Western Technical College

10513170 Introduction to Molecular Diagnostics

Course Outcome Summary

Course Information

Description	Introduces the principles and application of molecular diagnostics in the clinical laboratory.
Career Cluster	Health Science
Instructional Level	Associate Degree Courses
Total Credits	2
Total Hours	42

Pre/Corequisites

Prerequisite 10513115 Basic Immunology Concepts

Textbooks

Molecular Diagnostics: Fundamentals, Methods and Clinical Applications. 3rd Edition. Copyright 2019. Buckingham, Lela. Publisher: F.A. Davis Co. **ISBN-13:** 978-0-8036-6829-4. Required.

513-170 Molecular Diagnostics Study Guide and Lab Manual. Western. Publisher: Western. Required.

10-513-170: Molecular Diagnostics Lab Manual. Western. Publisher: Western. **ISBN-13:** 979-8-822-79216-6. Required.

Learner Supplies

Safety Splash Goggles, ALLSAFE goggle, ANSI Z87.1, Fisher Scientific 19-181-504 or 19-181-502. **Vendor:** Campus Shop. Required.

Lab Coat. **Vendor:** Campus Shop. Required.

Sharpie Permanent Marker. **Vendor:** Campus Shop. Required.

Success Abilities

1. Refine Professionalism: Improve Critical Thinking
2. Refine Professionalism: Participate Collaboratively

Program Outcomes

1. Practice laboratory safety and regulatory compliance
2. Monitor and evaluate quality control in the laboratory
3. Apply modern clinical methodologies including problem solving and troubleshooting according to predetermined criteria
4. Correlate laboratory results to diagnosis of clinical conditions and/or diseases

Course Competencies

1. Summarize foundational concepts of molecular biology

Assessment Strategies

1.1. Oral, Written or Graphic Assessment

Criteria

1.1. describe the history of the development of molecular diagnostics
1.2. describe eukaryotic and prokaryotic cell structures
1.3. explain the structure and function of DNA and RNA
1.4. explain semi-conservative DNA replication
1.5. explain transcription and translation

Learning Objectives

1.a. Describe the history of the development of molecular diagnostics.
1.b. Describe eukaryotic and prokaryotic cell structures.
1.c. Explain the structure and function of DNA and RNA.
1.d. Explain semi-conservative DNA replication.
1.e. Explain transcription and translation.

2. Investigate the structure of human, bacterial, and viral genomes

Assessment Strategies

2.1. Oral, Written, Graphic and/or Skill Assessment

Criteria

2.1. compare and contrast viral, bacterial, and human genomes
2.2. describe bacterial and human chromosome structures
2.3. characterize Mendelian and non-Mendelian genetics
2.4. summarize the varying types of mutations and polymorphisms and their roles in disease
2.5. explain Epigenetic modifications of human genes

Learning Objectives

2.a. Compare and contrast viral, bacterial, and human genomes.
2.b. Describe bacterial and human chromosome structures.
2.c. Characterize Mendelian and non-Mendelian genetics.

2.d. Summarize the varying types of mutations and polymorphisms and their roles in disease.
2.e. Explain Epigenetic modifications of human genes.

3. Summarize specimen collection and processing requirements for molecular diagnosis and nucleic acid isolation techniques

Assessment Strategies

3.1. Oral, Written or Graphic Assessment

Criteria

3.1. list human samples that can be used for molecular diagnostic testing
3.2. describe various methods to collect human samples for molecular diagnostic testing
3.3. describe appropriate specimen processing and transportation of samples for molecular diagnostic testing
3.4. state the proper storage of human specimens for molecular diagnostic testing
3.5. explain preanalytical variables that can impact samples used for molecular diagnostic testing
3.6. articulate the purpose of RNA and DNA extraction and isolation
3.7. outline the necessary steps involved in DNA and RNA extraction

Learning Objectives

3.a. List human samples that can be used for molecular diagnostic testing
3.b. Describe various methods to collect human samples for molecular diagnostic testing
3.c. Describe appropriate specimen processing and transportation of samples for molecular diagnostic testing
3.d. State the proper storage of human specimens for molecular diagnostic testing
3.e. Explain preanalytical variables that can impact samples used for molecular diagnostic testing
3.f. Articulate the purpose of RNA and DNA extraction and isolation
3.g. Outline the necessary steps involved in DNA and RNA extraction

4. Investigate nucleic acid identification and manipulation techniques

Assessment Strategies

4.1. Oral, Written or Graphic Assessment

Criteria

4.1. describe the action of nucleic acid modifying enzymes
4.2. summarize the principle of nucleic acid electrophoresis
4.3. provide examples of different electrophoretic techniques and their use in a molecular diagnostics laboratory
4.4. compare and contrast western, northern, and southern blots
4.5. explain microarray technology and its use in a molecular diagnostics laboratory
4.6. describe Sanger Sequencing and Next Generation Sequencing methods in DNA sequencing

Learning Objectives

4.a. Describe the action of nucleic acid modifying enzymes.
4.b. Summarize the principle of nucleic acid electrophoresis.
4.c. Provide examples of different electrophoretic techniques and their use in a molecular diagnostics laboratory.
4.d. Compare and contrast western, northern, and southern blots.
4.e. Explain microarray technology and its use in a molecular diagnostics laboratory.
4.f. Describe Sanger Sequencing and Next Generation Sequencing methods in DNA sequencing

5. Investigate nucleic acid amplification

Assessment Strategies

5.1. Oral, Written or Graphic Assessment

Criteria

5.1. identify assay components required to amplify DNA and RNA targets
5.2. describe the phases (denaturing, annealing, and extension) of nucleic acid amplification
5.3. describe the logarithmic nature of nucleic acid amplification
5.4. evaluate how primer and target sequences affect cycling parameters
5.5. compare single target, multiplexed, quantitative, and reverse transcriptase PCR methods
5.6. describe the factors that can affect amplification of nucleic acids (storage, handling, purity, Mg+2, etc.)

5.7. identify intrinsic components of human samples that may interfere with nucleic acid amplification
5.8. describe the sources and impact of contamination and common methods used to eliminate contamination

Learning Objectives

5.a. Identify assay components required to amplify DNA and RNA targets.
5.b. Describe the phases (denaturing, annealing, and extension) of nucleic acid amplification.
5.c. Describe the logarithmic nature of nucleic acid amplification.
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5.f. Describe the factors that can affect amplification of nucleic acids (storage, handling, purity, Mg+2, etc.).
5.g. Identify intrinsic components of human samples that may interfere with nucleic acid amplification.
5.h. Describe the sources and impact of contamination and common methods used to eliminate contamination.

6. Investigate techniques used to detect amplified nucleic acids

Assessment Strategies

6.1. Oral, Written or Graphic Assessment

Criteria

6.1. identify assay components (e.g., intercalating dyes, probes) required to detect amplified nucleic acids
6.2. compare detection of amplified nucleic acids using endpoint and real-time PCR methodologies
6.3. explain the use of agarose gel electrophoresis, cycle threshold (Ct), and melting temperature (Tm) in endpoint and real-time PCR product analysis
6.4. compare the pros and cons of real-time PCR (closed system) and agarose gel-based end point PCR detection methods
6.5. identify the different types of probes (e.g., hydrolysis [TaqMan], FRET, molecular beacons, Plexor) used in real-time PCR methods
6.6. describe target amplification techniques
6.7. explain a PCR method used to detect a specific DNA sequence
6.8. summarize the importance of quality controls

Learning Objectives

6.a. Identify assay components (e.g., intercalating dyes, probes) required to detect amplified nucleic acids.
6.b. Compare detection of amplified nucleic acids using endpoint and real-time PCR methodologies.
6.c. Explain the use of agarose gel electrophoresis, cycle threshold (Ct), and melting temperature (Tm) in endpoint and real-time PCR product analysis.
6.d. Compare the pros and cons of real-time PCR (closed system) and agarose gel-based end point PCR detection methods.
6.e. Identify the different types of probes (e.g., hydrolysis [TaqMan], FRET, molecular beacons, Plexor) used in real-time PCR methods.
6.f. Describe target amplification techniques.
6.g. Explain a PCR method used to detect a specific DNA sequence.
6.h. Summarize the importance of quality controls.

7. Explain the utilization of molecular diagnostics in diagnosis of diseases and health conditions

Assessment Strategies

7.1. Oral, Written or Graphic Assessment

Criteria

7.1. describe ethical considerations associated with molecular testing
7.2. explain the role of molecular diagnostic testing in patient care
7.3. provide examples of clinical applications of molecular testing for inherited diseases, genetic links to cancer, infectious diseases, and pharmacogenetics

Learning Objectives

7.a. Describe ethical considerations associated with molecular testing.
7.b. Explain the role of molecular diagnostic testing in patient care.
7.c. Provide examples of clinical applications of molecular testing for inherited diseases, genetic links to cancer, infectious diseases, and pharmacogenetics.