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Creativity in Biology

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I have always thought that there's no room for creativity in the sciences. When I think about this field, I think about the tedious laboratory experiments, disinterested scientists, and thick, boring textbooks. And since I've always been artistically inclined, I've never really considered becoming a part of this field. The arts and the sciences to me, back then, were their own separate worlds never to be commingled. However, that perception changed in high school. There, I met some of the most inspiring teachers who made me realize that the line separating science and art was actually very fuzzy. Science is not just about binary, static facts. Rather, it's more dynamic than that because it revolves around patterns, relationships between living things, and stories as in the case of evolution. They encouraged me to follow my curiosities, ask questions, and most importantly, leverage my creativity to understand the concepts better. I had the chance, for example, to create a stop-motion video explaining the cell signaling pathways involved in cystic fibrosis and a movie trailer about the DNA replication process, both of which were an absolute joy to make. Overall, I found both through my high school experience and my research that the seemingly tedious side of Biology, or any sciences for that matter, is only one of its many facets. Creativity, for the most part, is embedded in the process of creating knowledge in this field. And this is made clear by the discipline's reliance on empirical inquiry, integration, and clear communication.

Problem solving in biology, like in any other field, begins by obviously, identifying a problem. Biologists do this by observing the natural and social world (Phillips & Burbules, 2000, as cited in Dowd, Thompson, & Reynolds, 2016, p. 37) and posing questions about these observations. Based on preexisting information in the

field such as scientific laws and theories or the scientist's own assumptions, the scientist will have to make an educated guess, also known as the hypotheses, to answer these questions. Hypotheses are usually formulated, as I've been taught in highschool, using an if-then-because statement; with the observation following the word *if*, the inference following the word *then*, and a scientific principle or reasoning following the word because. While practicing biologists might have more advanced knowledge of scientific theories and use more elevated language than beginning students, the idea of using observations of the physical world as a catalyst for further investigation remains at the core of the biological sciences and is used in all levels of expertise. This process of hypothesis formation makes it obvious that much like artists, biologists must have keen, observing eyes and a curious spirit to find where potential problems exist. After all, Gregor Mendel's laws of inheritance did not just come out of thin air but rather from his attentive noticing of seemingly trivial peas.

Aside from taking inspiration from the physical world through observation, biologists can also take inspiration from other biologists to find a potential topic to investigate. Biologists are encouraged to look into historical or long-standing problems in the field , locate "gaps in existing knowledge" ("Writing the Scientific Paper," 2022), and "synthesize sources to create an original argument" ("Writing in Biology," 2021). So there's a never-ending source of inspiration in the field of biology. Pay close attention to them and you might just spark the quest to the next groundbreaking discovery.

The next step then, is to test whether or not the proposed hypothesis is true, through experimentation. This is perhaps the most dreaded step because it usually involves the use of numbers and complicated pieces of equipment. While this process can certainly be viewed as dull, it's not so much different from how artists develop their craft by experimenting with different skills and tools. This is in part why most institutions, like CSUMB, emphasize the importance of students having the "ability to design and execute the collection, evaluation and interpretation of scientific data" (Bergsma, p.3). By allowing students to come up with methods that would yield the most accurate and hence reliable data by themselves, this class not only develops creativity but also independence. And independence is important because Biology is not a field that's entirely by the

book. While students are indeed expected to know specific concepts and mechanisms, the field also expects students to apply and sometimes even integrate them with other disciplines to solve complex problems. (MLO 3) They can even, for example, choose from a variety of existing techniques (needless to say they should give credit to who invented them), modify those techniques , use specialized equipment, focus on a specific population, or use different software programs to gather data. ("Writing the Scientific Paper," 2022) In short, people in the field of biology should know what things are, how they work, and when to use them to potentially figure out something no one has before and add to the ever-growing knowledge of the field.

Once all the data has been collected, biologists would then have to make sense of them. This usually involves comparing the control and experimental groups or turning numerical data into "tables, figures, and graphs" ("Writing the Scientific Paper", 2022) to visualize any patterns. All in all, the goal of this process is to highlight any key information, changes, or relationships that either prove or disprove the aforementioned hypothesis. The scientist brings all of these together and comes up with an inference about what has taken place. It's important to note though, that while it's possible for biologists to interpret the data in many different ways (perhaps even in a way that favors their hypothesis), the field has its own system of checks and balances to make sure that no scientist goes running around and spreading false information. For example, the field requires for all evidence to be "publicly available for inspection and replicable by the relevant professional community" (Phillips & Burbules, 2000, as cited in Dowd, Thompson, Reynolds, 2016, p. 37) and literature reviews or the "evaluations, analysis, [and] comparison or contrast of other research" ("Writing in Biology," 2021) to be written by biologists. This spirit of inquiry and skepticism among scientists ensures that only accurate and reliable data are being put out to the public. And this is important because scientific knowledge is used to treat diseases, solve environmental problems, and many more.

Aside from ensuring that only accurate information is being presented, scientists also see to it that this said information is presented well. And by *well* it means that anyone with limited knowledge of a topic should be able to understand most, if not all, of the procedures

and findings of a particular study. This is important because they have a wide range of audience including: "fellow researchers and other academics, students, government officials, business professionals, or the general public." ("Writing in Biology", 2021). Therefore, scientists are encouraged to use clear and concise language regardless of whether they choose to present the information in oral or written form. (Bergsma, p. 3) While this might seem limiting, it actually allows for students and professionals to view concepts in different ways and make use of other resources to communicate scientific concepts. We see this play out, for example, with science researchers who combine texts with graphics to create the most presentable and eye-catching posters. ("Poster Sessions," 2022) But for the most part, we see this creativity being used by science communicators and educators. How else would Sal Khan of Khan Academy or Hank Green of Crash Course Biology have established their huge online platform if not for their ability to explain the most complex of ideas using only everyday language, amusing visuals, and impeccable sense of humor?

Overall, Biology, like any sciences, is a dynamic field. Biologists are continuously refining and expanding their knowledge of the natural world by being inquisitive and integrating knowledge and skills from within and outside of the discipline which are reflective of the field's inherent creativity. And it is through this creativity and collaboration that biologists are able to come up with new solutions to the world's biggest problems. So if you are someone who can make original connections between ideas, the field of Biology might just be the right fit for you.

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About the author:

Denisse Emeterio is currently a freshman majoring in Biology. What she loves most about this field is its love for stories. Biology use stories to explain how things work and how everything came to be. So similarly, Denisse is interested in using the art of storytelling to get more people interested in science.