How are scientific concepts best learnt? What are some best teaching practices in Biology instruction? What resources could improve students’ learning of scientific concepts? These and other issues are explored in the 13 papers under this theme.

Baojun Yao and Yuhong Huang examine how biological concept is formed in the classroom using the hypothesis testing model. The model suggests that the character of biological concept formation is to begin at a higher level and infers there may be a threshold in concept formation, and that different concepts have different thresholds. Their findings are presented in “An Exploration of Biological Concept Formation in the Classroom”.

Another study by Thasaneeya R. Nopparatjaimomras, “Developing a Social Constructivist Teaching and Learning Module on DNA for High School Students in Thailand”, examines the current situation in the teaching and learning of genetics concepts in four schools in Bangkok. Nopparatjaimomras reports that a learner-centered approach is an important feature in Thailand’s national education. Subsequently, the DNA module was developed based on the social constructivist approach, with an emphasis on allowing peer interaction and teachers adopting the role of a facilitator. There were three stages of learning – orientation, focus and conclusion, incorporating hands-on activities, small group discussions and whole class discussions.

The importance of timely and targeted feedback on student learning is highlighted in “Importance of Lecture Feedback in H2 Biology Lecture in a Junior College” by Woon Keat Foo-Lam et al. By using post-lecture feedback, the researchers evaluated if main concepts taught in a lecture have been conveyed to students, and if any major concepts confused a significant proportion of the lecture group. Surveys conducted since 2007 have shown a positive correlation in the use of feedback with students’ ability to grasp concepts, and provided evidence that students improved in their capability to make connections between related themes. For example, nearly 80% of students surveyed reported a link between effectiveness of lecture feedback with the enhancing and consolidation of main points from a previous lecture, before moving on to new content. Another positive finding was that students found lecture feedback as a good way of interacting with the lecturer that might otherwise be difficult in large lecture groups. These findings were further substantiated in the use of pre and post-lecture tests in which students from the “lecture feedback group” did better than the control group.
Another attempt to improve learning outcomes is explored in Narenda D Deshmukh’s study, “Designing and Field Testing of Remedial Material to Rectify Students’ Misconceptions in Biology at the Secondary School Level”. This paper looks at the common misconceptions secondary students have about biological concepts. It was found that across grade levels in rural and urban India, misconceptions about respiration, vitamins, blood circulation and gas exchange persist. Remedial materials were then developed taking into account the nature of these misconceptions and their sources. This material was then tried in a sample of rural and urban students, and was found helpful in rectifying some of the misconceptions.

In “The Development and Evaluation of an Inquiry-Based Lesson on Plants”, Sheau-Wen Lin examines the effectiveness of an inquiry-based lesson that employed a backward design to teach elementary students about plants. The findings showed that the experimental group performed better on attitudes towards science, metacognition and concept understanding than did the control group. In “Correlates of Achievement Test Performance in Biology 1 of Second Year Students in the Philippine Science High School-Central Visayas Campus, Argao, Cebu from 2007–2010”, Sherry P Ramayla looks at the factors that contribute to the achievement test performance of the abovementioned students. The findings suggest that there is a strong correlation between the grade and IQ of the students. Less relevant were the teacher’s experience and whether students graduated from private or public elementary schools.

In “Improving Science Learning through Learning-To-Write Strategy: Writing Claim and Evidence in Classroom Teaching”, Hang Chuan Teng et al. qualify and quantify the effects of using writing-to-learn science for a group of Primary 5 students. The research investigates how writing claims and evidence statements can support learning of science concepts and ideas. The study highlights the important role teachers play in supplying rhetoric and writing structures, and by pointing out critical aspects of the object of learning.

A quasi-experimental design was also conducted in two 6th grade classes to study the effectiveness of using concept map strategies for science learning. It was found that students in the experimental group scored higher in both the achievement test and attitudes towards science than the control group that had no exposure to the concept map teaching strategy. These findings are presented in “Effectiveness of Concept Map Strategies for Science Learning in 6th Grade” by Ching-San Lai and Chi-Yao Ni.

Apart from writing strategies, the influence of cues and prompts in facilitating students’ thinking processes was also examined. First, students visited dinosaur exhibits at the Gwacheon National Science Museum in Seoul, Korea, and were asked to explain what they saw and understood. Then teachers provided prompts related to the exhibits and asked students to revise their explanations. It was found that students exhibited inferential thought in the second instance, when they were given prompts, which functioned as cognitive supports. For example, a student was asked if he knew the environment of “The Cretaceous Period in Korea” represented in an exhibit. He successfully linked the palm trees he saw to a warm climate and inferred that the dinosaurs would have lived in a hot environment because they did not have fur. The researchers conclude that prompts served as
cognitive supports for students’ thinking processes. These findings are reported in “The Influence of Prompts on Students’ Thinking Processes in Dinosaur Exhibits” by Eunhee Kang, Jane Jiyoung Lee and Heui-Baik Kim.

Another paper “A study of 1st Graders’ Science Learning on Biodiversity at Taipei Zoo, Taiwan” by Ching-San Lai looks at the impact of incorporating zoo resources into science teaching and biodiversity issues. Over 400 elementary 1st graders participated in a study, which included classroom teaching on animals and biodiversity issues, and a one-day field trip to the Taipei zoo. Results showed that close to 60% of students had a greater understanding on animals, and over 50% were willing to visit the zoo again in the near future.

Apart from relevant field trips, what other resources could improve students’ learning of science concepts? The paper “A Designed-and-Developed Biology Laboratory Kit for Rural High School Students in Philippines” explores the effectiveness of a designed and developed science laboratory kit in increasing students’ academic achievement and laboratory skills competency. It includes a manual, the teacher’s guide and materials for use. Topics were identified using the learning competencies in the Biology curriculum provided by the Department of Education. Experimental activities were then designed based on the topic. Melindam M Garabato and Manuel B Barquilla conducted a pilot test and found that the experimental group registered improved marks achievement and experimental skill competency as seen from pre and post-test scores, and recommends that the kit be used in more schools. Further study is also necessary to refine the design of the laboratory kit for students in other grades.

The role of student participation is also investigated in a few papers. In “Exploring Middle School Students’ Attitudinal Changes Towards Science through Participation in Club Activities in Creating and Publishing a Science Magazine”, Minjoo Lee and Heui-Baik Kim examine the impact of student participation in creating and publishing a science magazine on their interest and attitudes towards science. The findings shed light on the factors that promote students’ understanding and highlights implications on how to improve students’ attitudes towards science and science learning.

Another study provided students with an opportunity to collaborate in environmental problem solving. It explores how students with different knowledge and skills communicate to collect data and make decisions throughout their investigatory fieldwork and problem solving process. Based on students’ discussions, fieldwork reports, and reflection notes, this research highlights the importance of knowledge integration and decision-making, amongst other attributes, as important qualities in science learning. These are presented in “Students’ Knowledge Integration and Decision Making: Learning from Collaboration during Environmental Field Study” by Mijung Kim and Hoe Teck Tan.

From using creative laboratory resources to teaching focused writing strategies, concept maps, providing timely feedback, and informal contexts of science learning, the papers in this theme present practical suggestions for improving learning outcomes in the science classroom. Beyond that, giving students practical avenues to apply scientific concepts in real-life settings has also been found to enhance the learning process and students’ interest in science.