

▼ Left to right: Ms LIN Mei-yu, Dr SUEN Ka-chun and Mr LI Man-ho



Nurturing Students' Scientific Literacy

Teachers presented with the Award

Dr SUEN Ka-chun
Ms LIN Mei-yu
Mr LI Man-ho

School

Po Leung Kuk
Laws Foundation College

Subjects taught

Science (S1-2)
Biology (S3-6)

“ Teaching Philosophy

We adopt the Predict-Observe-Explain (POE) approach in science teaching. To broaden students' horizons, we have been enhancing our school-based Science curriculum by adding Biotechnological topics to junior Science curriculum. We believe that scientific literacy is properly cultivated through the provision of authentic learning experience.

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Interview with the Teachers

Nurturing critical thinking

"The nature of science is to find solutions to a problem. We encourage students to act as scientists when dealing with an issue. Before jumping to conclusion, they have to observe, collect evidence, conduct experiments and analyse the findings," said Dr SUEN Ka-chun, the Head of the Board of Science, who coordinates the development of the Science curricula at the School. "The training in science will benefit students for a lifetime. Nowadays, we receive tons of information through the media. Scientific and unbiased analysis of the information would come in handy when we need to verify the accuracy of information."

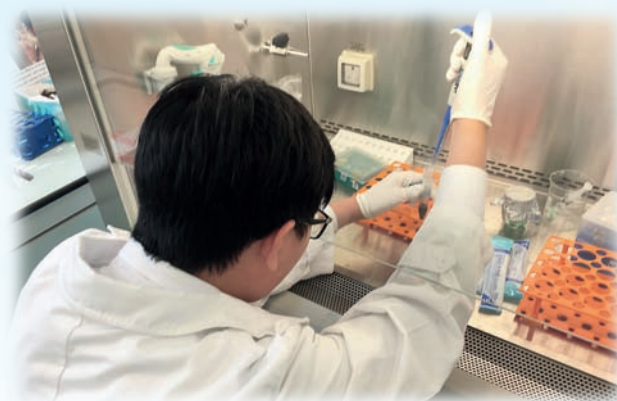
Adopting integrated curriculum

The School sees the importance of Biotechnology in the future development of science. So all junior students are required to study Biotechnology as is an integral part of the school-based Science curriculum. The topics covered are intriguing, such as the genetic modification of *E. coli* and the effects of antibiotics and anti-bacterial agents like Dettol. When there are closer links between the Science curriculum and daily life, students are motivated to learn more.

Mathematics can be a hurdle deterring students from studying science. "Certain science formulae do require mathematical interpretation that may be a bit abstract for some students, but we seek to explain the relationship among different variables in a formula through experiments," explained Mr LI Man-ho, the teacher-in-charge of the Gifted Education Programme. He gave an illustration, "When we



▲ Two students and Dr. SUEN taking part in a "brainwave" competition in a neuroscience conference in the United States of America (U.S.A.)



▲ A student preparing plant extract to conduct cell culture experiments

teach the density formula (density equals to mass over volume), we ask students to mould the same amount of resin clay into various shapes and put the moulded objects in water. They find that some float while some sink, despite the fact that all objects have the same weight. Then they understand better what density means. They get so thrilled that they start a competition to see whose designs have a lower density and float better."

Over the years, Mr LI has witnessed improvement in students' learning attitude when they become engaged in science lessons through conducting experiments. In some cases, students even learnt the relevant mathematical concepts by themselves in order to develop a deeper understanding of the science concepts that interest them. This shows that students have the ability to learn, although not at the same pace and in the same way.

Inspiring budding scientists

Students seldom get bored, as they can explore a wide range of topics in science lessons. For example, the problem-based learning approach prompts students to review science literature by themselves to find answers to questions. "Not long ago, there was widespread news coverage about the harmful effects of using Millennium Oil for cooking. I then came up with the idea of asking students to find out what would happen when cells were exposed to Millennium Oil. They were motivated to conduct experiments," Dr SUEN recalled.

The lesson on Millennium Oil is certainly one of the many memorable lessons Dr SUEN's students had. When asked about the next hot topic to be examined, Dr SUEN firmly said, "Stem cells. Stem cells bring us tremendous medical benefits, but they can turn themselves into cancer cells too."

Students at Po Leung Kuk Laws Foundation College (PLKLFC) are nurtured to contribute to society using their science knowledge. Dr SUEN added, "Not only are new issues worth exploring, some seemingly trivial topics, like insects, also shed light on science investigations."

Creating new learning opportunities

Knowing that exposure to the outside world could have lasting effects on students' personality and intellectual development, teachers at PLKLFC keep offering new learning opportunities for students to expand their knowledge and stretch their potentials. Interdisciplinary links were created between the Science curriculum and other subjects, such as Geography. For instance, students are guided to do research on horseshoe crabs, and to participate in various local and overseas conferences to promote the conservation of the species.

The most rewarding of all is not about winning awards and prizes, but gaining first-hand experience through collaborating with like-minded counterparts through joining competitions and conferences. The students at PLKLFC are encouraged to demonstrate their capability in the "Be-A-Scientist" programme. Moreover, five batches of students have participated in international conferences, such as Annual Meeting of Society for Neuroscience held in the U.S.A.. Six research reports written by students were published in *Science Arena*, an international science journal.



▲ Students discussing the experimental procedures with Mr LI

"Peer interaction facilitates learning and sharing of knowledge, and bridges the ability gap between students," said Ms LIN Mei-yu, the Head of the Integrated Science Department, as she recalled one of her most memorable experience. "Once, we asked students to investigate the life span of lobsters. Students turned surprisingly enthusiastic about taking care of the lobsters after this project started. They formed groups and shared the duties among themselves. Some were responsible for feeding the lobsters and cleaning the tank, while others nursed the lobsters to breed. They even went back to school during

holidays to ensure that the little creatures were well taken care of. In the process, they shared the practices which worked and reflected on those which failed. Because of this, they developed a closer collaboration. Since I guided them along the way during the project, I also became closer to them too. It's truly satisfying to see them develop deeper understanding of the subject through collaborating with their classmates," Ms LIN's eyes twinkled with merriment when she recalled such fruitful work.



▲ Students discussing how to make wine

Reviewing and improving Science curricula

Conducting experiments requires patience and perseverance. There is no guarantee on getting the desired results. No matter how cautious one seeks to be, the possibility of failing cannot be eliminated. "Undesirable outcomes are meaningful findings too," Dr SUEN said in an encouraging tone. "As Carl Jung said, 'Knowledge rests not upon truth alone, but upon error also.' " It is this point of view that has inspired the awarded teachers at PLKLFC to keep reviewing and improving their Science curricula. To them, the satisfaction lies not in how brilliant students do in examinations, but how fruitful the learning experience is. The Award presented to the teachers is an acknowledgement of their endeavours and the School's commitment to providing a comprehensive Science curriculum for nurturing the all-round development of students in all these years. "There are still lots to be done," the team of teachers nodded in agreement. "We hope that we would trigger a ripple effect by sharing our teaching experience," said Dr SUEN.

With no doubt, this dedicated team of teachers always think positive. Supported by the school management's forward-thinking, the teachers at PLKLFC will continue to enhance the school's science education and help students learning more about science.



Teachers' Sharing

By providing various learning opportunities for students, their interest, curiosity and creativity in science can be nurtured. As scientists always predict, observe and explain the results of experiments, we adopt the "Predict-Observe-Explain (POE)" approach in science lessons to nurture students' scientific literacy. To develop scientific literacy of students, we plan interactive lessons for them and create various learning opportunities in which students can enhance their science process skills.

Reflecting on teaching effectiveness

In lesson planning and curriculum development, we, as science teachers, always ask ourselves, "Are students learning science in our science lessons?" Sometimes, we may think that our lesson is good enough as it is full of interactive activities, manageable lesson content and well-designed assignments. Yet, students might be regurgitating concepts listed in textbooks or worksheets without truly understanding them. For example, although students may be able to give many reasons why plants need water, they may have no interest in predicting and observing what a plant will become in the absence of water. Then, it is time for us to think about whether the objective of the lesson is properly met.

Enhancing students' understanding

How can we make lessons effective for students to learn science? To answer this question, we need to know how scientists conduct investigations and analysis. They always predict, observe and explain the results of experiments. Therefore, we adopt the POE approach in science lessons. The POE approach allows students to make predictions before doing an experiment. Through discussing the predictions made by different students, teachers can create an interactive lesson. From our experience, the POE approach can be applied to all science lessons as students' prior knowledge is challenged. Once it is challenged, new knowledge is built up and active learning occurs. Another important reason why we implement POE approach in science lessons is that students' perceptions of

a scientific concept is uncovered in the process of "Predict, Observe and Explain". Therefore, a science teacher can understand what students are thinking about and then develop a suitable learning strategy to help them build up a new science concept. In the process of "Explain", students utilise and integrate the concepts that they have learnt to explain observations. Therefore, POE is a good approach to promote inquiry-based learning and enhance science understanding. It is our belief that students under the training of POE will develop interest towards science. In our classes, we observe that students like science as they are not asked to memorise a fact but inspired to learn a concept.

Nurturing future scientists

In some of our enrichment programmes for scientifically gifted students, we integrate POE into research-based learning. It is encouraging to see that they like science very much as they are excited to do experiments in the laboratory after school. We believe that our teaching strategy is effective in promoting students' interest, curiosity and creativity in science.



▲ Two students examining the quality of products invented by other students



▲ Two students awarded a prize in The China Adolescents Science and Technology Innovation Contest
► Students sharing their experience of invented products

As a science teacher, we are dedicated to nurturing future scientists. In recent years, many of our students who are groomed as young scientists have achieved outstanding performance in scientific research and inventions.

Highlights of the school-based curriculum

It is important that we cater for students with different interests and abilities. We create various learning opportunities for students to explore and experience science.



▲ Students discussing how to make an effective parachute on Science Day

To nurture students' scientific literacy, we have incorporated elements of biotechnology, adopted gifted education programmes and devised different "Be-a-scientist" activities in our school-based Science curriculum for junior levels in addition to covering the core parts in the junior Science curriculum. In 2011/12, we launched "Young Scientists' Conference" in which P6 and S1 students shared their scientific research data and inventions. To nurture gifted students, we also started "Budding Scientists" programme aiming at P6 to S2 students in 2012/13 and encouraged our students to present their research findings in international conferences.



▲ Students presenting their research findings in an international conference held in the U.S.A.

Establishing a learning community

In the past 12 years, we also put much emphasis on teachers' continuing professional development in curriculum planning. Our whole team of science teachers put various teaching strategies into practice when teaching different topics in the Science curriculum and formed a learning community to share our experience.

Conclusion

Our belief is that students will like science when they are engaged in interactive activities which give them the experience of being a scientist.



▲ Awarded teachers sharing their experience in conducting learning and teaching activities





Assessment Summary

“The implementation of the "Predict-Observe-Explain" approach to nurture students' scientific and analytical skills”

The awarded teachers are enthusiastic for their work. To achieve the goal of nurturing young talents, the Board of Science has been set up to develop the school-based Science curriculum which promotes scientific literacy among students on the one hand, and grooms the talent of the gifted students on the other. Such innovative school-based Science curriculum serves to provide students with extensive science research opportunities.

The awarded teachers have profound knowledge in Biological Science. They always have close collaboration with each other and have professional sharing meetings and peer lesson observations, so as to enable them to reflect and refine their strategies and skills in science teaching.

For the junior levels, the awarded teachers have further developed a 3-year junior gifted programme, the Budding Scientists, for students from P6 to junior secondary levels, to help students acquire basic knowledge and skills in setting up experiments related to Biology, Chemistry and Physics. As for the senior levels, regarding the gifted education programme, some of the students are selected to advance their studies in the school-based Neuroscience Curriculum in which students try to apply knowledge and skills acquired by doing research projects.

The awarded teachers are able to help students develop curiosity, interest and creativity in scientific investigation. They provide students with various learning experience, enabling them to apply their knowledge and skills acquired and cultivate positive values and attitudes in the process. Lessons conducted by the awarded teachers were very well planned and incorporated lots of students' group activities. They were able to skillfully adopt the "POE" teaching model, which encourages students to predict, to observe and to explain. As observed, through this "POE" approach, students' investigation skills and presentation skills were enhanced.

In order to better bridge the science learning from P6 to S1 and S2, the awarded teachers design the Biology and junior



▲ Students engaging in a group discussion about water and plant issues

secondary Science curricula for students studying at P6 in its through-train partner primary school, targeting the smooth transition at interface with the junior secondary Science Curriculum and the provision of a balanced foundation in Science Education for students. In addition, the awarded teachers have organized Joint-school Young Scientists' Conference for P6 and S1 students, which serves to enhance students' abilities to apply science knowledge in daily life and to develop their potential to conduct scientific investigation.

The awarded teachers have successfully nurtured students' scientific literacy. Students have participated in a number of international competitions and events in science research projects, delivered their research results, and won a number of awards in national competitions and events.

The awarded teachers have shared the school's experience in the development of STEM education and the school-based Biotechnology Curriculum through conducting workshops, conferences and seminars.

Ways to Obtain Information on the Teaching Practice

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