

**Clackamas Community College**

## Online Course/Outline Submission System

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 Show changes since last approval in red**Section #1 General Course Information****Department:** Sciences**Submitter**First Name: **Eden**Last Name: **Francis**Phone: **3352**Email: **edenf**

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**Course Prefix and Number:** CH - 105

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**# Credits:** 5**Contact hours**

Lecture (# of hours): 44

Lec/lab (# of hours):

Lab (# of hours): 33

Total course hours: 77

For each credit, the student will be expected to spend, on average, 3 hours per week in combination of in-class and out-of-class activity.

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**Course Title:** Introductory Chemistry**Course Description:**

A laboratory course discussing heat; molecular and ionic interactions in solids, liquids, gases and solutions; chemical reactions including acid-base, electron transfer and equilibrium.

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**Type of Course:** Lower Division Collegiate

Is this class challengeable?

**Yes**

Can this course be repeated for credit in a degree?

**No**

Is general education certification being sought at this time?

**Yes**

**Check which General Education requirement:**

**✓ Science & Computer Science**

Is this course part of an AAS or related certificate of completion?

**No**

Are there prerequisites to this course?

**Yes**

**Pre-reqs:** Pass CH-104 (CH-112 not acceptable)

**Have you consulted with the appropriate chair if the pre-req is in another program?**

**No**

Are there corequisites to this course?

**No**

Are there any requirements or recommendations for students taken this course?

**No**

Are there similar courses existing in other programs or disciplines at CCC?

**No**

Will this class use library resources?

**Yes**

**Have you talked with a librarian regarding that impact?**

**No**

Is there any other potential impact on another department?

**No**

Does this course belong on the Related Instruction list?

**No**

**GRADING METHOD:**

A-F or Pass/No Pass

**Audit: Yes**

When do you plan to offer this course?

 **Summer** **Winter** **Spring**

Is this course equivalent to another?

If yes, they must have the same description and outcomes.

**No**

Will this course appear in the college catalog?

**Yes**

Will this course appear in the schedule?

**Yes****Student Learning Outcomes:**

Upon successful completion of this course, students should be able to:

1. apply scientific and technical inquiry, individually and collaboratively, to critically evaluate existing or alternative explanations and solve problems; (SC2)
  2. use electronic resources and common laboratory equipment in the pursuit of scientific inquiry, (SC1) (SC2)
  3. describe the scientific method and the procedures used in generating hypotheses and solving scientific questions in the context of chemistry; (SC1) (SC2) (SC3)
  4. analyze problems and apply appropriate problem-solving methods, including the correct use of experimental data, units and significant figures; (SC1) (SC2)
  5. clearly communicate and comprehend basic scientific principles and concepts important to an understanding of major topics in introductory chemistry, (SC1)
  6. demonstrate understanding of fundamental concepts of chemistry by definition, explanation, and use of these ideas in examinations and laboratory exercises; (SC1) (SC2)
  7. critically examine the fundamentals of chemistry in their role as applied to human society and the environment. (SC3)
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**AAOT/ASOT GENERAL EDUCATION OUTCOMES  
COURSE OUTLINE MAPPING CHART**

**Mark outcomes addressed by the course:**

- Mark "C" if this course completely addresses the outcome. Students who successfully complete this course are likely to have attained this learning outcome.
- Mark "S" if this course substantially addresses the outcome. More than one course is required for the outcome to be completely addressed. Students who successfully complete all of the required courses are likely to have attained this learning outcome.
- Mark "P" if this course partially addresses the outcome. Students will have been exposed to the outcome as part of the class, but the class is not a primary means for attaining the outcome and assessment for general education purposes may not be necessary.

***As a result of completing the AAOT/ASOT general education requirements, students will be able to:***

**WR: Writing Outcomes**

1. Read actively, think critically, and write purposefully and capably for academic and, in some cases, professional audiences.
2. Locate, evaluate, and ethically utilize information to communicate effectively.
3. Demonstrate appropriate reasoning in response to complex issues.

**SP: Speech/Oral Communication Outcomes**

1. Engage in ethical communication processes that accomplish goals.
2. Respond to the needs of diverse audiences and contexts.
3. Build and manage relationships.

**MA: Mathematics Outcomes:**

- P** 1. Use appropriate mathematics to solve problems.
- P** 2. Recognize which mathematical concepts are applicable to a scenario, apply appropriate mathematics and technology in its analysis, and then accurately interpret, validate, and communicate the results.

**AL: Arts and Letters Outcomes**

1. Interpret and engage in the Arts & Letters, making use of the creative process to enrich the quality of life.
2. Critically analyze values and ethics within range of human experience and expression to engage more fully in local and global issues.

**SS: Social Science Outcomes**

1. Apply analytical skills to social phenomena in order to understand human behavior.
2. Apply knowledge and experience to foster personal growth and better appreciate the diverse social world in which we live.

**SC: Science or Computer Science Outcomes**

- S** 1. Gather, comprehend, and communicate scientific and technical information in order to explore ideas, models, and solutions and generate further questions.
- S** 2. Apply scientific and technical modes of inquiry, individually, and collaboratively, to critically examine the influence of scientific and technical knowledge on human society and the environment.

**S**

3. Assess the strengths and weaknesses of scientific studies and critically examine the influence of scientific and technical knowledge on human society and the environment.

**CL: Cultural Literacy Outcome**

1. Identify and analyze complex practices, values, and beliefs and the culturally and historically defined meanings of difference.

**Outcomes Assessment Strategies:**

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**Major Topic Outline:**

1. Gases.

- a. Describe gases using the kinetic molecular theory.
- b. Describe real gases and ideal gases, explain how real gases differ from ideal gases.
- c. Explain what causes pressure and describe how it is measured.
- d. Describe how the pressure of a gas sample depends on the volume, temperature, and number of moles of gas in the sample.
- e. Describe how the volume of a gas sample depends on the number of moles in the sample, its pressure, and its temperature.
- f. State and recognize Avogadro's Law, Boyle's Law, and Charles' Law.
- g. Describe when and why it is necessary to use the Kelvin temperature scale and be able to convert between Kelvin and Celsius.
- h. State what is meant by STP and know the volume of one mole of gas at STP.
- i. State and recognize the ideal gas law and know the value and units for the ideal gas constant.
- j. Use measurements of the mass, volume, density, pressure, and temperature of a gas sample to calculate its molecular weight.
- k. Define partial pressure and describe how it is related to the total pressure of a gas mixture.
- l. State and recognize Dalton's Law of Partial Pressures.
- m. Given experimental data, perform calculations using the ideal gas law, the combined gas law, and Dalton's Law, as appropriate.

2. Heat (chemical and physical changes).

- a. Describe the bonding and molecular motion in the solid, liquid, and gas phases.
- b. (Review) Describe the types of interatomic bonds (covalent, ionic, metallic) and intermolecular bonds (hydrogen, dipole-dipole, van der Waals) and compare their strengths to one another.
- c. (Review) From formulas of chemicals, determine what types of interatomic and intermolecular bonds the chemicals have.
- d. Describe energy, heat, and temperature.
- e. Describe the relationship between heat and temperature.
- f. Define and properly use the terms endothermic and exothermic.

3. Bonding and phases.

- a. Relate chemical bonds to the energy changes involved in making and breaking them.
- b. Draw and interpret heating and cooling curves.
- c. Define heat capacity (or specific heat) and memorize the value of the heat capacity (or specific heat) for water.
- d. For a material changing temperature, do calculations relating the heat lost or gained, change in temperature, mass of the material, and heat capacity (or specific heat) of the material.
- e. Define and use proper symbols, units, and signs for heat of fusion, heat of vaporization, heat of condensation, and heat of crystallization.
- f. For a material changing phase, do calculations relating the heat lost or gained, mass of the material, and  $H$  for

the phase change.

g. For materials changing temperature and phase, do calculations relating the heat lost or gained, change in temperature, heat capacity (specific heat), mass of the material, and  $\Delta H$  for the phase change.

h. Interpret heating and cooling curves in terms of bonding.

i. Relate chemical bonds (interatomic and intermolecular) to the processes involved in making and breaking them.

j. Use kinetic molecular theory and bonding to describe phases, phase changes, melting and boiling points, and heating and cooling curves.

k. Identify and describe viscosity, surface tension, volatility, pressure, and vapor pressure.

l. Relate thermal properties of different chemicals to differences in interatomic and intermolecular bonds.

4. Solutions, precipitation and other aqueous reactions.

a. Define and describe solutions (unsaturated, saturated, and supersaturated), pure liquids, colloidal dispersions and suspensions.

b. Use molecular polarity to predict whether or not two substances will mix with one another to form a solution.

c. Use solubility rules to determine whether an ionic compound is soluble in water and predict the product in a precipitation reaction.

d. Explain why saturated solutions containing undissolved solute are examples of dynamic equilibrium.

e. Describe and classify solutions as nonelectrolytes, weak electrolytes, and strong electrolytes.

f. Write equations for solvation reactions and for precipitation reactions, showing the ions present in solution.

g. Describe the physical and bonding changes that take place when ionic, polar, and nonpolar solutes dissolve in water or precipitate from solution.

h. Calculate the heat of solution for a reaction from experimental data.

i. Discuss and analyze colligative properties of solutions.

j. Describe osmosis at both the observable and molecular levels.

k. Express concentrations of solutions in weight percent, volume percent, weight/volume percent, and molarity.

l. Use molarity and percent concentration data to perform routine calculations, including dilution and species concentration.

m. Use colorimetry to determine the concentration of colored solutions.

n. Analyze the advantages of expressing concentration in various ways and describe the situations in which each is most useful.

o. Write solubility product expressions ( $K_{sp}$ ) for ionic compounds and perform standard  $K_{sp}$  calculations given appropriate data.

5. Acids and bases - general properties.

a. Describe and use procedures for safely handling acids and bases.

b. Observe, describe, and recognize the properties of acids and bases, use these properties to experimentally identify acids and bases.

c. Name common binary and ternary acids and bases.

d. Define and describe acids and bases using the Arrhenius, Brønsted-Lowry, and Lewis concepts.

e. Classify electrolytes as acids, bases or salts based on their formulas and the ions formed when they dissociate in water.

f. Know the formula for hydronium ion and explain how it is formed.

g. Describe and recognize conjugate pair relationships

h. Describe amphoterism.

i. Describe the auto-ionization reaction of water.

j. Describe how acids and bases are formed from oxides and water.

k. Describe the relationship of the  $H_3O^+/OH^-$  balance in a solution to the acidity or basicity of that solution.

l. Define pH.

m. Calculate pH from the hydronium ion concentration and vice versa.

n. Use the value and equation for  $K_w$  to calculate either the concentration of hydronium ion or the concentration of hydroxide ion when the other is known.

o. Define an equivalent and calculate the number of equivalents of an acid or base.

p. Define and calculate equivalent weights of acids and bases.

q. Define normality and calculate the normality of a solution.

6. Titrations and neutralization reactions.

a. Write balanced equations ("molecular" and ionic) for acid-base neutralization reactions.

b. Describe titration and explain what it is used for.

c. Use the proper techniques for performing a simple titration.

d. Calculate the concentration of a solution using titration data.

e. Experimentally determine the equivalent weight or molecular weight of a solid acid using titration data.

7. Acid-base strength and equilibrium.

a. Describe equilibrium in terms of reversible reactions.

b. Describe acid strength and base strength in terms of reversible reactions and equilibrium.

c. Recognize and distinguish between strong and weak acids and bases given their formulas.

- d. Write equilibrium constant expressions for acids and bases.
  - e. Relate the strengths of acids and bases to values for  $K_a$  and  $K_b$ .
  - f. Perform calculations relating  $K_a$ ,  $K_b$ , acid concentration, hydronium concentration, and pH.
  - g. Define hydrolysis and recognize substances that will undergo hydrolysis.
  - h. Identify neutral, acidic, and basic salts from their formulas.
  - i. Predict whether and explain why hydrolysis will result in an acidic or basic solution.
8. Reaction rates and equilibrium.
- a. State and recognize Le Chatelier's Principle.
  - b. Apply Le Chatelier's Principle to predict and explain the effects that changes in concentration and pH have on acid-base systems at equilibrium.
  - c. Describe how buffers work.
  - d. Describe the chemical reaction process using the collision theory.
  - e. Describe the bonding and energy changes that take place during chemical reactions.
  - f. Draw, label, and interpret reaction diagrams.
  - g. Do calculations involving amounts of chemicals and heats of reaction ( $\Delta H$ ).
  - h. List the factors which affect reaction rates and describe how they affect the rate.
  - i. Describe how and why the reaction rate is affected by:
  - j. Use the collision theory to explain how chemical equilibrium is attained, altered, and affected by changes made to the system.
  - k. Write equilibrium constant expressions for a variety of chemical reactions and perform calculations using those equations.
9. Oxidation-reduction reactions.
- a. Describe what happens when an electric current is passed through water, an aqueous solution, or a molten salt.
  - b. Name the electrodes used in electrolysis, name and describe the reactions that take place at each electrode, write equations for those reactions.
  - c. Describe the process of electroplating, write equations for the reactions that occur in electroplating.
  - d. Describe the relationship between current, time and amount of chemicals reacting in electrolytic cells.
  - e. Define or describe oxidation-reduction reactions, recognize examples, and explain why oxidation and reduction must occur at the same time.
  - f. Determine which of two chemicals will be more easily oxidized (or reduced), either from trends on the periodic table or from information on an experiment involving the two elements or from a standard oxidation potential (SOP) list.
  - g. Describe voltaic cells.
  - h. List and describe a few important biological processes that consist of oxidation-reduction reactions.
  - i. List and describe methods that can be used to protect chemicals (and things made of them) from oxidation.

Does the content of this class relate to job skills in any of the following areas:

- |                                      |           |
|--------------------------------------|-----------|
| 1. Increased energy efficiency       | <b>No</b> |
| 2. Produce renewable energy          | <b>No</b> |
| 3. Prevent environmental degradation | <b>No</b> |
| 4. Clean up natural environment      | <b>No</b> |
| 5. Supports green services           | <b>No</b> |

Percent of course: 0%

## Section #2 Course Transferability

Concern over students taking many courses that do not have a high transfer value has led to increasing attention to the transferability of LDC courses. The state currently requires us to certify that at least one OUS school will accept a new LDC course in transfer. Faculty should communicate with colleagues at one or more OUS schools to ascertain how the course will transfer by answering these questions.

1. Is there an equivalent lower division course at the University?
2. Will a department accept the course for its major or minor requirements?
3. Will the course be accepted as part of the University's distribution requirements?

If a course transfers as an elective only, it may still be accepted or approved as an LDC course, depending on the nature of the course, though it will likely not be eligible for Gen Ed status.

Which OUS schools will the course transfer to? (Check all that apply)

**PSU (Portland State University)**

**OSU (Oregon State University)**  **UO (University of Oregon)**

Identify comparable course(s) at OUS school(s)

CH LDT Introductory Chemistry (OSU)

CH 105, CH 108 (PSU)

CH 120T (UO)

How does it transfer? (Check all that apply)

**general education or distribution requirement**

**general elective**

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Provide evidence of transferability: (minimum one, more preferred)

**Other. Please explain.**

OSU Course Equivalencies List (online)

Transferology website (PSU, UO)

First term to be offered:

Next available term after approval

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