associate Professor Ben Mullins from Curtin’s School of Public Health says research began with the development of computational fluid dynamic models for other aerosol science applications.

“We realised that the models we’d developed were much more advanced than what’s currently used in aerosol drug delivery and respiratory science,” Mullins.

According to Mullins, previous airway models used static geometries which created an artificially simplified representation of respiratory function and compromised accuracy when used for modelling the deposition of aerosol drugs and environmental pollutants.

“The expansion and contraction of the lungs is responsible for the flow of air, and any particles present in the air, in and out,” he says.

“If we want completely accurate computer models for studying aerosol drug delivery this must be taken into account.”

Using high resolution computerised tomography (CT) scans of live animals or humans, they applied fluid dynamics modelling to create a moving mesh model; breaking the surface of the airway into discrete regions to then allow the simulation of physiologically accurate movement.

Simulation of aerosol drug deposition patterns using the moving mesh model for rats was shown to give results with a stronger correlation with in vivo animal data than results produced by standard static lung models, supporting the usefulness of the model in the review of aerosol drug properties and delivery mechanisms for sufferers of chronic lung diseases.

“Several hundred million dollars a year of asthma inhalers are sold in Australia and at the moment 90–95 per cent of the medication doesn’t get deep into the airways where it is needed; now that we have accurate models for both the airflow and aerosol deposition, we can start to generate the best particle properties and better design inhalers,” he says.

The group also hope that personalised lung models, created using individual patients’ CT scans, may become a tool for use in surgical intervention for lung conditions.

“Rather than just standard lung function tests we can actually look at localised airflow, simulating their existing airways and the effect of having a section of the lung removed.”

Results of the study were published in the Journal of Aerosol Science.

Explore more WA science news at sciencewa.net.au

Banksia response to reducing groundwater examined
By Chris Thomas, ScienceNetwork WA

GROUNDWATER-dependent plants on the Gnangara mound have
Heads up on Science with ScienceNetwork WA

been put to the test in research that is asking if they can adapt to falling water tables.

Edith Cowan University research fellow Dr Caroline Canham explored this in her thesis *The response of Banksia roots to change in water table level in a Mediterranean-type environment* which looked at plant root connectivity.

“No one has studied the way the roots interact with the water table before because it's difficult to represent what is happening five or more metres below the ground,” she says.

“In the Mediterranean-type climate of Perth, the water table rises by up to 1m in winter and spring due to recharge from rainfall. It then falls during summer and autumn due to evapotranspiration.

“We found as the water table fell over summer and autumn the roots grew, following the groundwater down.

“This showed us Banksia roots [Banksia attenuata and Banksia littoralis] will follow a declining water table, however this was tested at a natural, seasonal rate of change.”

Dr Canham also designed a series of glasshouse studies to test the maximum rate of change in water table levels the study species were capable of surviving.

“The first study aimed to determine the maximum rate of root elongation the study species are capable of and this was found to be considerably faster than the rate adult plants generally experienced in the field,” she says.

“But when this was tested in a second study, using older plants, it was found the rates of water table decline the plants could survive must be considerably slower. This is due to changes plants undergo after first establishing from seed.

“Older plants are more vulnerable to rapid changes in the water table, due to their roots being less able to adapt to change, which is related to the whole plant response to changes in water availability.

“This is supported by evidence from mature trees in the field, where older plants are often the first to die from drought stress.”

Based on this research, Dr Canham found WA’s south-west is experiencing a drying trend with decreased rainfall and a consequent reduction in groundwater levels—threatening to significantly alter the species composition structure of vegetation that is globally recognised as unique and diverse.

“Our studies have shown there are physiological limits to the rate of change in water table levels that Banksia can survive,” she says. “However, there are indications they can adapt to a declining water table.”

Dr Canham’s research was supported by the Water Corporation of WA and the Australian Research Council and has helped in planning groundwater bore operations to minimise environmental impacts.

Explore more WA science news at sciencewa.net.au

Published 14 June 2013
**Bed-sharing notions challenged by Murdoch researchers**

By Camilo Mejia Giraldo, ScienceNetwork WA

Bed-sharing risks for newborn babies include sleeping on soft or improper bedding such as sofas and couches, exposure to tobacco smoke, sleeping with an intoxicated adult, and sleeping with someone who is not the parent.

Associate Professor Catherine Fetherston of Murdoch’s School of Health Professions says current sudden infant death syndrome (SIDS) policies and scientific studies that strongly advise parents against bed-sharing do not clearly define individual risks involved or address broader parenting issues.

Prof. Fetherston says parents seeking to find out information on safe bed-sharing with their newborn babies are met with a hard-line approach, which can shut down important communications between new parents and health professionals.

The connection between bed-sharing and SIDS has been widely debated with some scientific studies showing a risk reduction of as much as 50 per cent if parents abstain from the practice.

“Debate surrounding bed-sharing policies is important as there is substantial evidence showing the practice can reduce sudden infant death syndrome (SIDS) cases by up to 50 per cent,” Prof. Fetherston says.

“However, we have a duty to inform parents of this risk reduction, however we are aware of the potential for bed-sharing to have other risks that may increase the risk of SIDS.

“SIDS is a complex disease that may involve a variety of factors, both genetic and environmental, which can influence the risk of SIDS.

“While the evidence for bed-sharing reducing SIDS is compelling, it is important to remember that SIDS is a complex disease that may involve a variety of factors, both genetic and environmental, which can influence the risk of SIDS.

“Parents need to be well informed and fully aware of the strategies that best protect their child.”

A recent Alaskan study examined 291 medical records and reports of child deaths due to SIDS or asphyxia while bed-sharing, and
Heads up on Science with ScienceNetwork WA

found that 94 per cent of deaths occurred when at least one of these risk factors was present.

The study found postnatal maternal tobacco use to be one of the most prevalent factors in bed-sharing deaths (75 per cent of cases).

However, these identified risks have prompted many organisations – such as the American Academy of Pediatrics and Australia’s SIDS and KIDS – to advise ‘room-sharing without bed-sharing’ as night time strategies.

According to Prof. Fetherston, even these safer practices can be difficult and can impact on parenting aspects—such as successful breastfeeding, which has been shown to have a protective effect against SIDS and a direct link to bed-sharing.

Explore more WA science news at sciencewa.net.au


Thursday, 25 July 2013 10:00

Grey reef diving patterns help prevent accidental fishing

By Rebecca Graham, ScienceNetwork WA

MOON phase, water temperature and time of day affect the diving behaviour of sharks, researchers from UWA’s Oceans Institute and Australian Institute of Marine Science have discovered.

Published in the international journal PLOS ONE, the study, led by shark researcher Gabriel Vianna, investigated the vertical movements of grey reef sharks *Carcharhinus amblyrhynchos.*

“Until very recently there was almost no information about what their preferred depths are and why,” Mr Vianna says.

“This information is important to understand how vulnerable reef sharks might be to fishing.”

Using acoustic telemetry, the researchers monitored 39 grey reef sharks over two years and nine months in coral reefs in Palau, Micronesia.

They discovered the sharks preferred certain areas (aggregation sites) along the outer reef slopes.

In addition, the depth of the sharks was associated with the depth of warm water.

During the day, the sharks gradually swam progressively deeper as the sunlight levels increased on the reefs until around noon (44 m), and moved back up to shallower waters around dawn and dusk (30 m).

This pattern also followed the seasons.

In winter they stayed at a shallower average depth of 35m, while in spring and summer, when the warm water layer expanded to deeper waters, they extended their range to 60m.

“Also very interesting was the movement of the sharks associated with the moon,” Mr Vianna says.

“The sharks tended to remain in deeper waters during nights of full moon, progressively using shallower waters during darker nights.”

They believe these vertical movement patterns enable the sharks to “keep optimal metabolic rates while optimising hunting and predator avoidance strategies”.

Mr Vianna says results are invaluable to understanding when during the day, month, and season the sharks are vulnerable to fishing.

“In areas where reef sharks move up and down the water column, like they do in Palau, this information could help reduce the accidental catches of reef sharks,” Mr Vianna says.

“This is a key element for management and conservation, because besides being extremely important for the health of reef systems, keeping sharks alive is also a very good business as tourists pay a lot of money to dive with them.”

The researchers have embarked on further research to uncover why the sharks spend so much time at the aggregation sites.

“This should help us understand what impact human disturbances have, [and] how vulnerable these sharks might be when they leave the protected areas.”

This study formed part of Gabriel Vianna’s PhD research.

Previous research conducted by the scientists investigated Socio-economic value and community benefits from shark-diving tourism in Palau: A sustainable use of reef shark populations.

Explore more WA science news at sciencewa.net.au

Bed-sharing risks for newborn babies include sleeping on soft or improper bedding such as sofas and couches, exposure to tobacco smoke, sleeping with an intoxicated adult, and sleeping with someone who is not the parent. Image: Janet McKnight

Researchers believe the vertical movement patterns enable the sharks to “keep optimal metabolic rates while optimising hunting and predator avoidance strategies”. Image: Peter Verhoog, Save Our Seas Foundation
### STAWA Council 2013

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<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief Executive Officer</td>
<td>John Clarke</td>
<td><a href="mailto:john@stawa.net">john@stawa.net</a></td>
</tr>
<tr>
<td>Treasurer</td>
<td>David Wood</td>
<td></td>
</tr>
<tr>
<td>CONSTAWA Convenor</td>
<td>Jodie Rybicki</td>
<td><a href="mailto:missjodes@me.com">missjodes@me.com</a></td>
</tr>
<tr>
<td>President</td>
<td>Bernadine Hunneybun</td>
<td>chisholmcc.wa.edu.au</td>
</tr>
<tr>
<td>Immediate Past President</td>
<td>Sue Doncon</td>
<td><a href="mailto:susan.doncon@education.wa.edu.au">susan.doncon@education.wa.edu.au</a></td>
</tr>
<tr>
<td>Vice President</td>
<td>Geoff Lewis</td>
<td><a href="mailto:lewis.geoff@mazenod.wa.edu.au">lewis.geoff@mazenod.wa.edu.au</a></td>
</tr>
<tr>
<td>Student Activities</td>
<td>Warwick Mathews</td>
<td><a href="mailto:warwickmat@gmail.com">warwickmat@gmail.com</a></td>
</tr>
<tr>
<td>Chair Primary Science Committee</td>
<td>Christine Howitt</td>
<td></td>
</tr>
<tr>
<td>Secretary</td>
<td>Stuart Argus</td>
<td><a href="mailto:sargus1@iinet.net.au">sargus1@iinet.net.au</a></td>
</tr>
<tr>
<td>Chair Science Talent Search</td>
<td>Julie Weber</td>
<td><a href="mailto:julie.weber@education.wa.edu.au">julie.weber@education.wa.edu.au</a></td>
</tr>
<tr>
<td>Editor SCIOS</td>
<td>Fiona Lorkiewicz</td>
<td><a href="mailto:fionalorkiewicz@gmail.com">fionalorkiewicz@gmail.com</a></td>
</tr>
<tr>
<td>Electronic Communications</td>
<td>Mark Lehmann</td>
<td><a href="mailto:mlehmann@mac.com">mlehmann@mac.com</a></td>
</tr>
<tr>
<td>Membership and Marketing</td>
<td>Stacy Fairhead</td>
<td></td>
</tr>
<tr>
<td>Curriculum</td>
<td>Mal Johnson</td>
<td><a href="mailto:johnson.mal@mazenod.wa.edu.au">johnson.mal@mazenod.wa.edu.au</a></td>
</tr>
</tbody>
</table>

The Science Teachers' Association of Western Australia  
PO Box 7310 Karawara WA 6152  
Office  
Unit 6, 10 Mallard Way  
Cannington WA 6107  
Contact details  
Tel +61 (0) 8 9244 1987  
Fax +61 (0) 8 9244 2601  
Email info@stawa.net  
Web www.stawa.net  
Chief Executive Officer  
John Clarke  
E-mail: john@stawa.net
Get your students out of the classroom and into our unique interactive hands-on learning environment.

Excursion opportunities for secondary schools

Costs & package options
Below is a summary of some of our more popular combined visit experiences. Prices start from $6.00 per student. Supervising adults are free and we prefer a 1:6 supervision ratio.

**Option A (2 hours for $6.00):**
- Structured visit - feature exhibition.
- Science show or Puppet show.
- Free time exploring other exhibits.

**Option B (2 hours for $6.00):**
- Session in Horizon – the Planetarium.
- Free time exploring exhibits.

**Option C (2 hours for $7.00):**
- Session in Horizon – the Planetarium.
- Structured visit in the feature exhibition or the CSIRO Lab.

**Option D (3-4 hours for $8.50):**
- Session in Horizon – the Planetarium.
- Structured visit - feature exhibition.
- Science show or Puppet show.
- Free time exploring other exhibits.

Want to know more, or need help deciding?
Comprehensive details of all our excursion programs are on our website, or contact our friendly bookings office for help, by email: bookings@scitech.org.au or phone 9215 0740.

All programs and activities are linked to the Australian Curriculum and so consolidate school-based teaching and learning. Some of the programs on offer for secondary students include:

**CSIRO Lab**
Students use hands-on activities to apply scientific research techniques and demonstrate science applications in everyday life.

**Lotterywest Science Theatre**
Our dynamic science communicators encourage your students’ curiosity with lively demonstrations and stimulating explanations.

**In Horizon – the Planetarium**
Students are taken on a journey with our immersive simulations to explore the planets, solar systems, stars and more.

**Exhibition: Top Secret**
Closes 14 October
Armed with a spy file, students will embark on a challenging mission to gather scientific intelligence and solve the crime.

**Exhibition: Ingenious!**
Opens 26 October
Design, build and test your ideas using a variety of materials and technologies. This exhibition will take your students to every corner of the scientific process and challenge them to create innovative solutions.

PLEASE NOTE: Scitech’s exhibitions and theatres regularly change content over time so please call the bookings office to see what is available on your preferred date.

Scitech is proudly supported by the Government of Western Australia

www.scitech.org.au
The STAWA Future Science Conference 2013 takes place on Friday 29th November 2013 at the University of Western Australia.

Keynote & Principal Speakers:

**KEYNOTE:** Fiona Wood
Winthrop Professor, BIRU, School of Surgery UWA
*The Quest for Scarless Healing*

**PRINCIPLE SPEAKER:**
Stephen Hopper
Centre of Excellence in Natural Resource Management, UWA
*Living Sustainably in the Southwest Australian Global Biodiversity Hotspot: Educational and Research Challenges*

**PRINCIPLE SPEAKER:**
Klaus Regenauer-Lieb
UWA & CSIRO
*Geothermal Energy*

**PRINCIPLE SPEAKER:**
Professor Andrew Whiteley
Winthrop Research Professor and WAFP Fellow, School of Earth & Environment, UWA
*MicroBlitz: Harnessing the Population of WA as Citizen Scientists in the 21st Century*

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The 2013 conference will begin with a welcome, the de Laeter Medal presentation and Key Note Address. Delegates will then move to one of three, 45 minute seminars featuring high profile speakers highlighting internationally recognised WA science.

Following morning tea delegates will be able to choose workshops within four concurrent session times of varying duration throughout the day. Sessions D & E run after lunch and the day closes with sundowner drinks at UWA.

Keep your eye on the website: [www.stawa.net](http://www.stawa.net) for further program details and registration.