Genomics in Action

Implementation Guide for Faculty

Contents

About *Genomics in Action*

Genomics in Action is an educational initiative in partnership between The Jackson Laboratory, the Connecticut State College and University (CSCU) system, and faculty collaborators at CT State Community College. It has been funded through a grant from the National Human Genome Research Institute (5R25HG013493). The overall objective of *Genomics in Action* is to enhance the training and education of undergraduates to prepare them for entry into the biomedical workforce.

To achieve that goal, the *Genomics in Action* team has developed thirteen high-quality online MiniCourses on topics related to human genomics that can be integrated into existing courses and curricula.

How to Use This Guide

This implementation guide is designed to help you identify, select, and integrate *Genomics in Action* MiniCourses into your classes. The guide is organized to take you from a broad overview to specific details:

- **MiniCourse Structure** explains what a MiniCourse looks like and how students will experience it.
- **MiniCourses at a Glance** gives you a snapshot of all thirteen MiniCourses at a glance so you can quickly identify modules relevant to your course.
- **MiniCourse Details** provides the full learning outcomes, faculty implementation suggestions, student-facing descriptions, and direct access links for each module.
- **CT State Alumni Science Influencers** introduces the video content featuring alumni who connect coursework to career paths.
- **Getting Started: LMS Integration** walks you through how to add MiniCourses to your learning management system, including a ready-to-use assignment template.

We recommend starting with MiniCourses at a Glance to find the modules that align with your course, then reading the detailed entries for those specific MiniCourses.

We hope the *Genomics in Action* modules elevate student learning in your classes and help to connect concepts in human genomics to real-world experiences. Should you have any questions about the content in the MiniCourses, please don't hesitate to reach out to our team at genomics_in_action@jax.org.

MiniCourse Structure

Every MiniCourse follows a consistent basic structure, so that students know what to expect. Each MiniCourse contains the following components:

- **Getting Started (5 min):** An introduction that orients students to the topic and sets up the learning context and technical requirements.
- **Core Lessons (~45 min):** Content lessons that introduce key concepts contextualized within a story or scenario. Each core lesson is designed to take about 10-15 minutes to complete and concludes with a Diving Deeper section where students apply their knowledge to new scenarios or discussions.
- **Learn More/Explore Career Paths (Optional):** Additional resources and short videos of the science influencers explaining more about their education, their career path, how they overcame hurdles, and what they love about their current job in biotechnology or healthcare.
- **Finishing Up (5 min):** A brief survey, instructions on how to access the certificate, and references.

MiniCourses at a Glance

The table below lists all thirteen MiniCourses organized by theme. Use it to quickly identify which modules align with the courses you teach. Select a MiniCourse title to jump to the detailed learning outcomes and implementation strategies.

MiniCourse	Theme	Suggested Course(s)
Types of Variation: Germline or Somatic	Types of Genomic Variation	Intro / General Biology; Genetics
Beyond the DNA Code: Epigenetics	Types of Genomic Variation	Intro / General Biology; Genetics; Molecular Biology
What is Next Generation Sequencing?	DNA Sequencing Technologies	General Biology
Sequencing Analysis: DNA and Beyond	DNA Sequencing Technologies	Biology for Majors; Biochemistry; Genetics; Molecular Biology
Genomic Sequencing in the Clinic	DNA Sequencing Technologies	General Biology; Genetics
Precision Medicine in Cancer Therapy	Genomic-Based Therapies	General Biology; Genetics; Human Biology

CRISPR as a Genomic Therapy	Genomic-Based Therapies	General Biology; Biotechnology; Genetics; Molecular Genetics
Exploring Genomic Data: Terminology and Tools	Genomic Data	General Biology; Biochemistry; Molecular Biology; Independent Research
Genomic Data: Playing FAIR	Genomic Data	General Biology; Genetics; Molecular Biology
CRISPR Ethics	Ethical, Legal, Social Implications of Genomics Research	General Biology; Genetics; Molecular Biology
Genetic Information Nondiscrimination Act (GINA)	Ethical, Legal, Social Implications of Genomics Research	General Biology; Genetics
Identifying Ancestry Through Genomics: How Does It Work?	Distinctions Between Ancestry and Race	General Biology; Genetics; Molecular Biology
Human Genomic Variation: Race, Ancestry, and Skin Color	Distinctions Between Ancestry and Race	General Biology; Genetics; Human Biology

MiniCourse Details: Learning Outcomes & Implementation Strategies

This section provides the complete learning outcomes, student-facing descriptions, direct access links, and implementation strategies for each MiniCourse. Implementation suggestions come from faculty partners who have successfully adopted the MiniCourses in their classes.

Types of Variation: Germline or Somatic

Are all genetic conditions and diseases inherited? Not always! While humans inherit their genomes from their parents, it is possible to acquire genomic variants later in life. There are some key differences in how inherited and non-inherited gene variants arise and persist in the genome. In this module, students learn more about these differences and how each type of genomic variation contributes to human health and disease.

Access This MiniCourse: https://education.learning.jax.org/gia-types-of-variation

Overall Learning Outcome: Distinguish between germline and somatic variants.

Core Lesson Learning Outcomes

- **Germline and Somatic Variants:** Outline the defining features of germline and somatic variants.
- **Genetic Predisposition:** Compare and contrast how germline and somatic variants contribute to the development of disease.
- **Case Study – Inherited or Not?** Determine if a cancer is likely to be associated with a germline variant.

Implementation Strategies From Faculty Partners

- Assign as independent learning/homework in your LMS for a General Biology or Genetics course.

Beyond the DNA Code: Epigenetics

Why don't identical twins always look exactly alike? If they share the same DNA, shouldn't they be perfect copies of each other? Part of the answer lies in epigenetics! Students explore the epigenetic code—the code beyond the DNA sequence—and discover how it contributes to changes in gene expression that have a pronounced effect on everything from physical traits to disease risk.

Access This MiniCourse: https://education.learning.jax.org/gia-beyond-the-dna-code-epigenetics

Overall Learning Outcome: Interpret how epigenetic modifications affect gene expression and phenotype.

Core Lesson Learning Outcomes

- **Same Genes, Different Expression:** Summarize how gene expression differences lead to different phenotypes.
- **What is Epigenetics?** Identify the molecular elements involved in epigenetics; and evaluate how epigenetic marks lead to change in gene expression.
- **What Shapes the Epigenome?** Relate how changes in the environment can influence epigenetics and the expression of genes.

Implementation Strategies From Faculty Partners

- Assign the core lesson *What is Epigenetics?* in an Introductory Biology, General Biology, or Human Biology course as a pre-assignment completed outside of class.
- Assign to a General Biology, Genetics, or Molecular Biology course as homework or classwork. Consider assigning it as homework due after the next class so students can begin independently and ask questions during class. Some parts of this MiniCourse may need instructor-led explanation to support student understanding.

What Is Next Generation Sequencing?

Have you ever wondered how researchers gather genetic and genomic data, like DNA and RNA sequences? In this module, students discover different sequencing techniques, learn about their applications, and help a researcher decide which technique is right for their project.

Access This MiniCourse: https://education.learning.jax.org/gia-what-is-next-generation-sequencing

Overall Learning Outcome: Distinguish between the features of NGS and other sequencing methods.

Core Lesson Learning Outcomes

- **Sequencing Basics:** Define Sanger and Next Generation Sequencing (NGS) technologies.
- **Choosing a Sequencing Technology:** Evaluate sequencing technologies and select the best technique for a particular research scenario.

Implementation Strategies From Faculty Partners

- Assign to General Biology students during a unit on biotechnology and/or genome structure and function. Assign as independent learning/homework with a follow-up in-class activity to support mastery.

Sequencing Analysis: DNA and Beyond

There are several different sequencing techniques that can be utilized to obtain genomic information. But once you have data visualizations from a sequencing experiment, how do you identify important features like DNA variants or gene expression? In this module, students practice interpreting three common visualizations from sequencing experiments: chromatograms, Manhattan plots, and volcano plots.

Access This MiniCourse: https://education.learning.jax.org/gia-sequencing-analysis-dna-and-beyond

Overall Learning Outcome: Analyze the major features of common visual outputs from sequencing technologies.

Core Lesson Learning Outcomes

- **Identifying DNA Variants Using Sanger Sequencing:** Evaluate key components of a Sanger sequencing chromatogram and analyze a chromatogram to identify a genotype.
- **Analyzing NGS Data:** Identify the purpose of a Genome Wide Association Study (GWAS) and interpret the primary elements of a Manhattan plot.
- **RNA Sequencing:** Identify the purpose of an RNA Sequencing study and analyze the major features of a volcano plot.

Implementation Strategies From Faculty Partners

- Assign as an in-class activity for Biology majors and/or Biochemistry courses, as students may need support analyzing the graphs and/or understanding p-values. This MiniCourse is likely not appropriate for an Introductory Biology class.
- This MiniCourse can be completed in a lab period along with the MiniCourse *Exploring Genomic Data: Terminology and Tools*. Afterward, students can analyze a sequence using the tools covered in both MiniCourses.
- Assign as homework or pre-lab assignment for a Genetics or Molecular Biology course. Consider excluding Whole Genome Analysis and RNA Sequence Analysis, which may be too detailed and beyond the scope of the courses.

Genomic Sequencing in the Clinic

In this module, students explore three powerful genomic technologies at the heart of modern medicine: targeted gene panels, whole exome sequencing (WES), and whole genome sequencing (WGS). Students learn what each method examines, how they differ, and why one might be chosen over the other in real-world medical scenarios.

Access This MiniCourse: https://education.learning.jax.org/gia-genomic-sequencing-in-the-clinic

Overall Learning Outcome: Distinguish between targeted gene panels, whole genome, and exome sequencing approaches.

Core Lesson Learning Outcomes

- **The Power of Genomic Testing in the Clinic:** Differentiate among the types of variants detectable through genomic sequencing, evaluate the evidence used to classify a DNA variant as clinically significant, and define the utility of genomic testing in medicine and disease diagnosis.
- **Genomic Testing Options in the Clinic:** Define targeted gene panels, whole exome sequencing, and whole genome sequencing and distinguish how each of these sequencing technologies examine different parts of the genome.
- **How Genomic Sequencing Works:** Outline the process of Next-generation sequencing; and compare and contrast the specific protocol steps that allow whole genome sequencing, whole exome sequencing, and targeted gene panels to investigate different genomic regions.
- **Choosing the Right Sequencing Approach in Patient Care:** Evaluate the key differences between targeted gene panels, WES, and WGS, including their strengths, weaknesses, and appropriate applications in clinical scenarios.

No Particular Implementation Strategies From Faculty Partners

Precision Medicine in Cancer Therapy

Precision medicine therapies leverage the power of genomics to treat cancer. How do they differ from traditional therapies, and how do they work? In this module, students explore biomarker testing, immunotherapies, and targeted therapies for cancer treatment.

Access This MiniCourse: https://education.learning.jax.org/gia-precision-medicine-in-cancer-therapy

Overall Learning Outcome: Evaluate how genomic data can be used to guide patient treatment.

Core Lesson Learning Outcomes

- **What is Precision Medicine?** Define the characteristics of cancer that make it a genetic disease and compare and contrast precision medicine and non-targeted therapies.
- **Biomarker Testing in the Cancer Clinic:** Identify common biomarkers and analyze how they can be used to inform cancer treatment and disease monitoring.
- **Fighting Cancer With Precision Medicine:** Targeted and Immune-Based Therapies: Distinguish between targeted therapies and immunotherapies and outline how they are used to treat cancer.

Implementation Strategies From Faculty Partners

- The content is suitable for students in General Biology, Genetics, and Human Biology courses. There are sufficient contextual clues to help students with basic knowledge to understand the topics explored in the module.
- Assign the full module in a Genetics course as a formative assessment to be completed outside of class.
- In General Biology, assign the *Precision Medicine in the Cancer Clinic* core lesson as an in-class activity following a discussion of cell signaling. This would provide real-world application of the signaling process and the mechanisms used to target signaling pathways in cancer cells. When teaching receptor tyrosine kinase signaling, the discussion of abnormalities in cancer cells and targeted therapies includes both small molecule inhibitors and monoclonal antibodies, both discussed in this MiniCourse.
- Assign in General Biology when starting a unit on DNA repair mechanisms. The MMR section is an effective way to help students understand how repair mechanisms can be examined for medicinal purposes. This could be assigned as homework so students can progress on their own with the lecture as a foundation. The module could also be an excellent starting point for further discussions on the medical relevance of these foundational concepts.
- The *What is Precision Medicine?* core lesson could be assigned as homework in a Human Biology course. Both the core lessons *What is Precision Medicine?* and *Precision Medicine in the Cancer Clinic* are appropriate for General Biology. All core lessons plus the *Diving Deeper* could be used in a Genetics course.

CRISPR as a Genomic Therapy

Can genetic diseases be cured by editing the human genome? This module covers how CRISPR/Cas9 technologies work to edit DNA sequences, how these systems are being used to develop therapies to treat genetic diseases, and the existing limitations for use of these therapies in the clinic.

Access This MiniCourse: https://education.learning.jax.org/gia-crispr-as-a-genomic-therapy

Overall Learning Outcome: Evaluate strategies for using CRISPR to treat a genetic disease.

Core Lesson Learning Outcomes

- **What is CRISPR?** Define the basic components of the CRISPR/Cas9 system required to edit the genome.
- **CRISPR as a Genomic Therapy:** Analyze advantages and limitations of using CRISPR/Cas9 to treat human genetic diseases.

Implementation Strategies From Faculty Partners

- Assign in a General Biology, Biotechnology, or Genetics course as a homework assignment in conjunction with readings on CRISPR/Cas9. This MiniCourse can serve as a preparatory assignment before any CRISPR/Cas9 application activities.
- Assign in a Molecular Genetics course as homework followed by an in-class discussion. This MiniCourse can be divided due to the level of technical detail; part can be assigned as homework for a lecture and part as homework for a lab activity.

Exploring Genomic Data: Terminology and Tools

Biomedical research generates large quantities of data on a daily basis. This is particularly true in the field of genomics. To study genomes, it is necessary to understand how genomes and their associated information are stored and organized in web-based databases. In this module, students learn about genomic data and the tools used to analyze it.

Access This MiniCourse: https://education.learning.jax.org/gia-exploring-genomic-data-terminology-and-tools

Overall Learning Outcome: Use the vocabulary associated with genomics data and apply the basics principles of gene annotation and alignment.

Core Lesson & Learning Outcomes

- **What is Genomic Data?** Define the features of mouse and human genomes and identify how biomolecules are presented as genomic data structures.
- **How do we use Genomic Databases?** Conduct a search on the genomic databases Ensembl, NCBI, and UCSC.
- **Doing a Sequence Alignment:** Identify how sequence alignment is used in genomics research and perform a sequence alignment using the online BLAST tool.

Implementation Strategies From Faculty Partners

- Assign this in a General Biology and/or Biochemistry course. This module is particularly relevant at the start of a research-based lab project that requires students to design primers to amplify regions of genomic DNA.
- Databases can be intimidating, so consider assigning this MiniCourse as homework and then reviewing it in class, allowing students to receive real time support as they are navigating these sites.
- Assign in a Molecular Biology or Genetics course, or in an Independent Research course as homework, and then review or discuss in class.

Genomic Data: Playing FAIR

Scientists create an enormous amount of genomic data each year, but data by itself isn't very useful to the research community unless it is properly managed. How can scientists efficiently and effectively use this existing data to help develop the treatments of the future? FAIR Data Principles are here to help!

Access This MiniCourse: https://education.learning.jax.org/gia-genomic-data-playing-fair

Overall Learning Outcome: Define FAIR Data Principles, identity how FAIR Data Principles apply to genomic data, and analyze the characteristics of data that has been stored and shared using the FAIR Data Principles.

Core Lesson Learning Outcomes

- **The What and Why of FAIR Data:** Identify what "FAIR" stands for and outline how FAIR Data Principles make it easier to reuse genetic and genomic data.
- **Making Data FAIR:** Outline the characteristics that make data Findable, Accessible, Interoperable, and Reusable.

Implementation Strategies From Faculty Partners

- A suggestion for a group assignment utilizing the FAIR data principles taught in this MiniCourse: After completing the MiniCourse, arrange students into groups, and assign each group a gene name (one that is a slight challenge to identify by acronym) along with a few hints about function. Have students use the NCBI database to find their assigned gene and identify how the FAIR data principles are used in relation to that particular gene. Then students perform a literature search for the gene by the acronym and then by the unique identifier to compare and contrast the search results.

CRISPR Ethics

CRISPR therapy is changing medicine, offering new treatment avenues for genetic conditions. Like the science, the ethical questions raised by these developments are complex. This module explores the ethical issues around the uses of CRISPR technology.

Access This MiniCourse: https://education.learning.jax.org/gia-crispr-ethics

Overall Learning Outcome: Evaluate the ethical concerns of using CRISPR for gene editing.

Core Lesson Learning Outcomes

- **What Is a Valid Edit?** Compare and contrast therapeutic and enhancement applications of CRISPR, distinguish between the medical and social models of disability, and analyze ethical concerns about what constitutes a valid edit.
- **The Ethics of Access:** Evaluate the ethical implications around access and affordability of CRISPR gene editing.
- **Ethics of Altering the Germline:** Identify key terms related to safety and risk assessment for CRISPR therapy, outline the complexities of informed consent, and analyze moral and cultural considerations of using CRISPR to edit embryos.
- **CRISPR in the Environment:** Analyze ways that CRISPR can change ecosystems.

Implementation Suggestions From Faculty Partners

- In a Genetics or Molecular Biology course, assign all core lessons except *CRISPR in the Environment*. Assign core lesson *What Is a Valid Edit?* as homework, then use core lessons *The Ethics of Access and Ethics of Altering the Germline* as in-class discussions.
- Assign the *CRISPR in the Environment* core lesson in a General Biology course.
- This MiniCourse could be a homework assignment, with the *Diving Deeper* section completed in class as a group discussion activity.

Genetic Information Nondiscrimination Act (GINA)

Have you ever had a genetic test or thought about getting tested through a product like 23andMe or Ancestry? Are you concerned about the use of your genetic information by health insurers or employers? The Genetic Information Nondiscrimination Act (GINA) protects individuals against genetic discrimination. This module defines the terms used in the act and discusses the protections and limitations it provides.

Access This MiniCourse: https://education.learning.jax.org/gia-genetic-information-nondiscrimination-act-gina

Overall Learning Outcome: Define how the Genetic Information Nondiscrimination Act (GINA) protects genetic and genomic information in different settings and identify the limitations and exclusions of GINA.

Core Lesson Learning Outcome

- **Genetic Information Nondiscrimination Act (GINA):** Define the following terms with respect to GINA: genetic information, genetic discrimination, genetic testing, and genetic predisposition.
- **GINA in Employment:** Identify information that is covered under GINA and protected from use by an employer.
- **GINA in Health Insurance:** Identify health information that is protected by GINA and cannot be used by health insurance companies.

No Particular Implementation Strategies From Faculty Partners

Identifying Ancestry Through Genomics: How Does It Work?

Have you ever wondered how DNA testing can be used to determine ancestral origins? In this module, students learn how variations in DNA patterns are used to determine ancestry.

Access This MiniCourse: https://education.learning.jax.org/gia-identifying-ancestry-through-genomics-how-does-it-work

Overall Learning Outcome: Evaluate how genomic sequence analysis and comparisons to population reference sequences are used to determine ancestry.

Core Lesson Learning Outcome

- **Genetic Variation Makes Us Unique:** Define how human genetic variation can be used to determine ancestry.
- **Detecting SNP Variants Through Sequencing Technology:** Outline the process of SNP array genotyping and analyze the results.
- **Inferring Ancestry Using Reference Panels:** Summarize how reference panels are made and used to determine ancestry.

Implementation Suggestions From Faculty Partners

- Assign in a General Biology, Genetics, or Molecular Biology course as homework or as an in-class activity. As a homework assignment, this MiniCourse could be used in tandem with readings on ancestry DNA testing or on the application of SNP microarray technology. For in-class use, consider following sequence: assign the *Genetic Variation Makes Us Unique* core lesson after discussing genetic variability and SNPs, then use the *Detecting SNP Variants Through Sequencing Technology* core lesson to reinforce the interpretation of SNP microarray data. The *Inferring Ancestry Using Reference Panels* core lesson and the *Diving Deeper* sections could then be assigned as homework.
- Assign to General Biology as a pre-lab exercise to boost interest and engagement.
- This MiniCourse works well as homework before a class discussion about ancestry and SNPs. Students who have completed this type of testing may be eager to share their results and thoughts, which stimulate great discussion. In general, students have a hard time getting excited about SNPs, and this module could increase curiosity and engagement about the importance of non-coding DNA regions and the vast amount of information contained within them.

Human Genomic Variation: Race, Ancestry, and Skin Color

Do you know the difference between race, genetic ancestry, and skin color? This module introduces historical scientific ideas around race, the difference between race and genetic ancestry, the genetics of skin color, and the impact of social determinants of health. This exploration of human genomic variation demonstrates that there is no genetic evidence supporting a biological basis for race.

Access This MiniCourse: https://education.learning.jax.org/gia-human-genomic-variation-race-ancestry-and-skin-color

Overall Learning Outcome: Analyze race, ancestry, and skin color through historical, scientific, and social perspectives.

Core Lesson Learning Outcomes

- **Race and DNA:** The Science Over Time: Outline the historical evolution of dominant scientific ideas of race and define "race" based on scientific evidence.
- **Race Is not Ancestry:** Distinguish between ancestry and race
- **Biological Basis of Skin Color:** Identify the ecological and biological contributors to skin color phenotype.
- **Racial Health Disparities:** Analyze the sociopolitical factors that contribute to racial health disparities.

Implementation Strategies From Faculty Partners

- Assign the module in a General Biology, Genetics, or Human Biology course. Students can complete the MiniCourse in sections; assign one core lesson as homework, discuss it in class, then move on to the next.
- Assign in a General Biology course when talking about the interaction of genes and environment. This MiniCourse could be a homework assignment, with the *Diving Deeper* section completed in class as a group discussion activity.

CT State Alumni Science Influencers

The *Genomics in Action* team has developed video content featuring CT State alumni who have pursued a career in biotechnology or healthcare. In short videos, the alumni share their academic and career paths, discuss the skills they use in their jobs, and give advice to current students about ways to succeed in school or how to find job opportunities.

These videos are integrated into the **Learn More/Explore Career Paths** component of each MiniCourse. The following links connect you with the video series created for each alumna:

Ashley Gonzalez – CT State Middlesex
Ashley earned her AS in Biotechnology and now works at Hartford Hospital managing the Animal Husbandry Division. Ashley shares how she learned skills at CT State Middlesex that she uses now in her current job and how it's important to push yourself to try new things.

Ashley Johnson – CT State Northwestern
After a break from college, Ashley restarted her educational journey in STEM at CT State Northwestern and then went on to get a BS and MS in Biomolecular Sciences at Central Connecticut State University. She now works as a Laboratory Technician at LambdaVision.

Karissa Mennes – CT State Capital
Karissa earned her AS in Biotechnology and now works as a Research Technician at Enable Life Sciences. Karissa describes how she got into research while she was a student at CT State Capital, which led her to an internship at Harvard and her current job at Enable.

Nattily Singleton – CT State Housatonic
Realizing nursing wasn't for her, Nattily pursued a certification in Respiratory Therapy and now works at Children's Hospital of Philadelphia. Nattily gives advice on the importance of focus when facing challenging STEM courses and how gaining practical experience can influence career choice.

Getting Started: LMS Integration

There are two ways you can integrate *Genomics in Action* content into your LMS course:

- **Option 1:** Link to an open-access MiniCourse as a supplemental resource.
- **Option 2:** Use a MiniCourse as an assignment.

Option 1: Link to a MiniCourse as a Supplemental Resource

Using the links and descriptions in the Appendix, copy and paste the *Genomics in Action* MiniCourse of your choice into your course.

Option 2: Use a Minicourse as an Assignment

- Create an Assignment in your course.
- Name the Assignment to match the *Genomics in Action* MiniCourse you are using (e.g. "Types of Variation").
- Copy and paste the assignment template below, replacing the bracketed placeholders with MiniCourse-specific information from the appendix.
- Set up the grading criteria for the assignment (e.g. points, letter grade, complete/incomplete, etc.)

Assignment Template

[Copy and paste MiniCourse description from Appendix]

To complete this assignment:

1. Access the JAX MiniCourse: **[MiniCourse name/URL]**.
2. Click the "Register" button.
3. You will be prompted to sign into or sign up for your free JAX learning platform account.
4. Complete the Core Lessons in the MiniCourse.
5. Complete the anonymous End-of-MiniCourse survey.
6. Download a PDF of your *Certificate of Completion* per the instructions in the MiniCourse.
7. Return to this assignment. Upload your *Certificate of Completion* PDF as your submission, then click "Submit."

Appendix: MiniCourse Links and Descriptions

Types of Variation

URL: https://education.learning.jax.org/gia-types-of-variation
Description: Are all genetic conditions and diseases inherited? Not always! While humans inherit their genomes from their parents, it is possible to acquire genomic variants later in life. There are some key differences in how inherited and non-inherited gene variants arise and persist in the genome. In this module, you will learn more about these differences and how each type of genomic variation contributes to human health and disease.

Beyond the DNA Code: Epigenetics

URL: https://education.learning.jax.org/gia-beyond-the-dna-code-epigenetics
Description: Why don't identical twins always look exactly alike? If they share the same DNA, shouldn't they be perfect copies of each other? Part of the answer lies in epigenetics! Get ready to explore the epigenetic code—the code beyond the DNA sequence—and discover how it contributes to changes to gene expression that have a pronounced effect on everything from physical traits to disease risk.

What Is Next-Generation Sequencing?

URL: https://education.learning.jax.org/gia-what-is-next-generation-sequencing
Description: Have you ever wondered how researchers gather genetic and genomic data, like DNA and RNA sequences? In this module, you will discover different sequencing techniques, learn about their applications, and help a researcher decide which technique is right for their project.

Sequencing Analysis: DNA and Beyond

URL: https://education.learning.jax.org/gia-sequencing-analysis-dna-and-beyond
Description: There are several different sequencing techniques that can be utilized to obtain genomic information. But once you have data visualizations from a sequencing experiment, how do you identify important features like DNA variants or gene expression? In this module, you will practice interpreting three common visualizations from sequencing experiments: chromatograms, Manhattan plots, and volcano plots.

Genomic Sequencing in the Clinic

URL: https://education.learning.jax.org/gia-genomic-sequencing-in-the-clinic
Description: In this module, you'll explore three powerful genomic technologies at the heart of modern medicine: targeted gene panels, whole exome sequencing (WES) and whole genome sequencing (WGS). You'll learn what each method examines, how they differ, and why one might be chosen over the other in real-world medical scenarios. By the end, you will be able to distinguish between these technologies, explain the advantages of each, and apply that understanding to case studies that mirror challenges faced by doctors and patients today.

Precision Medicine in Cancer Therapy

URL: https://education.learning.jax.org/gia-precision-medicine-in-cancer-therapy
Description: Precision medicine therapies leverage the power of genomics to treat cancer. How do they differ from traditional therapies, and how do they work? In this module, you will explore biomarker testing, immunotherapies, and targeted therapies for cancer treatment.

CRISPR as a Genomic Therapy

URL: https://education.learning.jax.org/gia-crispr-as-a-genomic-therapy
Description: Can genetic diseases be cured by editing the human genome? This module covers how CRISPR/Cas9 technologies work to edit DNA sequences, how these systems are being used to develop therapies to treat genetic diseases, and the existing limitations for use of these therapies in the clinic.

Exploring Genomic Data: Terminology and Tools

URL: https://education.learning.jax.org/gia-exploring-genomic-data-terminology-and-tools
Description: Biomedical research generates large quantities of data on a daily basis. This is particularly true in the field of genomics. To study genomes, it is necessary to understand how genomes and their associated information are stored and organized in web-based databases. In this module, you will learn about genomic data and the tools that are used to analyze it.

Genomic Data: Playing FAIR

URL: https://education.learning.jax.org/gia-genomic-data-playing-fair
Description: Scientists create an enormous amount of genomic data each year, but data by itself isn't very useful to the research community unless it is properly managed. How can scientists efficiently and effectively use this existing data to help develop the treatments of the future? FAIR Data Principles are here to help!

CRISPR Ethics

URL: https://education.learning.jax.org/gia-crispr-ethics
Description: CRISPR therapy is changing medicine, offering new treatment avenues for genetic conditions. Like the science, the ethical questions raised by these developments are complex. This module will explore the ethical issues around the uses of CRISPR technology.

Genetic Information Nondiscrimination Act (GINA)

URL: https://education.learning.jax.org/gia-genetic-information-nondiscrimination-act-gina
Description: Have you ever had a genetic test or thought about getting tested through a product like 23andMe or Ancestry? Are you concerned about the use of your genetic information by health insurers or employers? The Genetic Information Nondiscrimination Act (GINA) protects individuals against genetic discrimination. This module will define the terms used in the act and will discuss the protections and limitations that the act provides.

Identifying Ancestry Through Genomics: How Does It Work?

URL: https://education.learning.jax.org/gia-identifying-ancestry-through-genomics-how-does-it-work
Description: Have you ever wondered how DNA testing can be used to determine ancestral origins? In this module you will learn how variations in DNA patterns are used to determine ancestry.

Human Genomic Variation: Race, Ancestry, and Skin Color

URL: https://education.learning.jax.org/gia-human-genomic-variation-race-ancestry-and-skin-color
Description: Do you know the difference between race, genetic ancestry, and skin color? This module introduces historical scientific ideas around race, the difference between race and genetic ancestry, the genetics of skin color, and the impact of social determinants of health. This exploration of human genomic variation demonstrates that there is no genetic evidence supporting a biological basis for race.