VOLUME 16 – SPRING 2010

the tribune

The Journal of the International School of Paris

What, How & Why? Science at ISP

Our Primary School students use the Units of Inquiry to learn about form *(what is it like?)*, function *(how does it work?)*, and reflection *(how do we know?)* in their exploration of science.

The Middle Years Programme emphasizes the nature of scientific enquiry, methods, concepts, technology, and evaluation, while the IB Diploma students concentrate on experimental evidence, collaborative work, advanced theory, and developing skills to analyze, synthesize and evaluate scientific information.

Finally, all ISP students learn how to utilize information technology as a scientific tool.

In this issue of *The Tribune*, you will discover the exciting world of science at ISP. **What** the IB programmes do to promote curiosity, a sense of wonder and critical thinking; **How** our teachers use the programmes, facilities and tools to engage the students; and **Why** a crucial component of science at ISP is to make a connection to the greater world, and to recognize our responsibility towards ensuring its future.

summary

From the Head of School

Audrey Peverelli

I must admit that I have never considered myself a scientist. However, I did study chemistry, physics and biology during my final high school years, and did particularly well in mathematics and psychology. This invaluable learning then came back when I needed it the most, for a statistics course that was required for my psychology studies at university.

I was also very lucky to be brought up in Venezuela, by adventurous parents, who regularly had us children snorkeling at the beach, even when we were very young. I had the singular pleasure of seeing turtles in their natural habitat, as well as undamaged coral reefs teaming with colorful fish.

Today, the world does not look quite the same as in those glorious days, and I realize the responsibility we all have in keeping what little we have left intact. Our IB science programmes take this ethical and ecological responsibility very seriously, and our students, through their academic research and discussions, as well as through clubs such as Eco-Ecole, have many opportunities to understand this, and to actually make a difference. Science can and should be used to make the world a better place for everyone. As you will see on the following pages, ISP certainly encourages and highlights this aspect of scientific enquiry through research, reflection and responsibility.

Science – As Old as Humanity Itself

Alec Beardsell, Head of Secondary School Science

Imagine looking many millennia back in time, and picture a small community of our distant ancestors living the most basic lifestyle of hunters and gatherers. Which of their qualities would we instinctively recognise in ourselves?

I believe that among the characteristics that we would identify as unmistakably human would be the capacity for wonder, linked with curiosity, and a desire for knowledge. These earliest humans felt the warmth of the sun, gazed at the splendour of the night sky, witnessed the life cycle of plants and animals, sheltered from thunder and lightning, and knew the fear and awe of raging fires, storms and floods. Some reflected on their observations and tried to understand them.

"Today more than ever before, science holds the key to our survival as a planet." Barack Obama

With time, our ancestors noted how seeds falling on stones failed to grow. Gradually they acquired detailed knowledge of plants that can heal sicknesses. By a long process of patient trial and error, they gained the ability to kindle fire, and steadily refined their hunting techniques and implements.

In all of these cases we see an instinctive process of observation and experimentation leading to greater knowledge and improved technology. This fundamentally human form of engagement with the natural world is precisely what finds expression today in the subjects collectively known as Science.

Science: A process of inquiry and investigation into the natural world whose defining characteristic is experiments and experimental evidence. An activity as old as humanity itself!

Why Study Science Today?

Genetic engineering, stem cell research, alternative energy, nuclear power and weapons, pharmaceuticals and climate change are all massive contemporary scientific issues that will affect the lives of billions of people in this century.

Equipping our young people with the knowledge and skills to make informed judgments about scientific issues and to participate fully in a technological society is becoming increasingly important. Effective science education is essential to ensure that generations to come are able to make the choices necessary to safeguard the future health, happiness and prosperity of a global society.

Science in the Secondary School

Science teaching at ISP's Secondary School is organised within the framework of two of the IBO programmes: The Middle Years Programme (MYP) for grades 6 to 10 and the Diploma Programme (DP) for grades 11 and 12.

The MYP identifies six distinct skill areas within science, including experimental work, knowledge and understanding, communication and the wider impact of science on society. Each skill area receives equal weighting, so students receive six marks, which are combined to work out a final science grade. With this approach, students gain an appreciation of science as more than simply a body of knowledge and facts to be learned. They understand the importance of experimental work as the core of the subject, and reflect on the significance of science in shaping society, as well as the need for clear communication of scientific ideas.

The well-known and long-established Diploma Programme is internationally recognised as an academically challenging pre-university course. The DP combines an impressive breadth of study with subject-specific depth and is respected world-wide for its rigour and detail. At ISP, Diploma Programme science courses are taught by highly qualified specialist teachers, all of whom have long experience in guiding students through these demanding courses.

Six Science Skills of the MYP

One World
Communication
Knowledge & Understanding
Scientific Inquiry
Processing Data
Attitudes in Science

Science courses within the DP retain the key element of experimental work established by the MYP and build considerably on the theory of each of the well-known disciplines of physics, chemistry and biology. There is also the option of studying Environmental Systems and Societies (ESS), a subject which makes explicit links between human activity and our environment.

In today's world, scientific progress arises from international teams of scientists working together towards shared goals. The DP acknowledges this cooperative element to science with the Group 4 Project. This is a collaborative, investigative challenge in which students who have chosen different science subjects work together in a small group to conduct basic scientific research around a common theme. The emphasis is on team work, adaptability and creative problem solving.

By completing a DP science course, students gain detailed scientific knowledge in their chosen subject, develop a range of experimental skills and will understand the scientific method of inquiry.

Eco-Ecole: An Investment in Our Future

Eco-School is an international program that helps schools become more ecological. ISP became a French-accredited Eco-School in 2008.

The project began in 2007, as ISP followed and completed a seven-step process. This included forming a committee, evaluating current practices, creating an action plan, providing follow-up, involving the community and raising awareness. An Eco-Ecole needs to work continuously on ecology and sustainability.

"Eco-Ecole is student-driven," explains Marianne Freire, Primary School Eco-Ecole coordinator. "The kids come up with projects; I help with planning and realization. Eco-Ecole is more than ecology – although sustainable development is naturally at the heart of it. It combines learning and action, encouraging the students to think globally and responsibly about what they learn in class. It teaches them that our everyday life decisions really make a difference."

Eco-Ecole students urge the community to reduce its environmental impact. They ask students to bring reusable cups and plates to events, encourage families to avoid plastic bags, and post notes to teachers, such as "think before you print."

PYP Science: Inquiring with Purpose

Tuija Wallgren, Communications Coordinator

Science is everywhere! This becomes clear when listening to the children in ISP's grade 3. The students are eager to talk about all the scientific observations, experiments and building models that they have been working on lately. "All Units are about science! In our Getting the Balance Right Unit, we studied the food pyramid, and in the Pollution Unit, we observed how matter dissolves," explains Lola. "Science is important for technology, medicine, machines, biology... it is important for understanding how things work, so that you can repair them if they get broken!" exclaim Syahmi, Ibrar and Hadi.

It starts with motivation...

The Exhibition in grade 5 is probably the most important Unit of the Primary Years Programme. Teacher Eileen McAteer explains: "The Exhibition often starts by finding each student's personal passion, a subject area that the student is genuinely interested in. The teacher's role is to supervise and facilitate the process, asking questions such as 'What interests you?,' 'What meaning does it have for the world?' and 'How can you communicate it to others?' The students are studying the scientific process in a real world context."

... is firmly connected with the real world...

While the Exhibition might be the most ambitious and demanding Unit, the students learn to recognize, understand and explore themes and concepts and their impact on their everyday life throughout the Primary Years Programme. The process already begins in the Pre-Primary School, where the children are encouraged to make connections between their environment and actions. In Pre-K, for instance, science is present throughout the year. Says teacher Jackie Todd-Morel: "We follow the changes in the trees around us, and care for the school garden. We involve the children with caring for the environment, awakening them to the beauties and wonders of nature; how we can effect change on our surroundings and vice versa. Our driving questions are: What do you see? What does it look like? How has it changed? What do you think will happen next? These are coupled with observational drawings and collections of their findings."

In addition to the spontaneous, student-initiated science inquiries, which are not only welcome but encouraged in the PYP philosophy, science learning is carefully planned and implemented throughout the curriculum. However, according to the IB Science Scope and Sequence Document, "teaching and learning science as a subject, while necessary, is not sufficient. Of equal importance is the need to learn science in context, exploring content relevant to students, and transcending the boundaries of the traditional subject area. " Marianne Freire makes the point: "We are preparing the children for the world, so we might as well teach in that context! When I was a kid, the only inquiry I ever had was what am I going to do with this knowledge, what is the purpose of learning all this?"

The Organizing Themes of the PYP:
- Who we are
- Where we are in place and time
- How we express ourselves
- How the world works
- How we organize ourselves
- Sharing the planet

Pre-Kindergarten students exploring the Primary School garden.

... while teaching the students the importance of scientific methods!

The grade 4 students' Space Unit is a perfect example of learning science in a real-world context. The students learned about the connections between space and weather and were given the chance to be real meteorologists. Through simple testing, the children learned about scientific methods and the principles of fair testing. They used data loggers to measure light and air temperature, rain gauges to measure rain, and anemometers to measure wind. They were encouraged to verify the conditions and tools in order to get comparable and accurate data. To connect with the wider world, the class visited the *Palais de la Découverte*, where they saw how *Météo France* uses satellites and other scientific instruments and methods to make forecasts and statistics about the weather, and learned more about the high technology of rain or shine.

Teacher Michelle Metail explains: "The Space Unit involved a lot of teamwork. The children were organized into groups with revolving responsibilities. In addition to learning about the scientific methods, such as fair testing, the children learned about working as a team, to be responsible and to communicate their findings. Weather forecasts are available to us every day, reminding us all about the role and importance of science!"

...the PYP (Primary Years Programme) leads learners to an appreciation and awareness of the world as it is viewed from a scientific perspective. It encourages curiosity and ingenuity and enables the student to develop an understanding of the world. Reflection on scientific knowledge also helps students to develop a sense of responsibility regarding the impact of their actions on themselves, others and their world.

It is recognized that teaching and learning science as a subject, while necessary, is not sufficient. Of equal importance is the need to learn science in context, exploring content relevant to students, and transcending the boundaries of the traditional subject area...

—Excerpt from the PYP Science Scope and Sequence Document

From CSI to Saving the World: Science Through the Eyes of an MYP Student

MYP students dissecting lamb lungs in one of ISP's five science labs.

Each June, ISP's grade 8 students organize a Science Fair. In preparation for this event, the students plan and carry out projects involving basic scientific testing. The methods and results are then presented to fellow students and the wider ISP community at the Fair.

Jaye Harris, a grade 8 student last year, looked into how music affects a person's heart rate. She played four different songs to 18 people, measuring their heart rates with a pulsometer before, during and after they listened to the song. Jaye explains: "I really like learning science at ISP because we do a lot of real life testing and lab work. The Science Fair project taught me that sometimes a scientific project can bring out more questions than answers! I found some patterns in my testing, suggesting that teenagers reacted to the music more strongly than adults. However, the results may be dependent on the choice of music. And there was naturally an exception to the rule: a teenager whose heart rate actually fell every time I played an upbeat song! Science is not easy, and the results you get do not necessarily correspond to your hypothesis. But you always learn how to do better next time!"

While Jaye's interest in science originates from a very common teenage activity, namely watching an American TV series, it has developed into a serious passion, affecting her academic choices and learning. "When I watched CSI: Crime Scene Investigation a couple of years ago, I thought that it might be cool to become a forensic scientist. Ever since that time, I have become more and more interested in science. Witnessing scientific reactions is fun; I love it when things go snap, crackle and boom!"

Learning Through the One World Essay

ISP's curriculum, facilities and teachers truly support active, hands-on science learning. This learning is then connected with both local and global communities. One way of doing this is the One World Essay, in which the students explore how science is applied to a specific issue, what the benefits and limitations of science are in solving these issues, and how science interacts with social, economic, political, environmental, cultural or ethical factors. This essay also teaches the students how to communicate their learning appropriately and accurately.

In the future, Jaye is planning to choose high level mathematics and as many science subjects as possible. "Science is sometimes difficult, and it has not been getting easier in grade 9! But I like puzzles, and science is a really interesting one for me. I like finding answers to questions and figuring out new ways of doing things. In the future, I would like to use science to the benefit of all people, our environment, and the world as a whole!" —TW

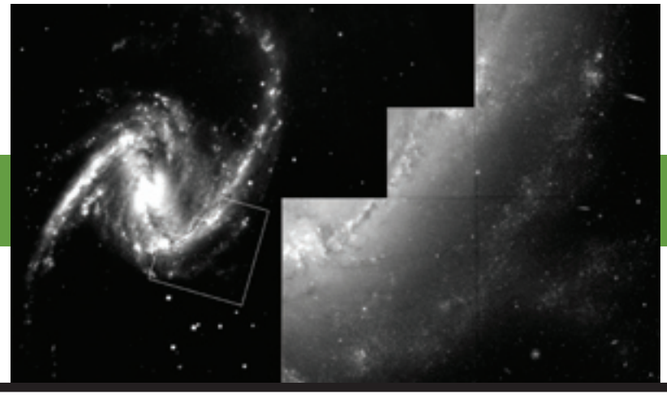


Image from the Hubble Telescope's project to measure the expansion rate of the Universe. (Courtesy of NASA)

Theory of Knowledge: Giving New Perspectives to Science

Theory of Knowledge (TOK) is a critical part of the IB Diploma requirements. This year, grade 12 students, Eri Sasaki, Olivier Raby and Chris Radka, prepared their final TOK presentation on a fascinating question: "How do we know what we know about the Universe?" The project was linked with physics and natural sciences, and the inspiration originally came from their teacher, Alec Beardsell, who discussed the topic in his astrophysics class.

Eri explains: "Our starting point was to look at different models of knowledge in astrophysics. The two previous models, which were geocentric (earth centered) and heliocentric (sun centered) models of the Universe, were once universally accepted and strong, just like our prevailing astrophysical model is today. We wanted to explore why people believe what they believe, and what the impact of these beliefs might be for science, and for the world."

"TOK looks at the validity of science as a whole. It encourages us to ask questions that we normally would not think about, and gives us new perspectives on the limitations and possibilities of science. TOK asks 'how can we be sure,' followed by 'will we ever find out'? It was an eye-opening experience to look at the world through TOK," says Chris.

Science is often perceived as the positive branch of academics, able to provide absolute values through valid and rigorous testing methods. All three IB programmes encourage the students to question the world, and to link what they learn with the wider world. Theory of Knowledge, taught in grades 11 and 12, is the culmination of this connectedness. It encourages the students to explore the limits of knowledge, and allows them to make interesting links between subjects. For instance, Eri, Chris and Olivier linked astrophysics with history, asking why people believe, how knowledge is formed, and how the truth changes over time.

"In addition to learning about our own topic, we learned important presentation and teamwork skills. It was also interesting to listen to other presenters, as every group had a different theme and subject that their project was linked to," says Olivier.

The list of planets has proved not to be eternal, but one thing is for sure: an IB student will never cease to question! —TW

NASA

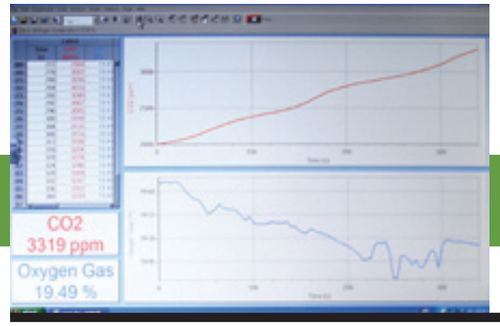
IB Diploma Science Methodology

All IB Diploma Science Programmes have a strong focus on providing experimental evidence for the phenomena and concepts studied. As part of this process, students will:

- **consider science in its international context.**
- **appraise the importance of communication and collaborative work in science.**
- **acquire a body of concepts and skills for solving scientific problems.**
- **develop an enquiring, investigative attitude.**
- **evaluate and design experimental procedures.**
- **develop the skills to analyze, synthesize and evaluate scientific information.**
- **consider the ethical / moral, social, economic and environmental implications of scientific change.**
- **develop an understanding and critical appraisal of the scientific method.**
- **utilize information technology as a scientific tool.**

Digital Technology in the ISP Science Labs

Paul Tagg, IT Consultant



We live in the digital age surrounded by devices and applications that capture, store, process and transmit digital information. The impact of these technologies has already been huge and they are now revolutionizing the way science is studied and taught in schools.

Out of Our Senses

Human senses are wonderful but quite limited. We can 'see' only a tiny fraction of the electromagnetic spectrum, our sense of smell is a million times worse than that of some animals and our ability to accurately assess temperature or other properties of matter is extremely crude. Birds and fish have built-in navigation systems that allow them to make remarkable journeys to migrate or spawn. Some people have trouble finding the travel agent!

Biologically we are generalists rather than specialists, and our brains are wired for learning and flexibility. We have used our creativity and ingenuity to develop tools that compensate for the shortcomings of our senses. For example, once we discovered that lenses bend light, making objects seem bigger or nearer, we used this principle to invent the telescope and the microscope, and found a better way to explore our universe.

Blowing Up the Biology Lab

The microscope is not new, but the digital microscope is. Optical technology is far more sensitive than the human eye, and the resulting image can be stored, displayed, or even enhanced digitally.

ISP's Biology lab boasts a powerful digital microscope. A sample can be prepared for the microscope, focused, and the image blown up for the entire class to see. The microscope can also capture video images so that the behaviour of tiny living organisms can be studied in detail!

Breaking the Time Barrier

Experimentation is at the heart of the scientific method. We design experiments to test hypotheses by making observations that can be analysed and by comparing the results with those predicted by theory. In many cases the physical act of taking the measurement or the mathematical challenge of analysing the results is the most time consuming and also the most error prone part of the process. With limited lab time, recreating important but time-consuming experiments in school has not always been practical. With new digital technologies we have the power to record the data automatically and the tools to present and analyse the results almost instantaneously, allowing more time for discussion and interpretation.

Breathing New Life into Science

Here's an example from our Environmental Science lab: In respiration, animals inhale oxygen and exhale carbon dioxide. If the environment is closed, the balance of oxygen and carbon dioxide will gradually change. The process is quite slow and we need a way of measuring that does not disturb the experimental conditions.

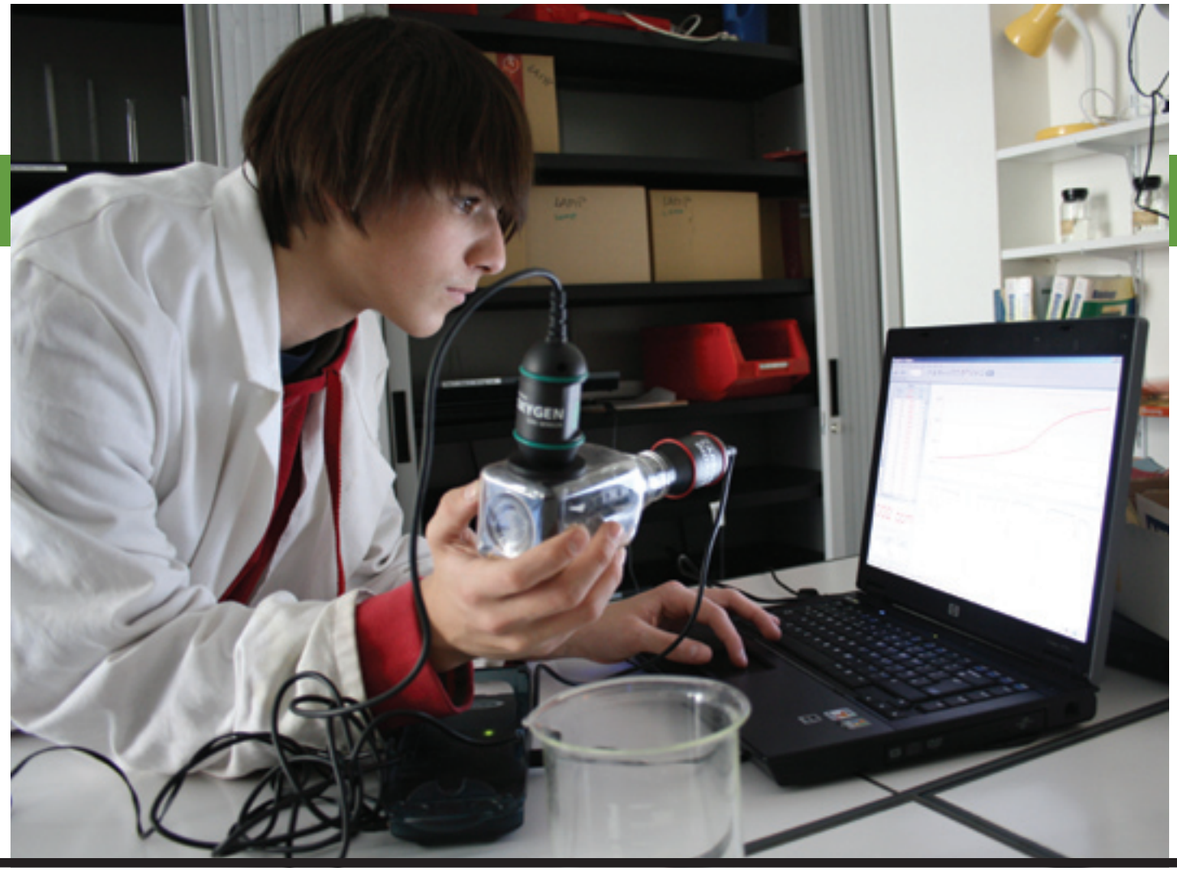
Digital gas detectors provide the perfect tool—they are efficient, non-intrusive and can accurately record the changes over extended periods of time.

Devices that are very sensitive capture a lot of data—so they require large storage capacity and very fast processing. These technologies have evolved so quickly that schools can now equip their labs with devices that would only have been found in large industrial organisations or research laboratories thirty years ago.

Reading Between the Lines

Another example comes from the Chemistry lab: Determining the chemical composition of a substance can be approached indirectly by observing its reactions with other chemicals, or directly by observing its atomic properties. The indirect method is straightforward but messy, inefficient and potentially dangerous—we really could blow up the lab!

The direct method is elegant—we use a spectroscope to generate an 'absorption spectrum' that identifies an element as clearly as a supermarket barcode. Classical analog spectroscopes required very careful preparation and delicate adjustment of the sample, but our digital spectroscopes are 'plug and play'.



Fantasy Physics - The Virtual Science Lab

So far, we have only talked about the hardware side of digital technology. Software applications open up a whole range of new possibilities for scientific education. Computer models allow basic concepts to be explored interactively, and simulation software allows students to perform virtual experiments. Such tools are easily shared amongst the educational community and ISP actively participates in such exchanges.

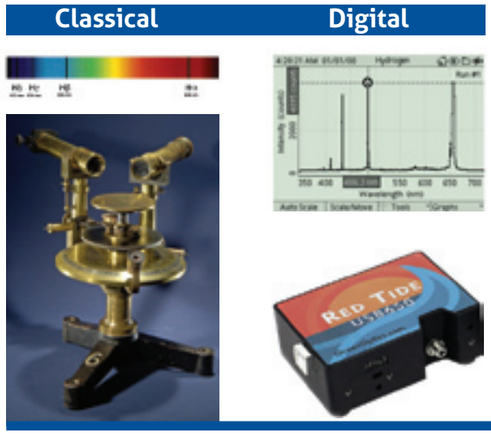
Alec Beardsell, ISP's Head of Secondary School Science, comments on a website of science simulations compiled by The University of Colorado at Boulder (http://phet.colorado.edu/simulations/):

"There are dozens of simulations here and the vast majority are very well thought out with many parameters that can be adjusted to produce very convincing and realistic results. They are 'ideal' for the Gas Laws, 'scintillating' for the Photoelectric Effect, 'right on target' for Projectiles and a 'natural selection' for Evolution!"

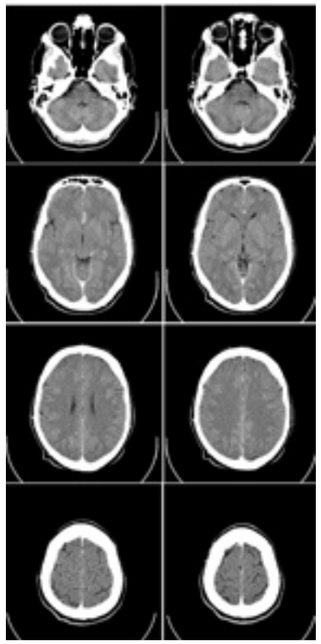
Back to the Future

Stephen Hawking has said: "Intelligence is the ability to adapt to change." Science teaching must adapt, especially when the changes are happening so quickly. The IB recognizes this, and the physics of these new devices is already part of the curriculum. The students of today are learning the science of technologies that did not exist when their parents were at school!

The maggots are in the bottle, the apparatus set up, the gas detector connected and a full 24 hours of data logging begins. (No animals were harmed during this experiment...)



Hydrogen spectrum determined by classical instrument and by the digital 'little black box'.



Top: Dr. Nadrljanski
Bottom: Computed tomography of the human brain.

Multidisciplinary Approach to Medicine & Science

Mirjan Nadrljanski, MD, MSc, ISP Class of 1993

My career as a physician is not a typical one, but nothing in my life has ever been typical, predictable or boring!

After graduating from the University of Belgrade School of Medicine in Serbia, I went to Milan, Italy and continued my postgraduate education in Piedmont, where I completed my Master's degree. Now, I am in the process of preparing a database for my PhD Dissertation. I am currently employed at the National Cancer Research Institute in Belgrade, at the Department of Diagnostic Radiology, dealing with sophisticated diagnostic procedures like computer tomography, used for regular follow-ups of cancer patients.

My interests also cover clinical trials, which evaluate tumor response to new medicines or protocols being tested, as I was previously at the National Drug Agency as the expert for the evaluation of clinical trials. This is an incredibly important task: to conclude whether, based on the results of the trials, one drug should be placed on the market or not. This was a challenge – but I like challenges and my devotion to scientific and ethical principles helped me make the right decisions! Although I am currently employed at the National Cancer Research Institute, I never actually lost the connection with my previous job. The unique experience that I gained during those years of work ranked me among the external experts in the region so that, last summer, I had the honor of being hired by the World Health Organization (WHO) to train my colleagues in Montenegro.

Every day, I bring my knowledge in radiology, clinical medicine, methodology of clinical trials and regulatory-based orientation together with the use of modern IT technologies. Physicians, particularly radiologists, are not merely describers of the pictures they get from sophisticated machines, but are active contributors to the patient's well-being by combining knowledge from many different fields of science. In my opinion, the credo for 21st century physicians should be to get a proper education in medicine, including the biomedical disciplines, as well as in technology, in order to do the most for their patients.

My multidisciplinary approach and orientation in science dates back to the early nineties and to the unforgettable period I spent at ISP. At ISP I became fully aware that a good knowledge of foreign languages and a great database of adequate resources (which in those days was across the Seine at the American Library of Paris)—together with the team of classmates engaged in the realization of the same goals and the enormous support from the teachers—led to the obvious results. These particular achievements widened our vision and horizons while we were still teenagers! I often say that if you give your children an adequate model and teach them how to think and how to properly use available resources, you give them the whole world; whether they work to realize their potential or not, depends on their own ambitions and strength!

BRAIN TOMOGRAPHY: WIKIMEDIA COMMONS

Thank you! 45th Anniversary Gala a Success!

In the elegant surroundings of the Serbian Ambassador's Residence, the ISP community gathered on February 13th to celebrate the 45 years of excellence at the school. Guests were greeted with a glass of champagne, offered delicious and copious hors d'oeuvres, and enjoyed dancing to a lively DJ.

But most importantly, this Gala funded all of the items from our teachers' wish lists due to our generous sponsors, profits from ticket sales and pledges, and the live auction. The items listed on this page will be used to enrich students' education at ISP.

Our international community celebrating ISP's 45th Anniversary.

PRIMARY SCHOOL

- Rosetta Stone software for ESL & French language learning
- 150 French books for the library
- 20 cameras for classroom use and field trips
- A tool box/bench for the Ranelagh garden
- Two interactive white boards for French & music

SECONDARY SCHOOL

Science

- An autoclave which sterilizes glassware so that, for the first time, micro-biology can be taught at ISP
- A sensitive electronic balance with milligram precision
- A microwave transmitter/receiver to teach wave phenomena

The Arts

- 10 educational videos for the new IB Diploma Drama program
- Sony Handycam Camcorder HDR-SR12
- Printing press for the Secondary School Art Room

Design Technology

- Sony Handycam Camcorder HDR-SR12
- Field trip to a packaging plant for the IB students

Language

- Guest speakers to work with students in writing workshops
- Rosetta Stone software for ESL and French students
- Set of headphones for an entire ESL class
- Production costs of the Literary Magazine

Technology

- 10 laptops
- 20 cameras for classroom use and field trips

Secondary School science teachers: (clockwise from bottom left) Mr. Beardsell, Mr. Hughes, Mr. Adedapo, Ms. Lavalle, Ms. Martini, Mr. Smulders. (Not pictured: Mr. McMillan, Ms. Boyce, and Ms. Deane.)

Making the Right Mix
Marie-Cyrille Lavalle, Lab Assistant

Ms. Lavalle

It is very obvious, when speaking with Ms. Lavalle, that she loves her job.

Since 1999 she has played a pivotal role in developing and sustaining the Science Department at ISP's Secondary School. As the lab assistant to all science teachers on the Beethoven Campus, she ensures that the biology, chemistry, physics and environmental science laboratories are safe places in which to teach and learn.

Ms. Lavalle began her career as an AIDS researcher, but quickly found the daily routine too isolating and boring. She says that she "missed the human contact. Here I am never bored, and each new teacher brings along new ideas, approaches and dynamics to the science team." ISP's science teachers and students depend on Ms. Lavalle to mix the right chemicals, to prepare and set up the right lab equipment, and to make sure that the budget is planned to accommodate all the scientific needs for the year. As French law is very strict, she must also fill out forms for each chemical mixture she creates, and then make sure that these are stored properly and securely.

"In 1999, there were two science labs at the Secondary School: one in 6 rue Beethoven and one in 7 rue Chardin. Now, we have five labs between the two buildings." In addition, the increased budget and new sophisticated equipment have made our science program "the envy of many other schools!"

Ms. Lavalle especially loves being involved with the students. She enjoys working one-on-one with grade 10 students on their personal projects, and is a founding member of ISP's Humanitarian Project in Namibia. "I like finding connections to science in everything ISP does, from Eco-Ecole to the Namibia Trip. This spring, in Namibia, we will be developing and teaching a science project to the children in the village, using what they see around them as a natural entry point to the teaching of science."

As a great role model to girls who are thinking of careers in science, Ms. Lavalle hopes that she can encourage all ISP students to pursue an active interest in the sciences and to "become happy and responsible adults."

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Design: A. Tunick (www.atunick.com)
Printed on Forest Stewardship Council Certified Paper / All texts & photos copyright ISP