Feb 23, 2004
YCBU 12

Chemistry Biology University Preparation 12

District Name: Abbotsford

District Number: SD # 34

Developed by: Mark Iannone and Jules Pryma

Date Developed: Sept. 1999

School Name: W. J. Mouat

Principal s Name: Des Mc Kay

Board/Authority Approval Date: APR - 5 2004

Board/Authority Signature:

Course Name: Chem/Bi University Prep 12

Grade Level of Course: Grade 12

Number of Course Credits: 4

Number of Hours of Instruction: 120

Prerequisite(s): Chemistry 11 Biology 11 **Corerequisite(s)**: Chemistry 12 Biology 12

Special Training, Facilities or Equipment Required: Computers, Internet access, Web Site, MOC software, Word, Excel with Statistical Tool Add in feature installed, Science Lab with equipment suitable for chemistry and biology labs. A Chemistry specialist and a Biology Specialist are required to instruct the course.

Course Synopsis:

This is a 4-credit course designed for students who will be attempting to qualify for Provincial Scholarships Awards in either Chemistry 12 or Biology 12 and are planning to enrol in university science courses. The focus of this course is twofold. The first goal is to ease the transition for students into first year sciences at university and to increase their level of preparation. This will be accomplished by having students study **university topics** in chemistry, biology, and statistics and perform **university level** laboratory research and technical report writing. These **university topics** are not covered in Chemistry 12 or Biology 12 curriculum. The second goal of the course is to allow students more opportunity to study **complex problem solving** in chemistry and biology based on chemical and biological theories and research. The level of complexity of this problem solving is typical of what is expected in **first year university** chemistry and biology courses and exceeds that normally found in Chemistry 12 and Biology 12. It is hoped that improved general problem solving skills will increases student scores on both the Chemistry 12 and Biology 12 exam and therefore their chances to earn Provincial and Entrance Scholarships to universities. Both of these scholarships are directly tied to Provincial Exam grades. The theme of **technology** will be used to both support the above two goals and allow the students to be more prepared the technology of the future. These students will be learning to use technology that other Chemistry 12 and Biology 12 students will not normally be exposed to. The students will learn invaluable technological, research, and lab skills that they would not usually be exposed to until the **first year of university.** Learning outcomes for the course are grouped under the curriculum organizers: Thinking Skills, Communication Skills, Research Skills, and Technology Skills.

Rationale:

This course has been developed to allow students to be more successful in University Chemistry and Biology both financially and academically. Some of the financial awards available for high grades are listed below.

- **$1000** to **$2000** provincial scholarship with high Provincial exam marks; typically about 90 % average in the best three Provincial exams.
- **$2400** (**UBC**), **$3600** (**SFU, UV**) per year for 4 years with a University Entrance scholarship by scoring **89 %** (**SFU, UV**) or **91 %** (**UBC**) in Ma 12, Ch 12, Bi 12, and En 12.
- Collect up to **$800** in Passport to Education Money for **good grades**.
- Receive **$200** to **$2000** by applying for other scholarships and bursaries for being a **good student** with **exceptional character**.

Grades based on 2003 data and do fluctuate from year to year.

Organizational Structure:

Unit/Topic	Title	Time
Unit 1	University Topics in Biology	18
Unit 2	University Topics in Chemistry	18
Unit 3	Chemistry Problem Solving Skill Development	18
Unit 4	Biology Problem Solving Skill Development	18
Unit 5	Laboratory Research and Technical Report Writing	48
	Total Hours	120

Note: the problem solving units are not meant to be a student evaluation tool but a learning opportunity for students to solve problems of high complexity typical of the first of year of University.

Unit Descriptions:

Unit 1: University Topics in Biology

The students will study topics from university biology courses. These will include cell biology, biochemistry, cell processes and laboratory skills. Student will also prepare and perform a prolonged experiment. They will plan a quantitative investigation involving an Experimental design requiring a minimum of four weeks of data collection in a co-operative group. The data will then be collected and analyzed using statistical methods. The statistical techniques are typical of **university science honours projects**. A web site with interactive problems will be made by the instructor and used by students to evaluate and gain feedback of their work.

Thinking skills

It is expected that students will:

- Describe cell structures and identify their functional interrelationships.
- Demonstrate knowledge of organic polymers such as carbohydrates, proteins, lipids and nucleic acids.
- Describe the processes of DNA replication and protein synthesis
- Compare and contrast the following: diffusion, facilitated transport, osmosis and active transport.
- Apply knowledge of proteins to explain the effects on enzyme activity of pH, temperature, substrate concentration, enzyme concentration, competitive inhibitors and heavy metals.
- Identify and give functions to the parts of the digestive, circulatory, respiratory, nervous, urinary and reproductive systems.

Communication Skills

It is expected that students will:

- Present work orally and write effectively.
- Analyze types of questions and formulate useful question of their own.
- Work with others to produce a presentation.

Research Skills

It is expected that students will:

- Read and discuss research literature
- Access databases.
- Perform reproducible experiments

Technology Skills

It is expected that students will:

- Students will learn to use statistics software to analyze lab results.
- Research literature using the Internet
- Assess data bases using the Internet

Unit 2: University Topics in Chemistry

The students will study selected topics from a **first year university chemistry course.** These include quantum orbital theory, organic chemistry, and error propagation calculations. They will work on the projects in small groups; and use technology for both research and for presentation. Molecular Organic Chemistry MOC interactive software will be used to study the topics in Organic Chemistry. For the organic chemistry unit the students will write and pass the quizzes for each topic to demonstrate their learning. For the other topics, the students will complete assignments in a portfolio that will evaluated by the instructor. A web site of problem solutions will be made by the instructor and used by the students to evaluate their own work.

Thinking Skills

It is expected that students will:

- Be able to draw s, p, d, and f orbitals.
- Relate the position on the periodic table to the type of orbital n = 1, 2, 3, 4, 5, 6, and 7.
- Write the quantum electron configuration for any element on the periodic table.
- Write the quantum electron configuration for any simple ion n = 1, 2, 3, 4, and 5.
- Identify from a formula a simple alkane, alkene, alkyne, cycloalkane, cycloalkyne, cycloalkyne, alcohol, carboxylic acid, ester, aldehyde, ketone, amine, and amide.
- Name from a formula a simple alkane, alkene, alkyne, cycloalkane, cycloalkyne, cycloalkyne, alcohol, carboxylic acid, ester, aldehyde, ketone, amine, and amide.
- Predict the product of hydrogenation and halogenation for alkenes, alkynes cycloalkenes, and cycloalkynes.
- Predict the products and the reactants in simple esterfication reactions.
- Perform error propagation calculations for addition, subtraction, multiplication and division.

Communication Skills

It is expected that students will:

- Present to the class a lesson on nomenclature and recognition of one functional group of organic compounds.
- Work in a group to produce the presentation.

Research Skills

It is expected that students will:

- Research a topic in organic chemistry on the Internet and prepare a presentation.
- Research a three-dimensional model of the f-orbitals on the Internet and draw it in their portfolio.

Technology Skills

It is expected that students will:

- Use MOC learning software to learn the topics in organic chemistry.
- Use Power Point and a LCD projector to present their project in organic chemistry.

Unit 3: Chemistry Problem Solving

Thinking Skills

It is expected that students will:

- Solve challenge problems in chemistry at a level similar to first year university covering various **university chemistry topics**

Communication Skills

It is expected that students will:

- Work in groups to solve the challenge problems
- Present to the class the solution to one of the challenge problems.
- Record in their portfolio the solutions to the challenge problems as well as notes demonstrating they have evaluated and corrected their own work.

Research Skills

It is expected that students will:

- Research using the Internet or Library any knowledge required for the solution of the challenge problems.

Technology Skills

It is expected that students will:

- Use a web site to evaluate their progress on solving the challenge problems.
- Use a computer to research knowledge areas as required by the challenge problems.
- Make a presentation using PowerPoint outlining a solution to one of their problems.

Unit 4: Problem Solving in Biology

Thinking Skills

It is expected that students will:

- Solve challenge problems in biology at a level similar to first year university covering various **university biology topics**

Communication Skills

It is expected that students will:

- Work in groups to solve the challenge problems
- Present to the class the solution to one of the challenge problems.
- Record in their notebook the solutions to the challenge problems as well as notes demonstrating they have evaluated and corrected their own work.

Research Skills

It is expected that students will:

- Research using the Internet or Library any knowledge required for the solution of the challenge problems.

Technology Skills

It is expected that students will:

- Use a web site to evaluate their progress on solving the challenge problems.
- Use a computer to research knowledge areas as required by the challenge problems.

Unit 5: Laboratory Research and Technical Report Writing

Thinking Skills

It is expected that students will:

- Demonstrate that they can perform error propagation calculations in two quantitative chemistry activities and one formal lab.
- Use chemical techniques to correctly identify all of the unknowns in two **university level** qualitative chemical analysis labs.
- Discuss the sources of error and describe what effect they would have on the results in two quantitative activities and one formal quantitative chemistry lab.
- Design a major **university level** quantitative research project in Biology including a proposal, introduction, data collection, analysis, sources of error and a conclusion.
- Calculate the descriptive statistics for the biology project.
- Calculate the comparative statistics for the biology project.
- Interpret the comparative statistics for the biology project using an alpha level of 0.05.

Note: These are all university level experiments not normally done in high School.

Communication Skills

It is expected that students will:

- Record in a portfolio all of the labs and activities in this unit.
- Work in a team to design experiments, collect data, analyse data, interpret data, identify unknowns, and write one formal lab report in chemistry and one in biology.
- Write in a portfolio an analysis of error section for two activities in chemistry, one formal chemistry lab, and one formal biology lab.
- Write two Introductions one for the formal biology lab and one for the formal chemistry lab.
- Write conclusions for the two chemical qualitative labs, two chemical quantitative activities, and the formal chemistry and biology lab.
- Record data for all of the labs in a portfolio.

Research Skills

It is expected that students will:

- Research using the Internet or Library any knowledge required for the introduction for the formal chemistry and biology lab
- Use Excel to report the descriptive and comparative statistics for the biology project.
- Collect, analyse, and interpret data for the biology project.
- Collect, analyse, and interpret data for the chemistry projects.
- Use descriptive and comparative statistics to complete the biology project.
- Research accepted values using the Internet for the chemistry projects.
- Study University Lab Manuals to format the two formal labs.
- Demonstrate competent lab skills rquired for the various labs completed.

Technology Skills

It is expected that students will:

- Research using a computer the Internet any knowledge required for the introduction for the formal chemistry and biology lab
- Use Excel to calculate the descriptive and comparative statistics for the biology project.
- Use a word processor to write two formal lab reports.

Instructional Component:

- Direct Instruction
- Problem Solving
- Inquiry
- Computer Interactive Instruction
- Group Work
- Experimental Design
- Data Collection
- Brain Storming
- Self Assessment
- Creative Problem Solving
- Modelling
- Research

Assessment Component:

All assignments and projects will be completed and organized in a portfolio. The instructors will evaluate this portfolio periodically. The chemistry and biology topics will be given equal weighting. The other 15 % will come from various assignments and activities making up the portfolio. The students will use a web site to evaluate their own problem solving in chemistry and biology, which will make up 30% of their mark. They will show evidence of corrections and a self-evaluation in their portfolio. The chemistry and biology lab activities will all be recorded in the portfolio and in total will make up 40% of the student grade.

University Topics in Biology Portfolio Assignments		15%
University Topics in Chemistry Portfolio Assignments		15%
Chemistry Problem Solving Portfolio		15%
Biology Problem Solving Portfolio		15%
Laboratory Research and Technical Report Writing	Biology Chemistry	20% 20%

Formative Assessment

1. **Laboratory research**
    - Using the master's thesis model to assess student work as they complete each section of the lab, starting with design and ending with final write-up. They will use both peer and teacher feedback to improve the quality of their report until it is at an acceptable **university standard**. This is based on Gardner's Theory of Authentic Evaluation (Gardner, 1993).

2. **Portfolio**
    - Various assignment will be evaluated bi-weekly and feedback provided to students. This is based on Gardner's Theory of Authentic Evaluation (Gardner, 1993).

3. **Problem sets**
    - Students will use web-based solutions to evaluate their own skill at solving complex problems. This is based on Glasser's model of self-evaluation (Glasser, 1990).

Summative Assessment

1. **Laboratory research**
    - The final lab report will be submitted and evaluated by the instructor when they are completed. This is based on Gardner's Theory of Authentic Evaluation (Gardner, 1993).

2. **Portfolio**
    - The summative assessment of portfolios will be made by the instructor and be based on evidence of student growth and development throughout the year. This is based on Gardner's Theory of Authentic Evaluation (Gardner, 1993).

3. **Problem sets**
    - Students have gone through the self-evaluation process and have used the feedback to improve their problem solving skills. Evidence of this process will be documented in the portfolio and evaluated by the instructor to ensure that all of the problems have been completed and the process of self-evaluation has been accomplished. This is based on Glasser's model of self-evaluation (Glasser, 1990).

Performance Methods

Portfolio of Completed, Projects, labs and Activities
Presentations
Experimental Proposal
Computer Quizzes
Self Evaluation
Lab Results
Lab Skills

Learning Resources:

Computers
Internet Access
Web Site Space
Excel, MOC, Word Processor, Power Point
Well Equipped Chemistry and Biology Lab.

Additional Information:

Students will do Chemistry curriculum for three weeks and then switch to Biology curriculum for three weeks with a specialist instructor in each area.

Course Reference Books

Biology 140: Laboratory Workbook 2003-2004 Term 1

Campbell, N. (2002). Biology 6th ed. Toronto: Benjamin Cummings.

Chemistry 113: Lab Manual 2002

Petrucci, R. (2001). General Chemistry 8th ed. Toronto: Prentice- Hall Inc.

Document References:

Gardner, H. (1993). Multiple Intelligences: The Theory and Practice. New York: Basic Books, Inc.

Glasser, W. (1990). The Quality School. New York: Harper Collins, Perennial

Oct-13 '06

Chemistry Biology University Preparation 12

District Name: Abbotsford

District Number: SD # 34

Developed by: Mark Iannone and Jules Pryma

Date Developed: Sept. 1999 (revised Oct. 2006)

School Name: W. J. Mouat

Principal's Name: Rob Comeau

Board/Authority Approval Date:

Board/Authority Signature:

Course Name: Chem/Bi University Prep 12

Grade Level of Course: Grade 12

Number of Course Credits: 4

Number of Hours of Instruction: 120

Prerequisite(s): Chemistry 11 Biology 11 **Corerequisite(s)**: Chemistry 12 Biology 12

Special Training, Facilities or Equipment Required: Computers, Internet access, Web Site, MOC software, Word, Excel with Statistical Tool Add in feature installed, Science Lab with equipment suitable for chemistry and biology labs. A Chemistry specialist and a Biology Specialist are required to instruct the course.

Course Synopsis:

This is a 4-credit course designed for students who will be attempting to qualify for Provincial Scholarships Awards in either Chemistry 12 or Biology 12 and are planning to enrol in university science courses. The focus of this course is twofold. The first goal is to ease the transition for students into first year sciences at university and to increase their level of preparation. This will be accomplished by having students study **university topics** in chemistry, biology, statistics and perform **university level** laboratory research and technical report writing. These **university topics** are not covered in Chemistry 12 or Biology 12 curriculum. The second goal of the course is to allow students more opportunity to study **complex problem solving** in chemistry and biology based on chemical and biological theories and research. The level of complexity of this problem solving is typical of what is expected in **first year university** chemistry and biology courses and exceeds that normally found in Chemistry 12 and Biology 12. It is hoped that improved general problem solving skills will increases student scores on both the Chemistry 12 and Biology 12 exam and therefore their chances to earn Provincial and Entrance Scholarships to universities. Both of these scholarships are directly tied to Provincial Exam grades. The theme of **technology** will be used to both support the above two goals and allow the students to be prepared for the technology of the future. These students will be learning to use technology that other Chemistry 12 and Biology 12 students will not normally be exposed to. The students will learn invaluable technological, research, and lab skills that they would not usually be exposed to until the **first year of university.** Learning outcomes for the course are grouped under the curriculum organizers: Thinking Skills, Communication Skills, Research Skills, and Technology Skills.

Rationale:

This course has been developed to allow students to be more successful in University Chemistry and Biology both financially and academically. Some of the financial awards available for high grades are listed below.

- **$1000** to **$2000** provincial scholarship with high Provincial exam marks; typically about 90 % average in the best three Provincial exams.
- **$2400** (**UBC**), **$3600** (**SFU, UV**) per year for 4 years with a University Entrance scholarship by scoring **89 %** (**SFU, UV**) or **91 %** (**UBC**) in Ma 12, Ch 12, Bi 12, and En 12.
- Collect up to **$800** in Passport to Education Money for **good grades**.
- Receive **$200** to **$2000** by applying for other scholarships and bursaries for being a **good student** with **exceptional character**.

Grades based on 2003 data and do fluctuate from year to year.

Organizational Structure:

Unit/Topic	Title	Time
Unit 1	University Topics in Biology	20
Unit 2	University Topics in Chemistry	20
Unit 3	Chemistry Problem Solving Skill Development	20
Unit 4	Biology Problem Solving Skill Development	20
Unit 5	Laboratory Research and Technical Report Writing	40
	Total Hours	120

Note: the problem solving units are not meant to be a student evaluation tool but a learning opportunity for students to solve problems of high complexity typical of the first of year of University.

Unit Descriptions:

Unit 1: University Topics in Biology

The students will study topics from university biology courses. These will include cell biology, biochemistry, cell processes and laboratory skills. Student will also prepare and perform a prolonged experiment. They will plan a quantitative investigation involving an Experimental design requiring a minimum of four weeks of data collection in a co-operative group. The data will then be collected and analyzed using statistical methods. The statistical techniques are typical of **university science honours projects**. A web site with interactive problems will be made by the instructor and used by students to evaluate and gain feedback of their work.

Thinking skills

It is expected that students will:

- **Metabolism**
  - identify the step of cellular respiration in the breakdown of glucose including glycolysis, the transition reaction and the citric acid (Krebs) cycle.
  - differentiated between anaerobic breakdown of glucose and fermentation.
  - examine the role of the electron transport chain in making ATP in the mitochondria.
  - explore the structure and function of the chloroplast including carbohydrate synthesis.
  - differentiate between concept of the metabolic pool, catabolism and anabolism.

- **Photosynthesis**
  - identify the structure and function of Chloroplasts
  - the purpose of light-dependent reactions in photosynthesis
  - the function of the cyclic electron pathway
  - carbohydrate synthesis during the Calvin cycle
  - other types of photosynthesis and how they compare
  - identify plant pigments using chromatography

- **DNA, Gene Function and Regulation**
  - examine how gene expression is controlled
  - examine the details of the *Lac* Operon as an example of gene expression
  - explore the function of transposons (jumping genes)
  - appreciate new developments coming from research from the Human Genome Project, including the concept of *alternative gene splicing*

- **Tissue types**
  - identify the four major tissue types
  - classify types of epithelial, connective and muscle tissues
  - examine role of actin and myosin in muscle contraction
  - examine the structure and function of bone tissue and the functional interrelationship of the skeleton and muscles
  - explore the complexity of skin
  - compare and identify tissue types using the light microscope

Communication Skills

It is expected that students will:

- present work orally and write effectively.
- analyze types of questions and formulate useful question of their own.
- work with others to produce a presentation.

Research Skills

It is expected that students will:

- read and discuss research literature
- access databases.
- perform reproducible experiments

Technology Skills

It is expected that students will:

- learn to use statistics software to analyze lab results.
- research literature using the Internet
- assess data bases using the Internet

Unit 2: University Topics in Chemistry

The students will study selected topics from a **first year university chemistry course.** These include quantum orbital theory, organic chemistry, and error propagation calculations. They will work on the projects in small groups; and use technology for both research and for presentation. Molecular Organic Chemistry MOC interactive software will be used to study the topics in Organic Chemistry. For the organic chemistry unit the students will write and pass the quizzes for each topic to demonstrate their learning. For the other topics, the students will complete assignments in a portfolio that will evaluated by the instructor. A web site of problem solutions will be made by the instructor and used by the students to evaluate their own work.

Thinking Skills

It is expected that students will:

- Be able to draw s, p, d, and f orbitals.
- Relate the position on the periodic table to the type of orbital n = 1, 2, 3, 4, 5, 6, and 7.
- Write the quantum electron configuration for any element on the periodic table.
- Write the quantum electron configuration for any simple ion n = 1, 2, 3, 4, and 5.
- Identify from a formula a simple alkane, alkene, alkyne, cycloalkane, cycloalkyne, cycloalkyne, alcohol, carboxylic acid, ester, aldehyde, ketone, amine, and amide.
- Name from a formula a simple alkane, alkene, alkyne, cycloalkane, cycloalkyne, cycloalkyne, alcohol, carboxylic acid, ester, aldehyde, ketone, amine, and amide.
- Predict the product of hydrogenation and halogenation for alkenes, alkynes cycloalkenes, and cycloalkynes.
- Predict the products and the reactants in simple esterfication reactions.
- Perform error propagation calculations for addition, subtraction, multiplication and division.

Communication Skills

It is expected that students will:

- Present to the class a lesson on nomenclature and recognition of one functional group of organic compounds.
- Work in a group to produce the presentation.

Research Skills

It is expected that students will:

- Research a topic in organic chemistry on the Internet and prepare a presentation.
- Research a three-dimensional model of the f-orbitals on the Internet and draw it in their portfolio.

Technology Skills

It is expected that students will:

- Use MOC learning software to learn the topics in organic chemistry.
- Use Power Point and a LCD projector to present their project in organic chemistry.

Unit 3: Chemistry Problem Solving

Thinking Skills

It is expected that students will:

- Solve challenge problems in chemistry at a level similar to first year university covering various **university chemistry topics**

Communication Skills

It is expected that students will:

- Work in groups to solve the challenge problems
- Present to the class the solution to one of the challenge problems.
- Record in their portfolio the solutions to the challenge problems as well as notes demonstrating they have evaluated and corrected their own work.

Research Skills

It is expected that students will:

- Research using the Internet or Library any knowledge required for the solution of the challenge problems.

Technology Skills

It is expected that students will:

- Use a web site to evaluate their progress on solving the challenge problems.
- Use a computer to research knowledge areas as required by the challenge problems.
- Make a presentation using PowerPoint outlining a solution to one of their problems.

Unit 4: Problem Solving in Biology

Thinking Skills

It is expected that students will:

- Solve challenge problems in biology at a level similar to first year university covering various **university biology topics**

Communication Skills

It is expected that students will:

- Work in groups to solve the challenge problems
- Present to the class the solution to one of the challenge problems.
- Record in their notebook the solutions to the challenge problems as well as notes demonstrating they have evaluated and corrected their own work.

Research Skills

It is expected that students will:

- Research using the Internet or Library any knowledge required for the solution of the challenge problems.

Technology Skills

It is expected that students will:

- Use a web site to evaluate their progress on solving the challenge problems.
- Use a computer to research knowledge areas as required by the challenge problems.

Unit 5: Laboratory Research and Technical Report Writing

Thinking Skills

It is expected that students will:

- Demonstrate that they can perform error propagation calculations in two quantitative chemistry activities and one formal lab.
- Use chemical techniques to correctly identify all of the unknowns in two **university level** qualitative chemical analysis labs.
- Discuss the sources of error and describe what effect they would have on the results in two quantitative activities and one formal quantitative chemistry lab.
- Design a major **university level** quantitative research project in Biology including a proposal, introduction, data collection, analysis, sources of error and a conclusion.
- Calculate the descriptive statistics for the biology project.
- Calculate the comparative statistics for the biology project.
- Interpret the comparative statistics for the biology project using an alpha level of 0.05.

Note: These are all university level experiments not normally done in high School.

Communication Skills

It is expected that students will:

- Record in a portfolio all of the labs and activities in this unit.
- Work in a team to design experiments, collect data, analyse data, interpret data, identify unknowns, and write one formal lab report in chemistry and one in biology.
- Write in a portfolio an analysis of error section for two activities in chemistry, one formal chemistry lab, and one formal biology lab.
- Write two Introductions one for the formal biology lab and one for the formal chemistry lab.
- Write conclusions for the two chemical qualitative labs, two chemical quantitative activities, and the formal chemistry and biology lab.
- Record data for all of the labs in a portfolio.

Research Skills

It is expected that students will:

- Research using the Internet or Library any knowledge required for the introduction for the formal chemistry and biology lab
- Use Excel to report the descriptive and comparative statistics for the biology project.
- Collect, analyse, and interpret data for the biology project.
- Collect, analyse, and interpret data for the chemistry projects.
- Use descriptive and comparative statistics to complete the biology project.
- Research accepted values using the Internet for the chemistry projects.
- Study University Lab Manuals to format the two formal labs.
- Demonstrate competent lab skills rquired for the various labs completed.

Technology Skills

It is expected that students will:

- Research using a computer the Internet any knowledge required for the introduction for the formal chemistry and biology lab
- Use Excel to calculate the descriptive and comparative statistics for the biology project.
- Use a word processor to write two formal lab reports.

Instructional Component:

- Direct Instruction
- Problem Solving
- Inquiry
- Computer Interactive Instruction
- Group Work
- Experimental Design
- Data Collection
- Brain Storming
- Self Assessment
- Creative Problem Solving
- Modelling
- Research

Assessment Component:

All assignments and projects will be completed and organized in a portfolio. The instructors will evaluate this portfolio periodically. The chemistry and biology topics will be given equal weighting. The other 15 % will come from various assignments and activities making up the portfolio. The students will use a web site to evaluate their own problem solving in chemistry and biology, which will make up 30% of their mark. They will show evidence of corrections and a self-evaluation in their portfolio. The chemistry and biology lab activities will all be recorded in the portfolio and in total will make up 40% of the student grade.

University Topics in Biology Portfolio Assignments		15%
University Topics in Chemistry Portfolio Assignments		15%
Chemistry Problem Solving Portfolio		15%
Biology Problem Solving Portfolio		15%
Laboratory Research and Technical Report Writing	Biology	20%
	Chemistry	20%

Formative Assessment

1. **Laboratory research**
    - Using the master's thesis model to assess student work as they complete each section of the lab, starting with design and ending with final write-up. They will use both peer and teacher feedback to improve the quality of their report until it is at an acceptable **university standard**. This is based on Gardner's Theory of Authentic Evaluation (Gardner, 1993).

2. **Portfolio**
    - Various assignments will be evaluated bi-weekly and feedback provided to students. This is based on Gardner's Theory of Authentic Evaluation (Gardner, 1993).

3. **Problem sets**
    - Students will use web-based solutions to evaluate their own skill at solving complex problems. This is based on Glasser's model of self-evaluation (Glasser, 1990).

Summative Assessment

1. **Laboratory research**
    - The final lab report will be submitted and evaluated by the instructor when they are completed. This is based on Gardner's Theory of Authentic Evaluation (Gardner, 1993).

2. **Portfolio**
    - The summative assessment of portfolios will be made by the instructor and be based on evidence of student growth and development throughout the year. This is based on Gardner's Theory of Authentic Evaluation (Gardner, 1993).

3. **Problem sets**
    - Students have gone through the self-evaluation process and have used the feedback to improve their problem solving skills. Evidence of this process will be documented in the portfolio and evaluated by the instructor to ensure that all of the problems have been completed and the process of self-evaluation has been accomplished. This is based on Glasser's model of self-evaluation (Glasser, 1990).

Performance Methods

Portfolio of Completed, Projects, labs and Activities
Presentations
Experimental Proposal
Computer Quizzes
Self Evaluation
Lab Results
Lab Skills

Learning Resources:

Computers
Internet Access
Web Site Space
Excel, MOC, Word Processor, Power Point
Well Equipped Chemistry and Biology Lab.

Additional Information:

Students will do Chemistry curriculum for three weeks and then switch to Biology curriculum for three weeks with a specialist instructor in each area.

Course Reference Books

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Campbell, N. (2002). Biology 6th ed. Toronto: Benjamin Cummings.

Chemistry 113: Lab Manual 2002

Petrucci, R. (2001). General Chemistry 8th ed. Toronto: Prentice-Hall Inc.

Skavaril, R. (1993). General Biology Lab Manual *Investigations into Life's Phenomena.* Saunders College Publishing

Document References:

Gardner, H. (1993). Multiple Intelligences: The Theory and Practice. New York: Basic Books, Inc.

Glasser, W. (1990). The Quality School. New York: Harper Collins, Perennial