

Number	Question	N	Mean	Std dev
	Your understanding of class content			
1	As a result of your work in this class, what GAINS DID YOU MAKE in your UNDERSTANDING of each of the following?			
1.1	The main concepts explored in this class	8	4.9	0.35
1.2	The following concepts that have been explored in this class			
1.2.1	Multiplicities, entropy, and the approach to equilibrium	8	4.9	0.35
1.2.2	The second law of thermodynamics	8	4.6	0.52
1.2.3	The dynamical basis of equilibrium	8	4.5	0.53
1.2.4	The meaning of temperature	8	4.2	0.71
1.2.5	The origin of macroscopic laws from microscopic properties	8	4.7	0.46
1.3	Please comment on HOW YOUR UNDERSTANDING OF THE SUBJECT HAS CHANGED as a result of this class.	7		
1.4	Please comment on how THE WAY THIS CLASS WAS TAUGHT helps you REMEMBER key ideas.	7		
	Increases in your skills			
2	As a result of your work in this class, what GAINS DID YOU MAKE in the following SKILLS?			
2.1	Derive the fundamental equations of physical chemistry	8	4.5	0.76
2.2	Work effectively with others	7	4.6	0.53
2.3	Solve problems independently	8	4.2	0.71
2.4	Please comment on what SKILLS you have gained as a result of this	6		
	Class impact on your attitudes			
3	As a result of your work in this class, what GAINS DID YOU MAKE in the following?			
3.1	Build a hypothesis (or premise), investigate it, and reach your own	8	4.1	0.35
3.2	Connect representations of physical chemistry: molecular, macroscopic, and mathematical	8	4.7	0.46
3.3	Seeing connections between mathematical reasoning and fundamental concepts in chemistry	8	4.6	0.52
3.4	Seeing that there can be multiple valid approaches to solve a complex	8	4.7	0.46
	Integration of your learning			
4	As a result of your work in this class, what GAINS DID YOU MAKE in INTEGRATING the following?			
4.1	Using systematic reasoning to analyze data, equations, and arguments	8	4.4	0.74
4.2	What will you CARRY WITH YOU into other classes or other aspects of your life?	5		
	The Class Overall			
5	HOW MUCH did the following aspects of the class HELP YOUR			
5.1	The instructional approach taken in this class	8	4.9	0.35
5.2	How the class topics, activities, reading and assignments fit together	8	4.9	0.35
5.3	The pace of the class	8	4.4	1.06
5.4	Please comment on how the INSTRUCTIONAL APPROACH to this class helped your learning.	5		

Class Activities

6	HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?			
6.1	Daily topic introductions and recaps by the instructor	8	4.5	0.76
6.2	Doing hands-on classroom activities	8	4.9	0.35
6.3	Participating in small group discussions during class	8	4.8	0.46
6.4	Participating in whole class discussions during class	8	5.0	0.00
6.5	Listening to whole class discussions during class	8	5.0	0.00
6.6	Please comment on how the CLASS ACTIVITIES helped your learning.	6		
6.7	Please comment on HOW OFTEN YOU PARTICIPATED in class discussions and HOW THE ATMOSPHERE IN THE CLASSROOM ENCOURAGED OR DISCOURAGED your participation.	6		

Assignments, graded activities and tests

7	HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?			
7.1	Graded assignments (overall) in this class	8	3.9	0.64
7.2	The feedback on my work received after tests or assignments	8	4.0	0.93

Class Resources

8	HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?			
8.1	The in-class activities (worksheets / packets)	8	4.9	0.35
8.2	The primary textbook	8	3.1	1.13
8.3	The homework	8	4.3	0.71

The information you were given

9	HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?			
9.1	The framing of each activity (how it was introduced, and how it related to other ideas)	8	5.0	0.00

Support for you as an individual learner

10	HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?			
10.1	Interacting with the instructor during class	8	4.9	0.35
10.2	Interacting with the instructor outside of class	7	5.0	0.00
10.3	Working with teaching assistants outside of class	1	5.0	0
10.4	Working with peers during class	8	4.7	0.46
10.5	Working with peers outside of class	7	4.3	1.50
10.6	Please comment on how the SUPPORT YOU RECEIVED FROM OTHERS helped your learning in this class.	6		

1. **Student Assessment of Learning Gains** Students responded to a panel of questions designed to focus attention on how teaching methodologies support student learning. Some questions have a Likert-like scale from 1 (no gain) to 5 (great gain). Others are long-form, free-response questions.

Model 1: The first sheet of this packet summarizes the quantitative section of the SALG survey. You can tear it off for easier reference.

Critical thinking questions: Consider the quantitative responses.

- (a) What is the typical number of respondents to the quantitative questions? What is the response rate? (*Hint: The class size was 25.*)
- (b) How much confidence can one have in interpreting the scores? What is the potential for bias in the resulting scores?
- (c) Considering all the categories, what contributed the most to students' highest learning gains? (*Hint: All questions are phrase in the positive, with 1 as lowest and 5 as highest.*)
- (d) Considering all the categories, what contributed the least to students' learning gains?

(e) Considering the quantitative responses, what are your observations? What trends do you see?

(f) Which question(s) do you find most interesting? Explain your reasoning.

2. In their long-form responses, students report gains in their ability to solve problems.

Model 2: The full free responses are available to each group in a separate packet. Relevant excerpts follow.

2.4 Please comment on the SKILLS you have gained in this class.

The way the class was presented at first seemed to be very difficult but in the end it helped me greatly in the way I looked at a problem at hand or the way I looked at a system as a whole. I learned to apply ideas that may not seem to be connected together to generate the correct solutions.

This class really helped to improve my ability to think through the material on my own and with classmates as opposed to feeling the need to wait to be taught by a lecturer.

4.2 What will you CARRY WITH YOU into other classes or other aspects of your life?

I think I approach complex problems more confidently, am more patient in the process of solving problems. I am not as hesitant to express my thoughts. I think about things more critically and constantly look for connections.

Not just looking at a problem that I might come across as having one solution or one approach. This class opened up the way that looked at the problems at hand and I was really able to explore the huge amount of variation in the "out of the box" thinking method. Seeing things from a very different viewpoint really helped me truly understand and breakdown tough and or weird problems.

I think I will be better prepared to analyze a situation and logically determine the best course of action or propose a good solution to a problem.

The open discussion in the classroom definitely opened me up to others ideas and made me for accepting and interested in others opinions and thought processes.

Critical thinking questions:

Consider the student free responses above, which are taken from several different questions but all comment on the theme of problem solving. What aspects of the class most supported student improvement in problem solving?

3. Students report gains in communication skills.

Model 3:

2.4 Please comment on what SKILLS you have gained as a result of this class.

I think it helped me contribute to discussion more, be more social with classmates, apply math to chemistry better, communicate science better,

4.2 What will you CARRY WITH YOU into other classes or other aspects of your life?

Being able to admit that I don't know what's going on; being quick to ask for someone to explain something to me; being quick to help others when they need a nudge

6.7 Please comment on HOW OFTEN YOU PARTICIPATED in class discussions and HOW THE ATMOSPHERE IN THE CLASSROOM ENCOURAGED OR DISCOURAGED your participation.

I think the most noteworthy part of the class activities is that there was always a lively combination of having problems explained to me by a group member or Sean, explaining problems myself to other group members or to the whole class, and working together with group members to solve problems at the same time.

Taught me how to learn from other people and admit to needing help. On the flip side it helped me be more open to helping others and improved my teaching abilities.

Everyday most of the class was presenting idea to the entire class and as we worked in small groups everyday we were able to talk and brainstorm idea/ information for almost the entire class period. Very helpful in building skills of team work and sharing of information with different sized groups of people.

Critical thinking questions:

Consider the student responses on the theme of communication improvements. What aspects of the class support these communication gains?

4. Students report gains in teamwork.

Model 4:

2.4 Please comment on what SKILLS you have gained as a result of this class.

This class really helped to improve my ability to think through the material on my own and with classmates as opposed to feeling the need to wait to be taught by a lecturer.

I am better prepared to work with colleagues and to think on my feet/work in an interactive setting.

6.7 Please comment on HOW OFTEN YOU PARTICIPATED in class discussions and HOW THE ATMOSPHERE IN THE CLASSROOM ENCOURAGED OR DISCOURAGED your participation.

Everyday most of the class was presenting idea to the entire class and as we worked in small groups everyday we were able to talk and brainstorm idea/ information for almost the entire class period. Very helpful in building skills of team work and sharing of information with different sized groups of people.

10.6 Please comment on how the SUPPORT YOU RECEIVED FROM OTHERS helped your learning in this class.

Being able to talk and bounce idea off other people from class was one of the most helpful parts of the class. The material presented in the class is difficult and hard to get a hold of but once you or someone else does get it, it forces you to become the teacher or learn in a different fashion. Because the class was based around the idea of group learning, asking questions to others in the class was easy and this pushed the environment of learning forward like no other class I have taken. This class formed very close connections with the people in the class and this was a huge factor in the way information was taken in and understood. Having that great deal of support from others within the class allowed for people to not fall behind like they might in another class that wasn't as closely formed and connected. I think that having the class designed in this fashion pushes the people taking it to become closer and this just reinforces the environment of learning that is taking place.

Critical thinking questions:

What aspects of the class best supported the student gains in teamwork?

5. Students reported gains in critical thinking.

Model 5:

4.2 What will you CARRY WITH YOU into other classes or other aspects of your life?

Being able to admit that I don't know what's going on; being quick to ask for someone to explain something to me; being quick to help others when they need a nudge

I think I approach complex problems more confidently, am more patient in the process of solving problems. I am not as hesitant to express my thoughts. I think about things more critically and constantly look for connections.

Not just looking at a problem that I might come across as having one solution or one approach. This class opened up the way that looked at the problems at hand and I was really able to explore the huge amount of variation in the "out of the box" thinking method. Seeing things from a very different viewpoint really helped me truly understand and breakdown tough and or weird problems.

I think I will be better prepared to analyze a situation and logically determine the best course of action or propose a good solution to a problem.

The open discussion in the classroom definitely opened me up to others ideas and made me for accepting and interested in others opinions and thought processes.

Critical thinking questions:

What aspects of the class supported the student gains in critical thinking?

6. Considering this data, what insights do you have for how class time can support your learning goals?