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Life Stories: Tools for Knowledge Integration

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INTRODUCTION

"Sometimes reality is too complex. Stories give it form" shared with the world Jean-Luc Godard, a French/Swiss filmmaker recognized as a pioneer of the French New Wave film movement several decades ago. Living matter is very complex itself, and teaching and learning about it greatly benefit from effective storytelling. Storytelling is perhaps the oldest and most informal form of teaching, in which generations share personal experiences and skill sets regarding how to interact with the surrounding world. In addition to being a source of new information, stories could be a powerful integration tool (1) if a "critical mass" of knowledge is accumulated and the time is ripe to see both the trees and the forest (which can vary in size and maturity but is still a forest). Scientific storytelling is considered an engaging tool for communicating science both inside and outside the classroom (2–4). Students get to be storytellers for the first time when they are learning to read and write and are repeatedly asked to share stories about themselves. A quick check of the website of the Scholastic company (https://www.scholastic.com), a global publisher serving the PK–12 community, shows a broad array of products associated with pedagogy of personal narratives starting with elementary school. In K–12 science instruction, storytelling frequently attaches a human reality element to aid information processing, e.g., the eukaryotic cell is presented as a city, and the nucleus is described as a command center. In higher education, the approach is widely used in education and humanities instruction and has been shown to be effective across disciplines and different learning contexts (5, 6). This article describes an instructional approach applying the concepts of personal narratives and storytelling to knowledge integration of basic principles of cell structure and function. The approach aims to accomplish two major goals, (i) to guide students to create a concise study aid integrating their knowledge and (ii) to create a mental template facilitating acquisition and integration of future knowledge.

PROCEDURE

The "Life story of. . ." approach was designed for a cell biology core course at the 200 level with the purpose of facilitating student transition to efficient integration of biological knowledge on the cellular and molecular levels. Students are presented with a blank template depicting the life of the biological entity as an arrow progressing from birth to death through life transformations/activities (Fig. 1). The simple diagram is projected on the classroom screen, as well as given to students in print. In the virtual classroom, Padlet (padlet.com) can be a useful interface, allowing answers to be written on virtual sticky notes and positioned within the assignment template. Initially, students work in small groups to assemble a life story, for example, that of the eukaryotic cell. They are verbally directed to repeatedly ask a series of four open-ended questions ("How?" "When?" "Where?" "Who?") and to summarize the big picture with single words or short bullet points. The answer to the "How?" question is expected to name the process(es) associated with a milestone in the life story, for example, "Eukaryotic cells are born via mitosis or meiosis." The answer to the "When?" question is expected to reference a time point or specific conditions that need to be met, for example, "Mitosis happens on a regular basis when the life conditions are optimal" or "after DNA and cellular organelles have been duplicated," or "during the M phase of the cell cycle." The answer to the "Where?" question is expected to reference a location in the cell, for example, an organelle where a certain life transformation/activity takes place, i.e., "Cells make energy in the mitochondria." The answer to the "Who?" question is expected to reference the active players in the discussed cellular milestone, for example, "The mitotic spindle is a key entity in mitosis." Once the group work has concluded, a copy of the filled template is collected for grading and the class works together on the board to assemble a class version of the life story, allowing for correction of misconceptions and finishing of the study aid. To encourage active student engagement, a reference study aid

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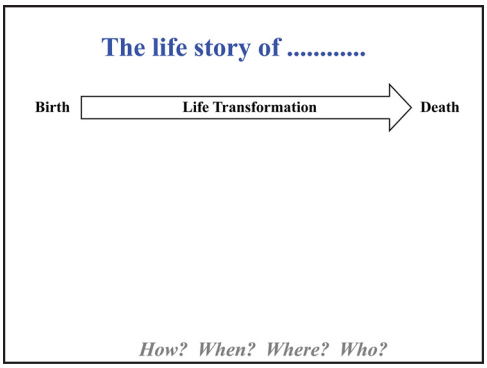

FIG 1. Graphic template for the "Life story of. . ." exercise.

is not provided, and taking pictures of the classroom board is not permitted. The assignment is graded for completion/effort for limited points. Depending on course logistics, the approach can be used as a single exercise or as a repetitive activity through the entire semester, budgeting around 30 min per occurrence.

In the author's experience, the exercise works the best when executed at the end of the discussion of a particular topic, such as the structure of the cell, or at the end of a series of topics focusing on a certain biological entity, for example, protein synthesis, protein trafficking, and regulation of protein activity. Student experience is most productive when (i) the connection to personal narratives is made when the goals of the exercise are introduced, i.e., the students become aware that they have done this before, (ii) group work is limited to 5 to 7 min, (iii) students are given examples of the life transformation/activity, and (iv) the approach is applied to writing open-ended exam questions. The philosophy of the approach can also be used for quick review/assessment of preexisting knowledge or to create writing-to-learn assignments. For example, at the beginning of a molecular biology course, students could be tasked to put together a life story of DNA or RNA to identify gaps in their knowledge. Writing-to-learn assignments can task students to synthesize a life story of an organelle following a review of relevant text or video content.

CONCLUSIONS

In the authors' experience, the described pedagogical approach eases the transition between studying biology on an organismal level and studying on a cellular/molecular level, where students often struggle to navigate structures and processes invisible to the naked eye and space/time scales that they have no sensory experience with. Every biological entity on the cellular and molecular levels has its life story that in principle is very similar to human/organismal life stories, which students have mastered growing up while describing the lives of plants, animals, or family members or their own lives.

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