**EDUC 272: METHODS IN SECONDARY CHEMISTRY**

**COURSE DESCRIPTION**

The goal of the course is to engage secondary science teachers in the critical exploration of inquiry-based science teaching using available resources. This is an integrated course which combines topics related to the senior chemistry curriculum with the skills and pedagogy of secondary science education. It includes principles of planning, assessment, and current educational research presented in the context of chemistry instruction. Course topics will include laboratory design and safety, the nature of science and science education (e.g., purpose, meaning, history, scientific process, nature of knowledge), generating interest and motivation in chemistry, lesson and unit planning, formative and summative assessment practices to support the learning of science, collaborative problem solving, classroom management, and fabrication and improvisation of simple chemistry teaching materials. Professional development of science teachers and recent developments in chemistry education will be reflected in the discussion.

**COURSE LEARNING OUTCOMES**

**At the end of this course, teachers will be able to:**

* Plan and conduct laboratory-based learning in a safe manner to generate interest, build knowledge, and cultivate inquiry in students.
* Plan lessons based on the Kenyan Chemistry curricula that effectively integrate chemistry content knowledge and pedagogical knowledge.
* Select and adapt methods, materials, and resources available in the educational context to support meaningful chemistry learning.
* Explain and exemplify the nature of science within the context of chemistry through meaningful hands-on student activities.
* Integrate effective teaching and classroom assessment practices to support student learning.
* Demonstrate a capacity to reflect on chemistry learning and teaching to improve one's teaching practice and the quality of students' learning.
* Explain and model attitudes and practices that include and support all students in learning science regardless of ability, gender, ethnicity, or background.

**COURSE OUTLINE**

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| Class 1 (On-line)  January 1 - 24 | |
| Topic | Laboratory-based learning – Selecting labs for context and purpose |
| Learning Outcomes | Select and adapt methods, materials, and resources available in the educational context to support meaningful chemistry learning.  Plan lessons based on the Kenyan Chemistry curricula that effectively integrate chemistry content knowledge and pedagogical knowledge. |
| Key Ideas | Understanding teachers, the teaching context  Reflecting on laboratory-based learning  Selecting labs appropriate to context and purpose |
| Handouts | **January Task**  **Handout 1.1 – Primer on labs**  **LAB 1 – LAB 20 (20 separate labs on pdf)**  Location: EDUC 272 - Class 1 (online) |
| Class 2 (On-line)  February 1 - 24 | |
| Topic | Laboratory-based learning – Planning |
| Learning Outcomes | Select and adapt methods, materials, and resources available in the educational context to support meaningful chemistry learning.  Plan and conduct laboratory-based learning in a safe manner to generate interest, build knowledge, and cultivate inquiry in students. |
| Key Ideas | Integrating chemistry and pedagogical content knowledge in a lab setting  Lesson sequence and planning |
| Handouts | 1. **February Task** 2. **Handout 2.1 – Generic Lesson Plan Sequence** 3. **Handout 2.2 – A Teaching Model** 4. **Handout 2.3 – What Not To Do** 5. **Handout 2.4 – Secondary safety**   Location: EDUC 272 - Class 2 (online) |
| Class 3 (On-line)  March 1 - 24 | |
| Topic | Laboratory-based learning – Plan it, do it, and film it! |
| Learning Outcomes | Plan and conduct laboratory-base learning in a safe manner to generate interest, build knowledge, and cultivate inquiry in students.  Select and adapt methods, materials, and resources available in the educational context to support meaningful chemistry learning.  Demonstrate a capacity to reflect on chemistry learning and teaching to improve one’s teaching practice and the quality of students’ learning. |
| Key Ideas | Using laboratory to promote meaningful learning |
| Handouts | **March Task**  Location: EDUC 272 - Class 3 (online) |
| Class 4 (Face-to-face)  2 hours | |
| Topics | 1) Laboratory-based learning debrief 2) Teaching perspectives 3) Inquiry |
| Learning Outcomes | Demonstrate a capacity to reflect on chemistry learning and teaching to improve one’s teaching practice and the quality of students’ learning  Plan and conduct laboratory-based learning in a safe manner to generate interest, build knowledge, and cultivate inquiry in students. |
| Key Ideas | Creating a professional, collegial community  Being a reflective practitioner: Teachers' Roles / Collective Lab Debrief  Moving from “cook-book” to inquiry |
| Handouts | 1. **EDUC 272 Course Outline**   **Handout 4.1 - Rethinking Laboratories**  **Handout 4.2 - Candle in the Jar - Student Worksheet**  **Handout 4.3 - Candle in the Jar - Teacher's Guide**  **Handout 4.4 - Candle in the Jar - Debrief**  **Handout 4.5 - Teachers' Roles** |
| Class 5 (Face-to-face)  2 hours | |
| Topic | 1) Task design and learning 2) Explaining concepts 3) Inquiry lab |
| Learning Outcomes | Explain and exemplify the nature of science within the context of chemistry through meaningful hands-on student activities.  Select and adapt methods, materials, and resources available in the educational context to support meaningful chemistry learning. |
| Key Ideas | Talking science: Atomic theory  Exploring the nature of science  Engaging in hands on learning |
| Handouts | **Handout 5.1 - Same Lab Three Tasks**  **Handout 5.2 - Atom Molecule Conception Cards**  **Handout 5.3 - Atomic Theory**  **Handout 5.4 - Rutherford Gold Foil Student Worksheet**  **Handout 5.5 - Rutherford Gold Foil Teacher's Guide** |
| Class 6 (Face-to-face)  2 hours | |
| Topic | Nature of science |
| Learning Outcomes | Explain and exemplify the nature of science within the context of chemistry through meaningful hands-on student activities. |
| Key Ideas | Explore the nature of science through historical stories about chemistry |
| Handouts | **Handout 6.1 - Domains of Scientific Knowledge**  **Handouts 6.2 - 6.5: Nature of Science Stories**  **Handout 6.6 - Teaching the Nature of Science**  **Extra Handout: Periodic Table Activity** |
| Class 7 (Face-to-face)  2 hours | |
| Topics | 1) Classroom assessment 2) Lesson planning |
| Learning Outcomes | Integrate effective teaching and classroom assessment practices to students in the meaningful learning of chemistry.  Plan lessons based on the Kenyan Chemistry curricula that effectively integrate chemistry content knowledge and pedagogical knowledge. |
| Key Ideas | Blending classroom assessment and instruction in support of learning  Planning lessons |
| Handouts | **Handout 7.1 - KCSE Chemistry Syllabus**  **Handout 7.2 - Five Big Classroom Assessment Ideas**  **Handout 7.3 - Backward Design**  **Handout 7.4 - Formative Assessment**  **Handout 7.5 - Assessment Tool Kit** |
| Class 8 (Face-to-face)  2 hours | |
| Topic | 1) Lesson planning 2) Questioning |
| Learning Outcomes | Integrate effective teaching and classroom assessment practices to students in the meaningful learning of chemistry.  Plan lessons based on the Kenyan Chemistry curricula that effectively integrate chemistry content knowledge and pedagogical knowledge. |
| Key Ideas | Planning lessons  Questioning Techniques |
| Handouts | **Handout 8.1 - Planning Lessons**  **Handout 8.2 - Lesson Templates**  **Handout 8.3 - Lesson Plan Exemplars**  **Handout 8.4 - Bloom's Taxonomy**  **Handout 8.5 - Bloom's Revised Taxonomy**  **Handout 8.6 - Questioning Techniques**  **Handout 8.7 - Probing Phrases** |
| Class 9 (Face-to-face)  2 hours | |
| Topic | 1) Explaining chemistry concepts 2) Giving effective feedback |
| Learning Outcomes | Plan lessons based on the Kenyan Chemistry curricula that effectively integrate chemistry content knowledge and pedagogical knowledge.  Integrate effective teaching and classroom assessment practices to students in the meaningful learning of chemistry. |
| Key Ideas | Talking science - KCSE content  Giving effective feedback |
| Handouts | **Handout 9.1 - Giving Feedback**  **Handouts 9.2 to 9.13 - Various Chemical Concepts** |
| Class 10 (Face-to-face)  2 hours | |
| Topic | 1) Lesson planning 2) Classroom management |
| Learning Outcomes | Integrate effective teaching and classroom assessment practices to students in the meaningful learning of chemistry. |
| Key Ideas | Plan lessons based on the Kenyan Chemistry curricula that effectively integrate chemistry content knowledge and pedagogical knowledge.  Integrate effective teaching and classroom assessment practices to students in the meaningful learning of chemistry. |
| Handouts | **Handout 10.1 - Advice from Bruce**  **Handout 10.2 - Expectations of Students**  **Handout 10.3 - Classroom Learning Structures**  **Extra Handouts - Strategies, Procedures, Activities** |
| Class 11 (Face-to-face)  2 hours | |
| Topic | Problem solving in chemistry |
| Learning Outcomes | Integrate effective teaching and classroom assessment practices to students in the meaningful learning of chemistry. |
| Key Ideas | Supporting students to be effective problem solvers |
| Handouts | **Handout 11.1 - Problem Solving Article**  **Handout 11.2 - Problem Solving Strategies** |
| Class 12 (Face-to-face)  2 hours | |
| Topic | 1) Lesson planning 2) Assessment |
| Learning Outcomes | Select and adapt methods, materials, and resources available in the educational context to support meaningful chemistry learning.  Integrate effective teaching and classroom assessment practices to students in the meaningful learning of chemistry. |
| Key Ideas | Planning lessons  Using classroom assessment to support learning |
| Handouts | **Various Classroom Assessment References** |
| Class 13 (Face-to-face)  2 hours | |
| Topic | Student-teacher organized review of course |
| Learning Outcomes | All |
| Key Ideas | Roundup of course topics by students |
| Handouts | None |

**GENDER STATEMENT**

Please incorporate gender inclusive language in your oral and written language. This language positions women and men equally. It does not exclude one gender or the other, nor does it demean the status of one gender or another. It does not stereotype genders [assuming all childcare workers are female and all police officers are male], nor does it use false generics [using mankind instead of human kind, or using man-made instead of hand crafted]. In addition, this language requires gender balance in personal pronouns, for example, use "he and she" rather than "he" or balance gendered examples in a paper, referring to both male and female examples. Make sure you adhere to these guidelines as you learn in groups, write your assignments, and post your responses on the blog.

**ASSESSMENT**

**CLASS PARTICIPATION**

Student-teachers are expected to participate fully in class, to demonstrate sensitivity and leadership in discussion, to contribute to the learning of others and to demonstrate capacity and willingness to collaborate and work co-operatively with others.

**ASSIGNMENT OVERVIEW**

**A Online tasks (12%)**

These tasks have been explained fully in the following documents: **January Task**, **February Task**, **March Task**.

**B Lesson Planning Assignment (18%)**

The purpose of this assignment is to further develop skills for developing an effective lesson plan which integrates the information in the Kenyan chemistry curriculum with the ideas you have learned in this course. This assignment will be done in two parts:

1. Working in pairs you will first select a topic or sub-topic from the chemistry curriculum for which you will design a teaching sequence and prepare a scope and sequence or "overview".
2. Secondly, each individual in your pair will be responsible for structuring one lesson each and the associated student activities and material for those lessons. The finished product for each pair will be two lessons developed in detail. Individual students who opt to work on their own need to hand in one lesson plan with materials.

Your Mini-Unit/Lesson Sequence for Meaningful Learning will include:

**Title Page**

Your title page will state the topic of your mini-unit and state which lessons each individual prepared.

**Overview-Rationale Statement**

In a brief Overview and Rationale to the lesson plans you will discuss how your unit will promote meaningful learning. As part of the overview, identify the curriculum alignment and link your objectives, key concepts, activities and assessment. In writing your rationale statement, explain WHY a particular procedure was selected and specifically address how, through the activities you designed, students will progress to meet to curriculum requirements and develop some higher order learning skills.

**Lesson Plan Components**

The lesson plans should include the topic(s) for each lesson, a list of the desired learning outcomes (cite the curriculum pages) a phrase outlining the student activities, materials required, key steps and assessment.

**Two Detailed Lesson Plans with Materials**

Each lesson should include the following components, but will follow the standard or similar format provided in the course:

* Learning outcomes
* Materials required -- include those for both the teachers and students
* Learning activities for each stage of the lesson including the following:

(i) Student activity sheets; (ii) Teacher answer keys; (iii) Closure and segue between lesson segments, (iv) A rationale for planning choices, (v) Formative assessment techniques integrated with instructional practice

* Summative assessment for the unit

**C Final Exam (70%)**