gene mutation pogil

gene mutation pogil is an educational approach designed to help students actively engage with the concept of gene mutations through guided inquiry and collaborative learning. This method facilitates a deeper understanding of genetic changes, their causes, and their implications on organisms. Gene mutation POGIL activities typically involve step-by-step investigations that encourage critical thinking, data analysis, and application of genetic principles. This article explores the fundamentals of gene mutations, the structure and benefits of POGIL (Process Oriented Guided Inquiry Learning), and how gene mutation POGIL activities enhance comprehension of genetic variation. Furthermore, it discusses common types of gene mutations, their biological effects, and the role of POGIL in genetics education. Readers will gain insight into effective strategies for teaching gene mutation concepts and the importance of inquiry-based learning in molecular biology.

Understanding Gene Mutations

Gene mutations are alterations in the nucleotide sequence of DNA that can affect the function and expression of genes. These mutations can occur spontaneously or be induced by environmental factors such as radiation or chemicals. Understanding gene mutations is fundamental to genetics, molecular biology, and medical research. The study of gene mutations provides insight into hereditary diseases, evolutionary processes, and cellular mechanisms that maintain genetic integrity. Gene mutation POGIL activities focus on guiding students through the analysis of mutation types, their causes, and consequences, fostering active engagement with genetic material.

Definition and Causes of Gene Mutations

A gene mutation refers to any change in the DNA sequence that makes up a gene. These changes can result from errors during DNA replication, exposure to mutagens, or viral infections. Mutations may affect a single nucleotide or larger segments of DNA. Common causes include:

- Spontaneous errors in DNA replication
- Exposure to ultraviolet (UV) light or ionizing radiation
- Chemical mutagens such as base analogs and alkylating agents
- Biological agents like transposons and viruses

Role of Mutations in Genetic Variation

Gene mutations are a primary source of genetic diversity within populations. While some mutations are harmful or neutral, others can confer advantages that drive natural selection and evolution. Mutation-induced genetic variation is essential for adaptation to changing environments and species survival.

Gene mutation POGIL exercises often emphasize the significance of mutations in shaping phenotypic traits and evolutionary fitness.

The POGIL Methodology in Genetics Education

POGIL, or Process Oriented Guided Inquiry Learning, is an instructional strategy that promotes student-centered learning through structured inquiry and teamwork. In genetics education, POGIL activities facilitate active exploration of complex concepts such as gene mutations by encouraging students to analyze data, develop models, and articulate reasoning collaboratively. The gene mutation POGIL framework incorporates guided questions and problems that scaffold understanding while promoting critical thinking skills.

Key Principles of POGIL

The POGIL methodology is based on several core principles that enhance learning outcomes:

1. **Guided Inquiry:** Students investigate concepts through carefully designed questions that progressively build knowledge.

2. **Collaborative Learning:** Small groups work together, fostering communication and peer teaching.

3. **Process Skill Development:** Activities target skills such as data interpretation, problem-solving, and evidence-based reasoning.

4. **Student-Centered Approach:** Learners actively construct understanding rather than passively receiving information.

Application of POGIL to Gene Mutation Topics

Gene mutation POGIL activities are structured to guide students through the exploration of mutation mechanisms, types, and consequences. For example, students may analyze DNA sequences to identify point mutations or frameshifts and predict their effects on protein synthesis. This method encourages connecting molecular changes to phenotypic outcomes and real-world scenarios such as genetic disorders or evolutionary adaptations.

Types of Gene Mutations

Gene mutations are classified based on the nature of the DNA sequence change and their impact on gene function. Understanding these types is crucial for interpreting genetic data and predicting biological effects. The gene mutation POGIL approach typically includes detailed investigations into each mutation category to build comprehensive knowledge.

Point Mutations

Point mutations involve a change in a single nucleotide base within the DNA sequence. These mutations can be further divided into:

- **Silent mutations:** Alter a codon without changing the encoded amino acid.
- **Missense mutations:** Change one amino acid in the protein sequence.
- **Nonsense mutations:** Introduce a premature stop codon, truncating the protein.

Insertions and Deletions

Insertions and deletions, collectively called indels, involve the addition or loss of nucleotide bases. These mutations can cause frameshifts, altering the reading frame of the gene and potentially leading to nonfunctional proteins. The severity of effects depends on the mutation size and location.

Other Mutation Types

Additional mutation types include:

- **Duplication:** A segment of DNA is duplicated, increasing gene copy number.
- **Inversion:** A DNA segment is reversed within the chromosome.
- **Translocation:** DNA segments are rearranged between nonhomologous chromosomes.

Biological Implications of Gene Mutations

The impact of gene mutations on an organism ranges from neutral to deleterious or beneficial. Understanding these implications is essential for fields such as medicine, agriculture, and evolutionary biology. Gene mutation POGIL activities help students analyze mutation effects and relate them to biological outcomes.

Effects on Protein Function

Mutations can alter the amino acid sequence of proteins, affecting their structure and function. Some mutations may impair enzymatic activity, disrupt cellular pathways, or lead to loss of function. Conversely, certain mutations can enhance protein function or confer new capabilities.

Genetic Disorders and Diseases

Many inherited diseases arise from gene mutations that disrupt normal gene function. Examples include cystic fibrosis, sickle cell anemia, and Huntington's disease. Gene mutation POGIL exercises often incorporate case studies to illustrate how specific mutations cause disease phenotypes.

Role in Evolution and Adaptation

Beneficial mutations contribute to evolutionary processes by providing genetic variation on which natural selection acts. Adaptive mutations may enhance survival or reproduction under particular environmental conditions. Understanding mutation-driven evolution is a key learning outcome of gene mutation POGIL modules.

Implementing Gene Mutation POGIL Activities

Successful implementation of gene mutation POGIL requires well-designed materials and effective facilitation. Educators must create activities that balance content knowledge with process skill development. This section outlines best practices for designing and conducting gene mutation POGIL sessions.

Designing Effective POGIL Materials

Materials should include clear learning objectives, relevant data sets, and scaffolded questions that promote inquiry. Examples include DNA sequence analyses, mutation impact predictions, and model-building exercises. Materials must encourage collaboration and critical thinking.

Facilitating Student Engagement

Instructors play a critical role in guiding discussions, prompting deeper analysis, and ensuring

equitable participation. Effective facilitation supports student autonomy while providing necessary support to overcome conceptual challenges.

Assessment Strategies

Assessment of gene mutation POGIL activities can include formative quizzes, group presentations, and written reflections. Evaluations should measure both content understanding and process skills such as data interpretation and reasoning.

Benefits of Gene Mutation POGIL in Learning

Using POGIL for gene mutation topics offers multiple educational advantages. This approach enhances student engagement, promotes deeper understanding, and builds transferable scientific skills.

Enhanced Conceptual Understanding

Active inquiry helps students internalize complex genetic concepts by applying knowledge rather than memorizing facts. This leads to improved retention and ability to solve novel problems.

Development of Scientific Skills

POGIL fosters critical thinking, collaboration, and communication skills essential for scientific literacy. Students learn to analyze data, construct arguments, and work effectively in teams.

Increased Motivation and Confidence

Participating in guided inquiry boosts student motivation and confidence in their ability to tackle

challenging material. The collaborative environment supports peer learning and reduces anxiety.

Frequently Asked Questions

What is gene mutation in the context of POGIL activities?

Gene mutation refers to a change in the nucleotide sequence of a gene, which can affect the structure and function of the resulting protein. In POGIL (Process Oriented Guided Inquiry Learning) activities, students explore gene mutations to understand how these changes impact genetic information and biological processes.

How do POGIL activities help students understand different types of gene mutations?

POGIL activities use guided inquiry and collaborative learning to help students identify and differentiate between types of gene mutations such as point mutations, insertions, deletions, and frameshift mutations. This hands-on approach encourages critical thinking and deeper comprehension of mutation effects on protein synthesis.

Why is understanding gene mutations important in genetics education?

Understanding gene mutations is crucial because mutations are the source of genetic variation and can lead to diseases or evolutionary changes. In genetics education, particularly through POGIL, students learn how mutations alter DNA sequences and influence traits, which helps them grasp fundamental biological concepts.

Can POGIL activities demonstrate the effects of silent, missense, and nonsense mutations?

Yes, POGIL activities often include scenarios or models where students analyze DNA sequences to identify silent, missense, and nonsense mutations. Through this process, students learn how different

mutations can either have no effect, change a single amino acid, or create a premature stop codon affecting protein function.

How do frameshift mutations differ from point mutations in gene mutation POGIL exercises?

Frameshift mutations involve insertions or deletions that shift the reading frame of the genetic code, often resulting in significant changes to the protein. Point mutations change a single nucleotide without shifting the reading frame. POGIL exercises help students visualize these differences and their consequences on gene expression.

What role do POGIL activities play in teaching the impact of gene mutations on protein synthesis?

POGIL activities engage students in analyzing how gene mutations affect transcription and translation processes. By working through guided questions and models, students discover how mutations can alter mRNA codons and ultimately change the amino acid sequence of proteins, impacting their structure and function.

How can POGIL enhance understanding of genetic diseases caused by gene mutations?

POGIL can enhance understanding by providing case studies and problem-solving tasks related to genetic diseases caused by specific gene mutations. This active learning approach encourages students to connect molecular changes to phenotypic outcomes, improving their ability to apply genetic concepts to real-world contexts.

Additional Resources

1. *Gene Mutation and Molecular Genetics: A POGIL Approach*
This book offers an interactive learning experience focused on gene mutation concepts using the

POGIL (Process Oriented Guided Inquiry Learning) methodology. It encourages students to explore the mechanisms of mutations, their types, and their effects on genetic information. Through guided inquiry, learners develop a deeper understanding of molecular genetics and mutation processes.

2. *Exploring Gene Mutations: POGIL Activities for Biology Students*
Designed for high school and undergraduate students, this collection of POGIL activities covers the fundamentals of gene mutations. It emphasizes critical thinking and collaborative problem-solving to help students grasp mutation causes, DNA repair, and genetic variation. The book includes real-world examples to connect theory with practical applications.

3. *Mutation Mechanisms and Genetic Variation: A Guided Inquiry Approach*
This text delves into the biochemical and molecular bases of mutations, using POGIL worksheets to facilitate active learning. Students investigate spontaneous and induced mutations, their roles in evolution, and the consequences for organisms. The inquiry-based format promotes engagement and retention of complex genetic concepts.

4. *POGIL in Genetics: Understanding Mutations and Their Impact*
Focusing on the role of mutations in genetics, this resource uses POGIL strategies to help students analyze mutation types, detection methods, and phenotypic outcomes. It integrates data interpretation and experimental design to reinforce scientific reasoning. The book is ideal for instructors seeking to enhance genetics curricula.

5. *Interactive Learning in Molecular Biology: Gene Mutation Modules*
This book presents a series of interactive modules centered on gene mutations and molecular biology principles. Using POGIL techniques, it guides students through DNA replication errors, mutagens, and genetic disorders caused by mutations. The modules are designed to foster collaborative learning and scientific inquiry.

6. *Genetic Mutations and Disease: A POGIL-Based Study Guide*
Targeted at students studying medical genetics, this guide uses POGIL activities to explore how mutations contribute to genetic diseases. It covers mutation types, inheritance patterns, and diagnostic

approaches. The inquiry-based format helps learners connect molecular changes to clinical outcomes.

7. *Mutation and Evolution: A Process-Oriented Guided Inquiry Learning Text*
This text links gene mutations to evolutionary processes through POGIL exercises that promote conceptual understanding and application. Students examine mutation rates, natural selection, and genetic drift within populations. The book encourages critical thinking about the dynamic nature of genomes.

8. *Teaching Gene Mutation Concepts with POGIL Techniques*
A practical resource for educators, this book provides lesson plans and activities focused on gene mutation concepts using POGIL methods. It emphasizes student-centered learning and includes assessment tools to measure understanding. The book supports effective instruction in biology and genetics courses.

9. *Applied Genetics: Mutation and Repair POGIL Workbook*
This workbook offers hands-on POGIL activities related to mutation processes and DNA repair mechanisms. Students engage in problem-solving tasks that illustrate mutation consequences and cellular responses. The workbook is designed to reinforce theoretical knowledge through active participation.

Gene Mutation Pogil

Gene Mutation POGIL Activities: A Guide to Understanding Genetic Variation

Name: Unlocking the Secrets of Genes: A POGIL Approach to Gene Mutations

Outline:

Introduction: What are gene mutations? Why study them? Introducing POGIL methodology.
Chapter 1: Types of Gene Mutations: Point mutations (substitutions, insertions, deletions), frameshift mutations, chromosomal mutations. Illustrative examples and POGIL activities.

Chapter 2: Causes of Gene Mutations: Spontaneous mutations, induced mutations (mutagens: radiation, chemicals), germline vs. somatic mutations. POGIL activities focused on causal mechanisms.
Chapter 3: Effects of Gene Mutations: Silent mutations, missense mutations, nonsense mutations, consequences for protein structure and function. POGIL activities exploring phenotypic effects.
Chapter 4: Repair Mechanisms: DNA repair pathways (mismatch repair, excision repair), their importance in preventing mutations and disease. POGIL activities simulating repair processes.
Chapter 5: Gene Mutations and Human Disease: Examples of diseases caused by gene mutations (cystic fibrosis, sickle cell anemia, Huntington's disease). PGIOL activities linking genotypes to phenotypes.
Chapter 6: Gene Mutations and Evolution: The role of mutations in genetic variation and adaptation. POGIL activities exploring evolutionary consequences.
Conclusion: Recap of key concepts, future directions in mutation research, and the importance of understanding gene mutations.

Unlocking the Secrets of Genes: A POGIL Approach to Gene Mutations

Introduction: Delving into the World of Gene Mutations

Gene mutations, the alterations in the DNA sequence of an organism's genome, are fundamental to the processes of evolution, adaptation, and disease. Understanding gene mutations is crucial for comprehending the diversity of life, the mechanisms of inheritance, and the development of various genetic disorders. This guide utilizes the Process-Oriented Guided-Inquiry Learning (POGIL) methodology to provide a dynamic and engaging approach to learning about gene mutations. POGIL activities encourage collaborative learning, critical thinking, and problem-solving, fostering a deeper understanding of this complex topic. We will explore the different types of gene mutations, their causes, effects, repair mechanisms, and their significance in human health and evolution.

Chapter 1: Exploring the Diverse Landscape of Gene Mutations

Gene mutations can be broadly classified into two main categories: point mutations and chromosomal mutations. Point mutations, also known as gene mutations, involve changes in a single nucleotide or a small number of nucleotides within a gene. These can further be subdivided into:

Substitutions: One nucleotide is replaced by another. This can lead to a silent mutation (no change in amino acid sequence), a missense mutation (change in one amino acid), or a nonsense mutation

(premature stop codon).
Insertions: One or more nucleotides are added to the DNA sequence.
Deletions: One or more nucleotides are removed from the DNA sequence.

Frameshift mutations, caused by insertions or deletions that are not multiples of three nucleotides, drastically alter the reading frame of the gene, resulting in a completely different amino acid sequence downstream from the mutation. This often leads to non-functional proteins.

Chromosomal mutations, on the other hand, involve larger-scale changes affecting entire chromosomes or significant portions of them. These include:

Deletions: Loss of a chromosomal segment.
Duplications: Repetition of a chromosomal segment.
Inversions: Reversal of a chromosomal segment.
Translocations: Movement of a chromosomal segment to a non-homologous chromosome.

POGIL activities in this chapter will focus on analyzing DNA sequences with different types of mutations, predicting the resulting amino acid sequences, and discussing the potential consequences of these mutations on protein function.

Chapter 2: Unraveling the Origins of Gene Mutations

Gene mutations can arise spontaneously through errors during DNA replication or be induced by external factors known as mutagens. Spontaneous mutations are random changes in the DNA sequence that occur without any external influence. These errors can result from DNA polymerase misincorporating nucleotides during replication or from spontaneous chemical changes in the DNA bases.

Induced mutations are caused by mutagens, which are physical or chemical agents that damage DNA and increase the mutation rate. Examples of mutagens include:

Radiation: UV radiation, X-rays, and gamma rays can cause DNA damage, including the formation of thymine dimers.
Chemicals: Certain chemicals, such as benzopyrene (found in cigarette smoke) and aflatoxin (produced by certain fungi), can directly interact with DNA and cause mutations.

It is crucial to differentiate between germline mutations, which occur in germ cells (sperm and eggs) and are heritable, and somatic mutations, which occur in somatic cells (body cells) and are not passed on to offspring. Somatic mutations can contribute to the development of cancer. POGIL activities in this chapter will involve analyzing scenarios involving different mutagens and predicting the types of mutations they might cause.

Chapter 3: Assessing the Impact of Gene Mutations on Protein Function

The effects of gene mutations on protein function vary greatly depending on the type and location of the mutation. As mentioned earlier, point mutations can be silent, missense, or nonsense.

Silent mutations have no effect on the amino acid sequence because the changed codon codes for the same amino acid.
Missense mutations result in a change in a single amino acid. The effect of this change depends on the location and properties of the amino acid involved. It can range from no significant effect to a complete loss of protein function.
Nonsense mutations introduce a premature stop codon, resulting in a truncated and usually non-functional protein.

Frameshift mutations and chromosomal mutations often have more severe consequences, leading to significant alterations in protein structure and function. POGIL activities in this chapter will involve analyzing the effects of different mutations on protein structure and function using protein modeling software or 3D models.

Chapter 4: The Cellular Defense System: DNA Repair Mechanisms

Cells have evolved sophisticated DNA repair mechanisms to correct errors in their DNA and prevent mutations from accumulating. These mechanisms include:

Mismatch repair: Corrects errors that occur during DNA replication.
Base excision repair: Removes damaged or modified bases.
Nucleotide excision repair: Removes larger DNA lesions, such as thymine dimers.

Defects in DNA repair pathways can increase the risk of mutations and contribute to the development of genetic disorders and cancer. POGIL activities in this chapter will involve simulating DNA repair processes and analyzing the consequences of defects in these pathways.

Chapter 5: The Link Between Gene Mutations and Human Disease

Many human diseases are caused by gene mutations. Examples include:

Cystic fibrosis: Caused by mutations in the CFTR gene, leading to defective chloride ion transport in cells.
Sickle cell anemia: Caused by a mutation in the beta-globin gene, resulting in abnormal hemoglobin.
Huntington's disease: Caused by a trinucleotide repeat expansion in the HTT gene, leading to the accumulation of a toxic protein.

POGIL activities in this chapter will involve analyzing case studies of human genetic diseases, linking specific gene mutations to their phenotypic effects, and exploring different diagnostic and therapeutic approaches.

Chapter 6: Gene Mutations: The Driving Force of Evolution

Gene mutations are the ultimate source of genetic variation within populations. This variation provides the raw material for natural selection to act upon, driving evolutionary change. Beneficial mutations can increase an organism's fitness, increasing its chances of survival and reproduction. Neutral mutations have no significant effect on fitness, while deleterious mutations decrease fitness. POGIL activities in this chapter will explore how mutations contribute to genetic diversity and adaptation in populations, using simulations and real-world examples.

Conclusion: A Continuing Journey of Discovery

Understanding gene mutations is crucial for advancing our knowledge in various fields, including medicine, genetics, and evolutionary biology. This guide has provided a comprehensive overview of gene mutations, utilizing the POGIL methodology to enhance learning and comprehension. Further research is needed to fully understand the complex interplay between gene mutations, environmental factors, and human health. The development of new gene editing technologies, such as CRISPR-Cas9, offers exciting possibilities for correcting gene mutations and treating genetic diseases.

FAQs

1. What is the difference between a germline mutation and a somatic mutation? Germline mutations are heritable and occur in germ cells, while somatic mutations are not heritable and occur in

somatic cells.

2. What are some common mutagens? UV radiation, X-rays, certain chemicals (e.g., benzopyrene, aflatoxin).

3. What are the three main types of point mutations? Substitutions, insertions, and deletions.

4. What is a frameshift mutation? A mutation caused by insertion or deletion of nucleotides that is not a multiple of three, shifting the reading frame.

5. How do DNA repair mechanisms work? They correct errors in DNA sequences through various pathways like mismatch repair, base excision repair, and nucleotide excision repair.

6. What are some examples of diseases caused by gene mutations? Cystic fibrosis, sickle cell anemia, Huntington's disease.

7. What is the role of mutations in evolution? Mutations provide the raw material for genetic variation, upon which natural selection acts.

8. How can gene mutations be detected? Through various methods like DNA sequencing, karyotyping, and genetic testing.

9. What are some future directions in mutation research? Further development of gene editing technologies and a deeper understanding of the interplay between genes, environment, and disease.

Related Articles:

1. DNA Replication and Repair Mechanisms: A detailed explanation of the cellular processes involved in maintaining genome integrity.

2. The Human Genome Project and its Impact: How the mapping of the human genome has advanced our understanding of genetic diseases.

3. Genetic Screening and Counseling: Information on different genetic testing methods and the counseling services available to individuals with genetic risk factors.

4. Gene Therapy: Current Advances and Future Prospects: An overview of gene therapy techniques and their potential for treating genetic diseases.

5. Cancer Genetics and Epigenetics: Exploration of the genetic and epigenetic factors involved in cancer development.

6. Evolutionary Genetics and the Modern Synthesis: The role of mutations in driving evolutionary change and the integration of genetics into evolutionary theory.

7. Population Genetics and Hardy-Weinberg Equilibrium: Understanding the principles of population genetics and the factors that can disrupt genetic equilibrium.

8. CRISPR-Cas9 Gene Editing Technology: A detailed explanation of this powerful gene editing tool and its applications.

9. Understanding Mendelian Inheritance Patterns: The basic principles of inheritance and how genes are passed from parents to offspring.

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gene mutation pogil: Adapted Primary Literature Anat Yarden, Stephen P. Norris, Linda M. Phillips, 2015-03-16 This book specifies the foundation for Adapted Primary Literature (APL), a novel text genre that enables the learning and teaching of science using research articles that were adapted to the knowledge level of high-school students. More than 50 years ago, J.J. Schwab

suggested that Primary Scientific Articles “afford the most authentic, unretouched specimens of enquiry that we can obtain” and raised for the first time the idea that such articles can be used for “enquiry into enquiry”. This book, the first to be published on this topic, presents the realization of this vision and shows how the reading and writing of scientific articles can be used for inquiry learning and teaching. It provides the origins and theory of APL and examines the concept and its importance. It outlines a detailed description of creating and using APL and provides examples for the use of the enactment of APL in classes, as well as descriptions of possible future prospects for the implementation of APL. Altogether, the book lays the foundations for the use of this authentic text genre for the learning and teaching of science in secondary schools.

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clarifying this complex subject by focusing on the big picture of genetics concepts. The new edition features an emphasis on problem-solving and relevant applications, while incorporating the latest trends in genetics research.

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systems and mission equipment; an analysis of current plans for radiation protection; and a strategy for mitigating the risks to VSE astronauts.

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gene mutation pogil: Botany Illustrated Janice Glimn-Lacy, Peter B. Kaufman, 2012-12-06 This is a discovery book about plants. It is for students In the first section, introduction to plants, there are sev of botany and botanical illustration and everyone inter eral sources for various types of drawings. Hypotheti ested in plants. Here is an opportunity to browse and cal diagrams show cells, organelles, chromosomes, the choose subjects of personal inter. est, to see and learn plant body indicating tissue systems and experiments about plants as they are described. By adding color to with plants, and flower placentation and reproductive the drawings, plant structures become more apparent structures. For example, there is no average or stan and show how they function in life.

The color code dard-looking flower; so to clearly show the parts of a clues tell how to color for definition and an illusion of flower (see 27), a diagram shows a stretched out and depth. For more information, the text explains the illus exaggerated version of a pink (Dianthus) flower (see trations. The size of the drawings in relation to the true 87). A basswood (Tifia) flower is the basis for diagrams size of the structures is indicated by X 1 (the same size) of flower types and ovary positions (see 28). Another to X 3000 (enlargement from true size) and X n/n source for drawings is the use of prepared microscope (reduction from true size). slides of actual plant tissues.

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gene mutation pogil: *Biochemistry Education* Assistant Teaching Professor Department of Chemistry and Biochemistry Thomas J Bussey, Timothy J. Bussey, Kimberly Linenberger Cortes, Rodney C. Austin, 2021-01-18 This volume brings together resources from the networks and communities that contribute to biochemistry education. Projects, authors, and practitioners from the American Chemical Society (ACS), American Society of Biochemistry and Molecular Biology

(ASBMB), and the Society for the Advancement of Biology Education Research (SABER) are included to facilitate cross-talk among these communities. Authors offer diverse perspectives on pedagogy, and chapters focus on topics such as the development of visual literacy, pedagogies and practices, and implementation.

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