Title: Unit VI: Genetic Technology

Subject/Course: Human Genetics

Topic: Altering DNA, Genetic Testing & Treatment, Reproductive Technology, Genomics

Grade: 11/12

Designer(s): Erin Gallagher

Stage 1- Desired Results

Established Goals:

Student knowledge & understanding of…

- Description of DNA alteration processes
- Description of genetic tests and gene therapy
- Implications of genetic alteration on reproduction
- Explanation of genetic reproductive technologies
- Impact of stem cell research
- Ethics of genetic manipulation in human populations
- Processes of sequencing the human genome
- Genomic analysis

PA Standards for Science & Technology:

3.1.10.B1. Describe how **genetic** information is inherited and expressed.
3.1.B.A3 Explain how all organisms begin their life cycles as a single cell and that in multicellular organisms, successive generations of embryonic cells form by cell division.
3.1.12.A4. Explain how the **cell cycle** is regulated.
3.1.12.A7. Describe the potential impact of stem **cell** research on the **biochemistry** and **physiology** of life.
3.1.12.B1. Explain gene inheritance and expression at the molecular level.
3.1.B.B4. Explain how **genetic technologies** have impacted the fields of medicine, **forensics,** and agriculture
3.1.12.B4. Evaluate the societal impact of **genetic engineering** techniques and applications.

PA Keystone Anchors/Eligible Content:

BIO.B.1.2 Explain how genetic information is inherited.
BIO.B.2.3 Explain how genetic information is expressed.
BIO.B.1.1 Describe the three stages of the cell cycle: interphase, nuclear division, cytokinesis.
BIO.B.2.4 Apply scientific thinking, processes, tools, and technologies in the study of genetics.

Transfer:

Students will be able to independently use their learning to…

- Identify modern technologies that allow us to manipulate DNA for study, disorder/disease treatmnets, and environmental choices
- Discuss the bioethics of genetic testing and gene therapies and debate pros and cons for each.
- Describe assisted reproductive technologies and benefits/drawbacks
- Discuss the bioethics of genomic study and genetic manipulation

<table>
<tr><th colspan="2">Meaning:</th></tr>
<tr><td>Understandings:
Students will understand that…
Ancient biotechnologies gave us bakeries and breweries. Modern biotechnologies manipulate DNA to give us new ways to study, monitor and treat disease, and alter the environment.
DNA based tests have moved from the realm of the health care setting to wide availability, thanks to the Internet. Such tests are not simple and can have effects beyond the individual. At the same time, gene therapy has recovered from setbacks with recent successes.
Assisted reproductive technologies provide intriguing and sometimes complex variations on the process of conceiving a child and carrying it to term.
Just over a decade ago, we saw the first human genome sequences. Today the cost has plummeted to the point that personal genome sequencing is possible. The question now is not could we, but should we?</td><td>Essential Questions:

1. How do modern technologies enable DNA manipulation?
2. What are the possible benefits and disadvantages to genetic manipulation?
3. What are some concerns involved with genetic testing?
4. How does gene therapy work?
5. How do assisted reproductive technologies support conception and full gestation?
6. Why is personal genome sequencing an ethical concern?</td></tr>
<tr><th colspan="2">Acquisition:</th></tr>
<tr><td>Students will know…
Criteria for DNA sequence patents
Problems and controversies concerning DNA sequence patents
Methods of DNA amplification
Methods of monitoring gene expression
Impact of gene silencing
Role of genetic counseling
Types of genetic testing
Impacts of genetic testing
Approaches of treating genetic diseases
Mechanism of gene therapy
Types of assisted reproductive technologies (ARTs)
Causes and tests for infertility and subfertility
Possible uses for extra embryos form ARTs
Relationship of genetics and genomics
Methods of DNA sequencing
Genome interpretations and analysis
Benefits and limitations of personal genome sequencing</td><td>Students will be skilled at …
1. Identifying the criteria for DNA sequence patents
2. Discussing current problems and controversies involving DNA sequence patents
3. Identifying uses of DNA amplification
4. Describing applications of DNA modification (recombination, transgenics)
5. Identifying applications of gene silencing
6. Describing the services of a genetic counselor
7. Describing fetal and newborn sequencing and screening
8. Discussing pros and cons of direct to consumer genetic testing
9. Describing genetic disease treatments (medications, gene therapy)
10. Distinguishing between infertility and subfertility
11. Describing causes of male and female infertility
12. Explaining different assisted reproductive technologies (sperm, oocyte, uterus donation, in vitro fertilization, preimplantation genetic diagnosis)
13. Discussing uses of extra embryo from ARTs
14. Distinguishing between approaches of human genome sequencing
15. Identifying questions addressable by comparative genomics</td></tr>
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	16. Discussing revelations of human genome analysis 17. Identifying types of information provided by personal genome sequencing 18. Identifying limitations of personal genome sequencing
Stage 2- Assessment Evidence	
Unit-Based Project <u>Ethics of Genetics</u> Students will pair and debate the ethics of one of the following issues: • Genetic testing • Gene therapies • Genetic manipulation Debate (pro or con) supports must include: • Description of issue (what is…?) • Statement of position • Three supporting arguments (pro or con) with research and case study references • Summation • Question & answer Additional evaluations: • Written essay prior to debate - • Project quality (neatness, layout, organization) • Accuracy and quality of information • Sources citations	**Other Evidence:** Chapter quizzes: • Ch19: Genetic Technologies: Amplifying, Modifying and Monitoring DNA • Ch20: Genetic Testing and Treatment • Ch21: Reproductive Technologies • Ch22: Genomics Unit test: Genetic Technology Laboratory Activities Chapter Case Studies
Stage 3- Learning Plan	
Pre-Assessment	

Learning Events

Vocabulary:

CH19: Genetic Technologies: Amplifying, Modifying and Monitoring DNA

Biotechnology, transgenic, recombinant DNA, polymerase chain reaction (PCR), restriction enzymes, cloning vectors, plasmid, genomic library, DNA probe, cDNA library, bioremediation, gene expression profiling, microarray, RNA interference (RNAi),

Vocabulary

Chapter topic scenario questions/discussion

- Chap 19: "Improving Pig Manure" p.371

Chapter outline

Lecture presentation/notes/discussion

Animations/videos

Exercises:

- Reading and interpreting PCR results
- Reading and interpreting microarray results
- Current events articles on genetics technologies, questions and answers

Chapter Review Questions

- Chap 19: pp.385-386

Online activities/webquests

- Chap 19 p.386

Laboratory exercises (online & hands-on)

- PCR lab
- Restriction enzymes lab (gel electrophoresis / microarrays)

Chapter Applied Questions

- Chap 19: pp.385-386

Bioethics reading and discussion questions

- Chap 19: "EPO: Built-in Blood Cell Booster or Performance-Enhancing Drug?" p.380

Forensics Focus and/or Case Studies

- Chap 19: pp.386-387

Guided reading/Review handouts

CH20: Genetic Testing and Treatment

Genetic counselor, pharmacogenetic test, pharmacogenomics test, germline gene therapy, somatic gene therapy, ex vivo gene therapy, in vivo gene therapy,

Vocabulary

Chapter topic scenario questions/discussion

- Chap 20: "Fighting Canavan Disease" p.388

Chapter outline

Lecture presentation/notes/discussion

Animations/videos

Exercises:

- Gene therapies: targets and treatments chart
- Venn diagram: pros and cons of genetic testing

Chapter Review Questions

- Chap 20: pp.403-404

Online activities/webquests

- Chap 20 p.404

Laboratory exercises (online & hands-on)
- See web activities

Chapter Applied Questions
- Chap 20: pp.403-404

Bioethics reading and discussion questions
- Chap 20: “Canavan Disease: Patients vs. Patents” p.402

Forensics Focus and/or Case Studies
- Chap 20: pp.404-405

Guided reading/Review handouts

CH21: Reproductive Technologies
Assisted reproductive technologies (ARTs), infertility, intrauterine insemination (IUI), in vitro fertilization (IVF), intracytoplasmic sperm injection (ICSI),

Vocabulary
Chapter topic scenario questions/discussion
- Chap 21: “The Twiblings” p.406

Chapter outline
Lecture presentation/notes/discussion
Animations/videos
- ART descriptions, targets, process and efficacy charts

Chapter Review Questions
- Chap 21: pp.419-421

Online activities/webquests
- Chap 21 p.421

Laboratory exercises (online & hands-on)
- See web activities

Chapter Applied Questions
- Chap 21: pp.419-421

Bioethics reading and discussion questions
- Chap 21: “Removing and Using Gametes After Death” p.414

Forensics Focus and/or Case Studies
- Chap 21: p.422

Guided reading/Review handouts

CH22: Genomics
Genome, genomics, exome, human microbiome

Vocabulary
Chapter topic scenario questions/discussion
- Chap 22: “100,000 Genomes and Counting” p.423

Chapter outline
Lecture presentation/notes/discussion
Animations/videos
Exercises:
- Reading and interpreting genetic analyses: Patient pedigrees and gene-environment interactions

Chapter Review Questions
- Chap 22: pp.437-438

Online activities/webquests • Chap 22 p.438 Chapter readings with 5 sentence synopsis • Reading 22.1: "Sequencing the Cacao Genome" p.432 • Reading 22.2: "The First Three Human Genome Sequences" p.435 Laboratory exercises (online & hands-on) • Research 5 species whose genome has been sequenced, and the diseases they cause in humans at The Institute for Genomic research (http://www.tigr.org) Chapter Applied Questions • Chap 22: pp.437-438 Forensics Focus and/or Case Studies • Chap 22: p.439 Guided reading/Review handouts	
Technology • Laptops and Internet for online activities and project research • Powerpoint/LCD projector for lecture/discussion • Laboratory equipment & materials for lab exercises • McGraw-Hill Connect Genetics (teacher): online assignments, quizzes, tests, online activities, questions, presentations, animations, student performance tracking • McGraw Hill ConnectPlus Genetics (student): eBook, assignments, quizzes, tests, questions, activities, vocab flashcards, animations • Text companion website: www.glencoe.com/lewis10 or www.mhhe.com/lewisgenetics10 • Discovery Streaming videos	**Pacing Guide** Chapters 19-22 = 2 ½ weeks Approx: 4 days: Chap 19 4 days: Chap 20-21 (quiz) 3 days: Chap 22 (quiz) Review/reteach Final Exam / Unit Project due