# Western Technical College

# 10513116  Clinical Chemistry

## Course Outcome Summary

## Course Information

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| **Description** | Introduces clinical chemistry techniques and procedures for routine analysis using photometric, potentiometric and separation techniques. Topics in this course include pathophysiology and methodologies for carbohydrate, lipids, proteins, renal function and blood gas analysis. Additional topics include hepatic, cardiac markers, tumor markers, endocrine function, miscellaneous body fluids, toxicology, enzymes and electrolytes. |
| **Career Cluster** | Health Science |
| **Instructional Level** | Associate Degree Courses |
| **Total Credits** | 4 |
| **Total Hours** | 90 |

## Pre/Corequisites

Prerequisite          10806186 Intro to Biochemistry

## Textbooks

*Clinical Chemistry: Principles, Techniques, and Correlations - with Access*. 9th Edition. Copyright 2022. Bishop, Michael L, Edward P. Fody, Carleen Van Siclen, James March Mistler, and Michelle Moy. Publisher: Jones and Bartlett Publishers. **ISBN-13:** 978-1-284-23866-0. Required.

*513-116 Clinical Chemistry Manual*. Western. Publisher: Western. Required.

## Success Abilities

1.      Live Responsibly: Foster Accountability

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 the theory of chemistry methodologies.**

**Assessment Strategies**
1.1.      Oral, Written and/or Skill Assessment

**Criteria**

*You will know you are successful when:*
1.1.      you explain the principles of potentiometry.
1.2.      you describe separation techniques (ELP and Chromatography).
1.3.      you explain the principles of photometry.
1.4.      you explain the principles of enzymatic reactions.

**Learning Objectives**
1.a.      Describe the principles of light
1.b.      Describe Beer's law as it relates to spectrophotometric analyses
1.c.      Identify the components of a spectrophotometer
1.d.      Describe the principle of fluorometry in the clinical chemistry department
1.e.      Describe the principle nephelometry in the clinical chemistry department
1.f.      Describe the principle reflectance densitometry in the clinical chemistry department
1.g.      List the application of spectrophotometric analysis in the clinical lab
1.h.      Explain ion selective electrodes
1.i.      Describe the theory utilized in the following electrodes: pH, $pCO_2$, $pO_2$
1.j.      Describe the theory of coulometry
1.k.      Describe the theory of electrophoresis
1.l.      Identify the components of an electrophoretic system
1.m.      Describe the factors affecting electrophoresis
1.n.      Define the principle of chromatography
1.o.      Describe enzyme methods used in the lab

**2.      Perform chemical analysis using instrumentation.**

**Assessment Strategies**
2.1.      Lab Report

**Criteria**

*You will know you are successful when:*
2.1.      you identify demographic data.
2.2.      you report test results.
2.3.      you describe references ranges.
2.4.      you calculate lab data.
2.5.      you verify control and patient test results.
2.6.      you correlate lab data with possible diseases.
2.7.      you describe methodologies.
2.8.      you verify calibration data.

**Learning Objectives**

2.a.      Identify demographic data used on chemistry lab reports
2.b.      Explain reference range
2.c.      Evaluate quality control results
2.d.      Correlate lab data with possible disease states
2.e.      Describe chemistry test methodologies
2.f.      Discuss calibration verification

## 3.      Evaluate renal function.

**Assessment Strategies**
3.1.      Oral, Written and/or Skill Assessment

**Criteria**

*You will know you are successful when:*
3.1.      you discuss the theory of renal function tests.
3.2.      you evaluate renal function test results.
3.3.      you correlate renal tests results with diagnosis, treatment, and prognosis.

**Learning Objectives**
3.a.      Identify lab tests used to evaluate renal function
3.b.      Explain methods of analysis of each renal function test
3.c.      Identify the reference ranges of the tests used to evaluate renal function
3.d.      Discuss specimen requirements for each renal function test
3.e.      Explain the creatinine clearance formula
3.f.      Review renal physiology
3.g.      Describe pathological conditions involving renal function
3.h.      Interpret clinical findings in renal disease

## 4.      Evaluate enzymatic reactions.

**Assessment Strategies**
4.1.      Oral, Written and/or Skill Assessment

**Criteria**

*You will know you are successful when:*
4.1.      you discuss the theory of enzymatic reaction tests.
4.2.      you evaluate enzymatic test results.
4.3.      you correlate results with diagnosis, treatment, and prognosis.

**Learning Objectives**
4.a.      Identify the basic properties of enzymes
4.b.      List the classes of enzymes and the reaction they catalyze
4.c.      Describe the ways in which the following factors may influence enzyme activity: substrate concentration, enzyme concentration, pH, temperature, cofactors, inhibitors
4.d.      Discuss the tissue sources, diagnostic significance, clinical assays, and the sources of error for the following enzymes:  Creatine kinase, lactate dehydrogenase, aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, acid phosphatase, gamma-glutamyltransferase, amylase, lipase
4.e.      Evaluate patient serum enzyme concentrations in relation to disease states

## 5.      Evaluate protein function.

**Assessment Strategies**
5.1.      Oral, Written and/or Skill Assessment

**Criteria**

*You will know you are successful when:*
5.1.      you discuss the theory of protein analysis.
5.2.      you evaluate test results for protein.
5.3.      you correlate results with diagnosis, treatment, and prognosis.

**Learning Objectives**
5.a.      Identify clinically significant protein tests

5.b.      Explain methods used to measure clinically significant proteins
5.c.      Identify reference ranges for clinically significant proteins
5.d.      Discuss specimen requirements for protein tests
5.e.      Describe the basic properties of proteins
5.f.      Review the metabolism of proteins
5.g.      Describe pathological conditions associated with proteins
5.h.      Interpret clinical findings of protein tests

## 6.      Evaluate carbohydrate function.

**Assessment Strategies**
6.1.      Oral, Written and/or Skill Assessment

**Criteria**

*You will know you are successful when:*
6.1.      you discuss the theory of carbohydrate analysis.
6.2.      you evaluate test results for carbohydrates.
6.3.      you correlate results with diagnosis, treatment, and prognosis.

**Learning Objectives**
6.a.      Identify lab tests used to evaluate carbohydrate levels
6.b.      Explain methods used to measure carbohydrate levels
6.c.      Identify reference ranges for carbohydrate levels
6.d.      Discuss specimen requirements for carbohydrate tests
6.e.      Review carbohydrate physiology
6.f.      Describe pathological conditions related to abnormal carbohydrate levels
6.g.      Interpret clinical findings associated with abnormal carbohydrate levels

## 7.      Evaluate electrolytes.

**Assessment Strategies**
7.1.      Oral, Written and/or Skill Assessment

**Criteria**

*You will know you are successful when:*
7.1.      you discuss the theory of electrolyte analysis.
7.2.      you evaluate test results for electrolytes.
7.3.      you correlate results with diagnosis, treatment, and prognosis.

**Learning Objectives**
7.a.      Identify tests included in the basic electrolyte panel
7.b.      Explain methods used to measure electrolytes
7.c.      Identify the reference ranges for electrolytes
7.d.      Discuss specimen requirements
7.e.      Explain the concept of osmolality concerning electrolytes
7.f.      Explain methods used to measure calcium, magnesium, phosphorous
7.g.      Identify the reference ranges for calcium, magnesium, phosphorus
7.h.      Discuss specimen requirements of calcium, magnesium, phosphorus
7.i.      Review the physiology of electrolyte balance
7.j.      Describe the pathological conditions associated with electrolyte imbalance
7.k.      Interpret clinical findings in electrolyte imbalance
7.l.      Explain the use of anion gap to correlate results with disease conditions
7.m.      Explain the use the osmolal gap results with disease conditions
7.n.      Review the physiology of calcium, magnesium, phosphorus
7.o.      Describe pathological conditions concerning abnormal calcium, magnesium, phosphorus values
7.p.      Interpret abnormal results of calcium, magnesium, phosphorus

## 8.      Evaluate hepatic function.

**Assessment Strategies**
8.1.      Oral, Written and/or Skill Assessment

**Criteria**

*You will know you are successful when:*

8.1.　　you discuss the theory of hepatic analysis.
8.2.　　you evaluate hepatic test results.
8.3.　　you correlate results with diagnosis, treatment, and prognosis.

**Learning Objectives**

8.a.　　Review the basic anatomy and physiology of the liver
8.b.　　Discuss the basic disorders of the liver and which laboratory tests may be performed to diagnose them
8.c.　　Describe the physiology of bile degradation
8.d.　　Identify reference intervals for liver function tests
8.e.　　Discuss specimen requirements for liver function tests
8.f.　　Evaluate liver-related data and correlate that data with normal or pathology states
8.g.　　Compare and contrast how total and direct bilirubin measurements are performed
8.h.　　Describe the various types of hepatitis to include cause, transmission, occurrence, alternate name, physiology, diagnosis, and treatment
8.i.　　Describe the endocrine and organ physiology of calcium metabolism
8.j.　　Discuss the laboratory tools used to evaluate calcium metabolism
8.k.　　Apply the laboratory tools to clinical disease states of calcium metabolism

## 9.　　Evaluate blood gasses.

**Assessment Strategies**

9.1.　　Oral, Written and/or Skill Assessment

**Criteria**

*You will know you are successful when:*

9.1.　　you discuss the theory of blood gas analysis.
9.2.　　you evaluate test results for blood gasses.
9.3.　　you correlate results with diagnosis, treatment, and prognosis.

**Learning Objectives**

9.a.　　Identify the tests used to evaluate acid-base balance
9.b.　　Explain the methods used to measure acid-base balance
9.c.　　Identify reference ranges of acid-base balance tests
9.d.　　Discuss specimen requirements for acid-base balance tests
9.e.　　Review the physiology of acid-base balance
9.f.　　Describe the pathological conditions associated with abnormal acid-base balance test results
9.g.　　Interpret acid-base balance results

## 10.　　Evaluate lipids.

**Assessment Strategies**

10.1.　　Oral, Written and/or Skill Assessment

**Criteria**

*You will know you are successful when:*

10.1.　　you discuss the theory of lipid analysis.
10.2.　　you evaluate test results for lipids.
10.3.　　you correlate results with diagnosis, treatment, and prognosis.

**Learning Objectives**

10.a.　　Identify the lab tests used to evaluate lipid levels
10.b.　　Explain methods of analysis used to evaluate lipid levels
10.c.　　Identify the reference ranges of the major lipids discussed
10.d.　　Explain factors associated with diet to lipoprotein analysis
10.e.　　Discuss specimen requirements for lipid analysis
10.f.　　Explain the Friedewald calculation
10.g.　　Describe the pathological conditions associated with abnormal lipid values

## 11.　　Evaluate cardiac function.

**Assessment Strategies**

11.1.     Oral, Written and/or Skill Assessment

**Criteria**

*You will know you are successful when:*

11.1.     you discuss the theory of cardiac analysis.
11.2.     you evaluate cardiac test results.
11.3.     you correlate results with diagnosis, treatment, and prognosis.

**Learning Objectives**

11.a.     Identify lab tests used to evaluate  cardiac function
11.b.     Explain methods used to measure cardiac markers
11.c.     Identify reference intervals for cardiac markers
11.d.     Discuss specimen requirements
11.e.     Identify the source of cardiac markers
11.f.     Describe the pathological conditions associated with heart disease including: myocardial infarction and congestive heart disease
11.g.     Interpret clinical findings in heart disease

## 12.     Evaluate tumor markers.

**Assessment Strategies**
12.1.     Oral, Written and/or Skill Assessment

**Criteria**

*You will know you are successful when:*

12.1.     you discuss the theory of tumor marker analysis.
12.2.     you evaluate test results for tumor markers.
12.3.     you correlate results with diagnosis, treatment, and prognosis.

**Learning Objectives**
12.a.     Explain the role of tumor markers in cancer management
12.b.     Identify the characteristics or properties of an ideal tumor marker
12.c.     State the major clinical value of tumor markers
12.d.     Describe the major properties, methods of analysis, and clinical use of alpha-fetoprotein, cancer antigen 125, carcinoembryonic antigen, beta-human chorionic gonadotropin and prostate-specific antigen

## 13.     Evaluate endocrine function.

**Assessment Strategies**
13.1.     Oral, Written and/or Skill Assessment

**Criteria**

*You will know you are successful when:*

13.1.     you discuss the theory of endocrine function analysis.
13.2.     you evaluate endocrine test results.
13.3.     you correlate results with diagnosis, treatment, and prognosis.

**Learning Objectives**
13.a.     Review the anatomy and physiology of the endocrine system
13.b.     Describe the pathological conditions associated with endocrine dysfunction
13.c.     Interpret clinical findings in selected endocrine disorders

## 14.     Evaluate body fluids.

**Assessment Strategies**
14.1.     Oral, Written and/or Skill Assessment

**Criteria**

*You will know you are successful when:*

14.1.     you discuss the theory of body fluid analysis.
14.2.     you evaluate body fluid test results.
14.3.     you correlate results with diagnosis, treatment, and prognosis.

**Learning Objectives**

14.a.   Review the physiology for the following body fluids: amniotic fluid, cerebrospinal fluid, sweat, synovial fluid, serous fluids, and semen

14.b.   Review the clinical significance of the following body fluids: amniotic fluid, cerebrospinal fluid, sweat, synovial fluid, serous fluids, and semen

14.c.   Identify the types of laboratory tests used to analyze the following body fluids: amniotic fluid, cerebrospinal fluid, sweat, synovial fluid, serous fluids, and semen

14.d.   Explain the methods used to analyze: amniotic fluid, cerebrospinal fluid, sweat, synovial fluid, serous fluids, and semen

14.e.   Discuss the specimen requirements for: amniotic fluid, cerebrospinal fluid, sweat, synovial fluid, serous fluids, and semen

14.f.   Describe the pathological conditions associated with abnormal tests results for the following body fluids: amniotic fluid, cerebrospinal fluid, sweat, synovial fluid, serous fluids, and semen

14.g.   Interpret test results for the following body fluids: amniotic fluid, cerebrospinal fluid, sweat, synovial fluid, serous fluids, and semen

## 15.   Evaluate toxicology and TDM.

**Assessment Strategies**

15.1.   Oral, Written and/or Skill Assessment

**Criteria**

*You will know you are successful when:*

15.1.   you discuss the theory of toxicology and TDM analysis.
15.2.   you evaluate toxicology test results.
15.3.   you correlate results with diagnosis, treatment, and prognosis.

**Learning Objectives**

15.a.   Describe the principles of toxicology
15.b.   Identify the importance of drug screening in the clinical setting
15.c.   Describe the specimen requirements for: drug screens, alcohol levels, carbon monoxide, acetaminophen, salicylate, and lead
15.d.   Explain the differences between quantitative and qualitative tests in toxicology
15.e.   Discuss drug characteristics that make therapeutic drug monitoring essential
15.f.   Discuss specimen requirements for therapeutic drug monitoring