CONCURRENT SESSION 3 (4.00 – 5.00 pm)

GPS and Relativity
Tan Leong Howe, Dunman High School

Students who offer MOE–H3 Physics have to learn Special Relativity. However, far from being purely abstract and theoretical, Einstein’s theory of relativity has real world applications and is critical to the operation of an extremely practical technology today – the Global Positioning System (GPS). Using resources from Perimeter Institute, a hands-on activity will be conducted to model how the GPS works. In addition, a video will explain how relativity has to be taken into account to ensure GPS works accurately. These are intended to support the teaching of Special Relativity by illustrating the application of time dilation in everyday life in GPS so as to excite students in their learning.

DNA Diffraction
Gohel Amarsinh, Meridian Junior College

The objective of this workshop is to introduce a lab activity on diffraction that will help students better understand the phenomenon. Through a series of guided, inquiry-based activities, students can come to conclusion for themselves some basic but very important properties of diffraction. The second part of the lab activity actually simulates the use of x-ray diffraction to determine the structure of DNA. This work, done by Rosalind Franklin in the early 1950s, was an important contribution to the proposal of the double helix structure of the DNA by Watson et al, which won the Nobel prize in 1964. Through the use of a commercially available optical transform slide, students will apply their understanding of diffraction (from the first part of the lab activity) to arrive at the correct DNA structure. This is a great opportunity for students to see how inter-disciplinary scientific research can be carried out and is a good introduction to biophysics. It is also a wonderful lab activity that can be done by a group of biology and physics students, where they can learn from one another and explain to each other what they observe in each part of the activity.

Frustrated Total Internal Reflection
Barnabas Tan, Huang Kexin, Sandra Ong, Curriculum Planning and Development Division

One of the most startling consequences of de Broglie’s wave hypothesis and Schrödinger’s equation was the discovery that quantum objects could tunnel through potential energy barriers that classical particles are forbidden to penetrate. One way of thinking about it uses an argument based on Heisenberg’s Uncertainty Principle – the energy-time uncertainty relation. Another approach is to look at the behaviour of more familiar waves. If we can convince students that waves also undergo tunnelling, then it would be easier to accept that quantum particles also undergo tunnelling because of their wave-particle duality. This experiment seeks to demonstrate the phenomenon of frustrated total internal reflection using microwaves as an attempt to convince the observer that waves also undergo tunnelling.
Using Lesson Study to improve student engagement in Physics tutorials

Aaron Rajoo, Charlene Lin, Ignatius Goh, Catholic Junior College

Many techniques such as videos and animations only go so far in exciting and engaging Physics students, and it is usually very difficult to excite them especially during tutorials in which question tackling is the main aim but these techniques are also limited in how much they can help with teaching question answering skills.

The physics teachers in Catholic Junior College used Lesson Study as a platform to improve student engagement during tutorials. The team met to discuss common methods like peer tutoring and collaborative tutorial activities upon which to build this new lesson structure and we found that we could capitalize on their usual yearning for all answers to be served on a silver platter.

Using the Lesson study platform, the physics teachers went through a few cycles, teaching the same topic, with three different classes of different abilities. In each subsequent lesson, through teacher reflection and discussion, we made adjustments according to in class observation to improve on the last lesson. Each lesson was conducted by a different teacher, which proved that the success of the lesson was not teacher dependent. This meant that the pedagogy used in this lesson is easily transferable between classes and across varying teacher types. In our lesson, we focused on methods to get students intrinsically motivated to;

1. Search for knowledge
2. Share what knowledge they have already.

The lesson study project resulted in a lesson that was highly effective; achieving 100% engagement of the students, 100% of the time.

Teaching Dynamics using Modeling Instruction

Renee Chong Kit Yue, Tay Su Lynn, Catholic Junior College

An action research was conducted to identify if students’ conceptual understanding of key concepts in the topic of Dynamics improved through the use of modeling instruction, a pedagogical approach. The effect of modeling on students’ engagement level was also another area we investigated.

Modeling instruction was used to develop students’ conceptual understanding of key concepts in the topic of Dynamics such as Newton’s 3rd law of motion etc. This approach deviates from the traditional delivery of lessons where students are simply told what the concepts are without a deep understanding of what it really means. Students engaged in hands-on activities, observed demonstrations, collected data through the use of data loggers, analysed the data collected and drew conclusions based on their observations to verify Newton’s law as well as develop understanding to concepts such as the conservation of momentum, impulse etc. Two key features of modeling instruction which are whiteboarding and Socratic questioning were also employed. A teaching package was crafted to assist in the teaching of the package. A pre test was conducted to identify what preconceptions students had regarding this topic and a post test was administered after the lesson to assess students’ conceptual understanding.

In this workshop, we will give an overview of the lesson of dynamics using modeling instruction. We will also be sharing our findings. There will be hands-on opportunities for teachers to engage in some of the activities crafted for our students.
Using the 4 E’s model and Think Cycle© in curriculum design

Alan Varella, Lisa Choo, Chee Yu Ping, Tan Seng Kwang, Muhd Iskandar Hairdin, Tan Hwee Lynn Cyreen, Temasek Junior College

In this workshop, participants will be introduced to the Think Cycle© approach and the 4 Es model. The THINK Cycle© is a novel problem-solving pedagogy which can be used for any subject at any level. It shifts the focus from content-based learning to ideas and content-creation, where students learn higher order skills and teamwork. The 4 E’s model when incorporated with the THINK Cycle© framework will enable teachers to develop TLLM Physics lesson plans that will enhance student inquiry, learning and engagement. Samples of worksheets on the topic ‘buoyancy’ will be given to participants. At the end, participants will have a hands-on session using the equipment provided.

Objectives of workshop
At the end of the session, participants should be able to
1. understand the need for an inquiry based approach like the THINK Cycle to develop TLLM lessons which can engage students and develop their lifeskills.
2. understand the importance of choosing the right triggers to achieve the desired learning of concepts.
3. learn the steps to develop a lesson plan based on the THINK Cycle, 4 Es model, UBD and thinking skills.
4. develop and build their pool of resources of triggers and lesson plans.

Promoting independent learning in the topic of Gravitation using Easy-Java Simulations

Jimmy Goh Giam Hwee, Tan Hao Kai, Wee Loo Kang, Yishun Junior College and Educational Technology Division

Gravitation is one of the topics that are more difficult for students to understand well, as they are not able to ‘see’ the gravitational field and forces acting on huge masses like planets and it is not easy to demonstrate gravitation effect on small masses using apparatus in school laboratory.

To improve students’ understanding of specific concepts in Gravitation, four easy-java simulations were modified, with the help of an Educational Technology Division (ETD) officer, and incorporated into existing set of tutorial questions at specific junctures. Guiding instructions and questions were designed to help students explore the simulations independently before they consolidate their learning collaboratively through classroom discussion.

A pilot study of this ICT lesson package was conducted with one of the JC1 classes in July 2011. The feedback from students was generally positive, although there was no significant improvement in assessment grades.
Teaching Questioning & Feedback to Students' Responses:
The “Questioning-based Discourse” Framework
Charles Chew, Ong Chee Wah, Sng Peng Poo, Yap Kian Wee, Academy of Singapore Teachers, Innova Junior College, Anderson Junior College and Anglo-Chinese Junior College

Questioning is an integral part of good teaching, especially to scaffold student thinking and help student construct scientific knowledge. Research has shown that the kinds of questions that teachers ask and the way teachers ask these questions can influence the type of cognitive processes that students engage in constructing scientific knowledge (Chin, 2006). Questioning technique mastery is vital in achieving students’ learning outcomes.

Using four real case studies of the presenters’ own video-taped lessons, this minds-on workshop seeks to equip participants with the knowledge & skills of applying the “questioning-based discourse” framework to analyse the four aspects of classroom discourse (namely, content, type of utterance, thinking elicited & interaction pattern).

Nanotechnology and its relevance to modern physics
A/Prof Sow Chorng Haur, National University of Singapore

(Note: This session is a repeat of the talk that was given last year)

The aim of this presentation is to give the teachers an appreciation of the nanosized regime and scientists’ fascination in the field of Nanoscience and Nanotechnology. The talk will focus on a few aspects of nanoscience including how we can make nanomaterials, the unique properties of nanostructures, how we can manipulate nanomaterials and potential applications of nanoscience. The second part of the presentation will focus on atoms and molecules. How do atoms combine together to create the various forms of matters? To study the properties of the atoms and matters up close, we need very powerful microscope. Two fascinating microscopic techniques will be discussed. Namely, scanning electron microscope and scanning tunneling microscope, that scientist invented to probe into small tiny structures. I will show “images” of atoms and molecules obtained using these techniques. Finally, I will discuss how scientists learn to manipulate individual atoms and arrange them into various structures. The talk shall be presented with the help of a number of demonstrations aiming to illustrate the concepts discussed. Hopefully the demonstrations will be useful to the teachers who wish to discuss similar concepts with their students.