# CHE 101 – Conceptual Chemistry Assessment Protocol Sept. 21, 2012

## **State of Texas Core Objectives**

Physical Science courses in the Core are required to meet the following Core Objectives (Texas Admin Code rule 4.28) [quoting verbatim]

- 1. <u>Critical Thinking Skills</u>: to include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information.
- 2. <u>Communication Skills</u>: to include effective development, interpretation and expression of ideas through written, oral, and visual communication
- 3. <u>Empirical and Quantitative Skills</u>: to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions
- 4. <u>Teamwork</u>: to include the ability to consider different points of view and to work effectively with others to support a shared purpose or goal

## **Student Learning Outcomes**

The course's Student Learning Outcomes (SLO's) parallel the state Core Objectives so that they directly address the state's interests.

- 1. Students will correctly interpret the chemical behavior of substances using the body of knowledge of chemistry as a foundation. (*critical thinking skills*)
- 2. Student will communicate effectively in written reports and oral presentations. *(communication skills)*
- 3. Students will correctly assemble laboratory equipment, collect appropriate data, and analyze and interpret the results. (*empirical and quantitative skills*)
- 4. Students will cooperate with each other in achieving successful completion of group projects. (*teamwork*)

## Process

## Selection of Students

Students will be assessed in two groups -

(1) a sample of students from all of the sections that are offered in a semester. This sample will be sufficient for evaluating the first three Core Objectives – Critical Thinking Skills, Communication Skills, and Empirical and Quantitative Skills.

For normally distributed data (or students), a sample size of 30 suffices. For example, if we enroll 6 sections of 40 students each for a total of 240, we need to select only 5 students from each section to secure an adequate sample. Selection for the sample must be at random. There are several ways random sampling can be achieved. The instructors teaching each section will

maintain portfolios of major projects, reports, etc. for the students selected for the sample from their sections.

(2) all of the students enrolled in each section for assessing Core Objective – Teamwork.

## Assessment Methods

There are two assessments per student learning outcome.

For the content-oriented Core Objectives – Critical Thinking Skills and Empirical and Quantitative Skills – we will assess complete portfolios and a single artifact chosen from the hands-on lab activities. All sections and all instructors will use the same single artifact in order to develop a longitudinal data set.

All students will present brief oral reports and written reports. One of each will be used to assess the Core Objective -- Communication Skills.

# Critical Thinking Skills [Student Learning Outcome 1]

1. Students will correctly interpret the chemical behavior of substances using the body of knowledge of chemistry as a foundation. (*critical thinking skills*)

Since we will have a minimum of mathematics in this course, our approaches to critical thinking in chemistry will emphasize logic, qualitative reasoning, and recognizing patterns of chemical behavior based on the body of knowledge of chemistry as a foundation.

## Method of Assessment #1:

A. Describe the procedures that will be used to collect information on student learning.

Portfolios of students selected for the sample will be developed and maintained through the semester. At the end of the semester, each portfolio in the sample set will be evaluated by the instructor using Rubric 1 to assess the evidence of the student's ability to interpret the chemical behavior of substances using the body of knowledge of chemistry as a foundation.

B. Describe the criteria for success related to this means of assessment.

Based on their portfolios, 70% of the students will demonstrate at least acceptable levels of performance in all items listed in Rubric 1 for this category.

## Method of Assessment #2:

A. Describe the procedures that will be used to collect information on student learning.

The course incorporates several common hands-on laboratory-related activities. The faculty will select an activity that can be used for several years to provide longitudinal assessment across sections. At the completion of the activity, the work on the project of each student in the sample set will be evaluated by the instructor using Rubric 1 to assess the evidence of the student's ability to interpret the chemical behavior of substances using the body of knowledge of chemistry as a foundation.

B. Describe the criteria for success related to this means of assessment.

Based on their performance on the activity, 70% of the students will demonstrate at least acceptable levels of performance in all items listed in Rubric 1 for this category.

### **Communication Skills [Student Learning Outcome 2]**

# 2. Student will communicate effectively in written reports and oral presentations. *(communication skills)*

Both oral and written Communication Skills will be assessed. Students will write formal library reports, lab reports, and solutions of problems. Students will be required to make at least one oral presentation in the semester.

#### Method of Assessment #1:

A. Describe the procedures that will be used to collect information on student learning.

The course incorporates several common hands-on laboratory-related activities. The faculty will select an activity that can be used for several years to provide longitudinal assessment across sections. At the completion of the activity, the written report on the project of each student in the sample set will be evaluated by the instructor using Rubric 2A to assess evidence of each student's ability to communicate effectively in writing.

B. Describe the criteria for success related to this means of assessment.

Based on their performance on the activity, 70% of the students will demonstrate at least acceptable levels of performance in all items listed in Rubric 2A for this category.

#### Method of Assessment #2:

A. Describe the procedures that will be used to collect information on student learning.

The course incorporates several common hands-on laboratory-related activities. The faculty will select an activity that can be used for several years to provide longitudinal assessment across sections. At the completion of the activity, the oral report on the project of each student in the sample set will be evaluated by the instructor using Rubric 2B to assess the evidence of each student's ability to communicate effectively orally.

B. Describe the criteria for success related to this means of assessment.

Based on their performance on the activity, 70% of the students will demonstrate at least acceptable levels of performance in all items listed in Rubric 2B for this category.

## **Empirical and Quantitative Skills [Student Learning Outcome 3]**

3. Students will correctly assemble laboratory equipment, collect appropriate data, and analyze and interpret the results. *(empirical and quantitative skills)* 

Empirical skills will be emphasized – setting up an experiment correctly, competently carrying out the task, and then drawing suitable conclusions from their observations.

#### Method of Assessment #1:

A. Describe the procedures that will be used to collect information on student learning.

Portfolios of students selected for the sample will be developed and maintained through the semester. At the end of the semester, each portfolio in the sample set will be evaluated by the instructor using Rubric 3 to assess the evidence of the student's ability to correctly assemble laboratory equipment, collect appropriate data, and analyze and interpret the results.

B. Describe the criteria for success related to this means of assessment.

Based on their portfolios, 70% of the students will demonstrate at least acceptable levels of performance in all items listed in Rubric 3 for this category.

#### Method of Assessment #2:

A. Describe the procedures that will be used to collect information on student learning.

The course incorporates several common hands-on laboratory-related activities. The faculty will select an activity that can be used for several years to provide longitudinal assessment across sections. At the completion of the activity, the work on the project of each student in the sample set will be evaluated by the instructor using Rubric 3 to assess the evidence of the student's ability to correctly assemble laboratory equipment, collect appropriate data, and analyze and interpret the results.

B. Describe the criteria for success related to this means of assessment.

Based on their performance on the activity, 70% of the students will demonstrate at least acceptable levels of performance in all items listed in Rubric 3 for this category.

## **Teamwork** [Student Learning Outcome 4]

4. Students will cooperate with each other in achieving successful completion of group projects. *(teamwork)* 

Assessment and evaluation of this Core Objective / Student Learning Outcome will be done over the entire population in a section. All students in each section will be perform a peer evaluation of each other as members of a team on two projects – one early in the semester and one later in the semester. Group membership may change during the course of a semester so that students will have the opportunity to work with new people. The intervening time between projects will provide an opportunity to assess shortcomings and strengths and deliver suitable instruction on working in teams.

#### Method of Assessment #1:

A. Describe the procedures that will be used to collect information on student learning.

The first assessment will take place early in the semester. All students in every section will use Rubric 4 to assess each other's ability to work as an effective team member in achieving successful completion of a group project.

B. Describe the criteria for success related to this means of assessment.

Based on peer evaluation, 70% of the students will demonstrate at least acceptable levels of performance in all items listed in Rubric 4 for this category.

#### Method of Assessment #2:

A. Describe the procedures that will be used to collect information on student learning.

The second assessment will take place later in the semester. All students in every section will use Rubric 4 to assess each other's ability to work as an effective team member in achieving successful completion of a group project.

B. Describe the criteria for success related to this means of assessment.

Based on their performance on the activity, 80% of the students will demonstrate at least acceptable levels of performance in all items listed in Rubric 4 for this category.

# CHE 101: Conceptual Chemistry Rubric 1

Artifact(s) / Activity Evaluated:

Core Objective 1: Critical Thinking Skills Student Learning Outcome 1. Students will correctly interpret the chemical behavior of substances using the body of knowledge of chemistry as a foundation.

\_\_\_\_\_

Student:

Date:

Evaluator:

Item	N/A	Unacceptable	Acceptable	Superior
Correctly uses chemical structures, formulae,				
equations, and nomenclature.				
Correctly uses chemical theories.				
Accurately interprets evidence, statements,				
graphs, questions, etc.				
Identifies the salient arguments (claims and				
reasons) for and against.				
Thoughtfully analyzes and evaluates major				
alternative points of view.				
Draws warranted, judicious, non-fallacious				
conclusions.				
Justifies key results and procedures, explains				
assumptions and reason.				
Fair-mindedly follows where evidence and				
reasons lead.				

Elaboration of Evaluations –

N/A:	Not applicable to the artifact(s) / activity being evaluated.
Unacceptable:	Student's level of understanding has too many or too serious flaws. Some or all of
	the work needs to be redone to be acceptable.
Acceptable:	Student shows understanding. However, there are flaws that are evidence of some
	weaknesses.
Superior:	Student shows substantial understanding without obvious weaknesses.

# CHE 101: Conceptual Chemistry Rubric 2A

# Core Objective: Communication Skills (Written) Student Learning Outcome 2. Student will communicate effectively in written reports and oral presentations.

Student: \_\_\_\_\_ Artifact(s) / Activity Evaluated:

\_\_\_\_\_

Date:

Evaluator:

Item	N/A	Unacceptable	Acceptable	Superior
Organization of Document to Enhance Reader				
Comprehension				
Articulation of Ideas: Clarity and Conciseness				
Construction and Use of Graphs, Tables,				
Diagrams, Figures				
Neatness of Document				
Correct Spelling and Grammar				
Professional, Formal Style				
Quantity and Quality of References Selected.				
Adherence to Prescribed Format (for example,				
style manual for professional publication like				
those published by the American Chemical				
Society)				

Elaboration of Evaluations -

N/A:	Not applicable to the artifact(s) / activity being evaluated.
Unacceptable:	Student's level of understanding has too many or too serious flaws. Some or all
	of the work needs to be redone to be acceptable.
Acceptable:	Student shows understanding. However, there are flaws that are evidence of some
	weaknesses.
Superior:	Student shows substantial understanding without obvious weaknesses.

# CHE 101: Conceptual Chemistry Rubric 2B

# Core Objective: Communication Skills (Oral) Student Learning Outcome 2. Student will communicate effectively in written reports and oral presentations.

 Student:
 Artifact(s) / Activity Evaluated:

Date:

Evaluator:

\_\_\_\_\_

## **Oral Communication**

Item	N/A	Unacceptable	Acceptable	Superior
Organization of Presentation				
Appropriate Amount of Detail and				
Content for Time Constraint and				
Audience				
Poise and Delivery: Eye Contact,				
Audibility, Speaking without Prompts,				
Visibility of Screen or Board, Nervous				
Habits				
Use of Formal Standard English				
Quality and Usefulness of Visual Aids				
Professional Appearance				
Listening Skills to Questioners and				
Ability to Respond				

Elaboration of Evaluations -

N/A:	Not applicable to the artifact(s) / activity being evaluated.
Unacceptable:	Student's level of understanding has too many or too serious flaws. Some or
	all of the work needs to be redone to be acceptable.
Acceptable:	Student shows understanding. However, there are flaws that are evidence of
	some weaknesses.
Superior:	Student shows substantial understanding without obvious weaknesses.

# CHE 101: Conceptual Chemistry Rubric 3

# Core Objective 3: Empirical and Quantitative Skills Student Learning Outcome 3. Students will correctly assemble laboratory equipment, collect appropriate data, and analyze and interpret the results.

Student: \_\_\_\_\_ Artifact(s) / Activity Evaluated:

\_\_\_\_\_

Date:

Evaluator:

Item	N/A	Unacceptable	Acceptable	Superior
Identifies the purpose, components, and variables				
of the investigation / project.				
Identifies the information required for the				
analysis of all investigative components.				
Formulates an investigatory plan for gathering				
data to attain objective				
Correctly assembles laboratory equipment to				
gather data sought.				
Collects, documents, analyzes and interprets data				
carefully and correctly using appropriate theory.				

Elaboration of Evaluations –

N/A:	Not applicable to the artifact(s) / activity being evaluated.
Unacceptable:	Student's level of understanding has too many or too serious flaws. Some or all
	of the work needs to be redone to be acceptable.
Acceptable:	Student shows understanding. However, there are flaws that are evidence of some
	weaknesses.
Superior:	Student shows substantial understanding without obvious weaknesses.

# CHE 101: Conceptual Chemistry Rubric 4

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# Core Objective: Teamwork Student Learning Outcome 4. Students will cooperate with each other in achieving successful completion of group projects.

 Student:
 \_\_\_\_\_\_ Artifact(s) / Activity Evaluated:

Date:

Evaluator:

Item	N/A	Unacceptable	Acceptable	Superior
Comes to meetings prepared to participate.				
Is on time for meetings.				
Meets deadlines for component tasks in the group				
project.				
Provides useful ideas in group discussions.				
Actively searches for and suggests solutions to				
problems.				
Maintains a professionally positive attitude about				
the project and the work of others.				
Stays focused on the task and what needs to be				
done.				
Produces quality work as part of the group				
project.				

Elaboration of Evaluations -

N/A:	Not applicable to the artifact(s) / activity being evaluated.
Unacceptable:	Student's level of understanding has too many or too serious flaws. Some or all
	of the work needs to be redone to be acceptable.
Acceptable:	Student shows understanding. However, there are flaws that are evidence of some
	weaknesses.
Superior:	Student shows substantial understanding without obvious weaknesses.