The Teaching Reform in Developmental Biology for Undergraduate

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Keyword: Developmental Biology; Curriculum Teaching; Reform

Abstract. Developmental biology has become an important fundamental subject in life sciences. Ensuring undergraduate to fully appreciate the nature of embryonic development and morphogenesis is a significant issue. The teaching reform of developmental biology course was discussed in this paper. Rational construction of curriculum structure system and content system, application of modern teaching methods including multimedia and network teaching and the reform of experimental teaching, were suggested to be taken to promote the development of developmental biology course.

Introduction

Developmental biology is a subject with a long and rich history, derived from the traditional embryology, and the content and methods of genetics and cell biology were fused. Developmental biology was promoted by the emergence of modern molecular biology over the past few decades. The main contents of the course focus on gene regulation and the relationship between genotype and phenotype [1]. Many significant new results related to the developmental biology occurred since 1980s, making it an important foundation to promote the development of life science disciplines [2,3].

In the 1960s and 1970s, developmental biology course was offered in some prestigious universities abroad. Until 1980s, the course was given to undergraduate in domestic universities such as Xiamen university, Shandong university and Lanzhou university, and the first developmental textbooks in China was published [4]. At present, developmental biology is widely established in the biology related majors of universities and local colleges. However, as an independent and young course, developmental biology needs continuous improvements in disciplinary framework and knowledge system [5]. From the perspective of the teaching reform of developmental biology, we make some reflections on animal developmental biology.

Construction of curriculum structure system

Firstly, the systematic principle should be followed to introduce the basic process of ontogenesis and the basic law of phylogeny. Secondly, principle of development should be followed to increase the research focus and new results served for the professional training objectives. Therefore, the developmental biology curriculum structure system should consist of three parts: the developmental biology foundation; The process and mechanism of development; Development of developmental biology. The basic parts of developmental biology include concepts, brief history of development, introduction of model organism and common research methods. The ontogenesis process should include pre-embryo development, embryo development and post-embryo development, and focus on various stages of embryonic development and gene regulation. The research progress refers to hotspot issues and new findings in the field of developmental biology.
Optimization of course content

For the basic concept and basic principle of developmental biology, with an emphasis on animal ontogenesis, represented by different organisms model, combining with the classic experiments in developmental biology research history, the introduction of the developmental processes and the main events with their regulatory mechanism should be presented. This is the basic knowledge of developmental biology, and the main content of developmental biology textbooks selected by colleges and universities in China. Among the three stages, pre-embryo development, embryonic development and post-embryonic development, the embryonic development including fertilization, cleavage, blastula, gastrula to germ layer differentiation and organ formation is the core of the course.

Scientific research in the field of developmental biology has developed rapidly, the new achievement constantly emerging and selectively be used to classroom teaching. Hot topics like stem cells, development and disease, are deepening the basic theories of developmental biology, promoting the progress of the discipline and the whole life science. These new findings and results have important role in helping undergraduate and graduate students to grasp the foreland of biology research.

Developmental biology is a practical course, and developmental biology experiments play important role in curriculum teaching. It is important for teaching reform of developmental biology to reform experimental teaching, including updating the experimental subjects, combining the theory teaching to students' innovative ability and comprehensive ability.

Reform of teaching methods

Traditional teaching is dominated by lectures, while teachers are the dominant force and students have low participation and easy to lose interest in learning. In modern teaching students are the subjects of teaching and should be respected during the process of autonomous learning.

1. Attach importance to multimedia teaching

With the development of computer technology and Internet, the teaching mode is changing constantly. The combination of multimedia courseware and traditional teaching method in classroom teaching is universal in classroom teaching in colleges and universities. The course of developmental biology is highly theoretical with many knowledge points are abstract and not easy to understand, while the most superiority of multimedia teaching is that it displays abstract content via various visual forms such as image, animation, audio and video. For example, during the gastrulation in embryonic development of animals, after cell movement and rearrangement, embryos form three cellular or germ layers - ectoderm, endoderm and mesoderm - which then go on to form the body's organs and tissues. Ectoderm becomes skin and nerves, endoderm becomes the gut and organs such as the liver, pancreas and thymus, and mesoderm becomes muscle, bones and blood. Through videos and pictures, the complicated process was presented, avoiding confusion that is easily generated by the description. The application of multimedia is pretty suitable for the contents of developmental biology, and multimedia teaching should be used to the classroom teaching as one of most powerful manner. At the same time, we should pay more attention to the contents displayed, avoiding over-reliance on multimedia and neglect the guidance from teachers and subjectivity of students. The proper use of multimedia teaching requires teachers to provide more works instead of light work. The organic combination of multimedia teaching and traditional teaching method make it hopeful and meaningful in developmental biology teaching reform.

2. Making full use of web-based teaching

With the fast development of the Internet, web-based teaching has gradually been acknowledged by more and more educators and becoming a powerful tool for classroom teaching. Web-based teaching has the advantages of openness and sharing, with not limited by time and space. To date, many online courses of professional courses were established in universities. As a young discipline, the developmental biology is relatively lagging in network course construction. The construction
and application of network course need to be paid more attention to in the future. For example, we can supplement the classroom teaching of developmental biology by setting up the MOOCs (Massive Open Online Courses) and micro-courses online. For students, preparation before class, review after class, homework, and teaching evaluation and so on, each link can be done through the network teaching, and interaction and communication between teachers and students become more convenient and frequent.

3. Experimental teaching reform

Deliberate experimentation is the lifeblood of good teaching. Experimental teaching is an important way to cultivate students who have the practical ability and the creativity. Developmental biology is a new experimental subject and the reform of its experimental teaching is the key part of course teaching reform. The traditional laboratory course of biology was comprised of independent experiments, each designed to teach common techniques rather than expose students to a better understanding of the research processes. In the experimental teaching of Developmental biology, we think comprehensive experiments should be added to the new curriculum. John F. Mulley introduced a comprehensive experiments system based on module of model organism in practical teaching of Developmental biology [6]. The rationale behind the course was to provide students with an understanding of key models and techniques used to study animal development; to enable them to develop practical skills in embryology and to give them the opportunity to combine background knowledge and independent research to interpret experimental results and solve problems. The module comprised 21 three-hour practica sessions, ranging from fairly basic single sessions involving direct observation of chicken (Gallus gallus), zebrafish (Danio rerio) and axolotl (Ambystoma mexicanum) embryos and setting up crosses of Drosophila melanogaster, to more complex in situ hybridisation and immunohistochemistry experiments to detect gene expression and protein distribution which ran across multiple sessions over several weeks. In addition to developmental biology skills, students were also given the opportunity to practise key molecular biology techniques, such as DNA/RNA extraction, PCR and RT-PCR, agarose gel electrophoresis, as well as to develop and improve existing skills in general numeracy, pipetting and microscopy, among others. The module was assessed via three pieces of written work (2000–2500 word combination practical write-ups and technique reviews, each worth 25%) and a laboratory notebook (also worth 25%). Via these experiments, students were not only given experience of several key laboratory model organisms, they were also given the opportunity to observe embryonic development for themselves.

Conclusion

In conclusion, in the course of developmental biology teaching, traditional teaching methods and modern teaching methods, such as multimedia and network teaching should be combined to improve the course teaching to a high level.

Acknowledgement

This research was financially supported by the Innovation Project of Shandong Province Graduate Education (SDYY13131) and Education scientific planning project of Shandong Province (2013GZ060).

Reference


