

Grays Harbor College  
Syllabus

Astro 101 - Introductory Astronomy  
5 Credits

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## I. Course Description:

Astro 101 Introductory Astronomy, 5 Credits

Prerequisites: Math 098 or placement in college level math

This course provides an introduction to the universe beyond the Earth. The course begins with a study of the night sky and the history of astronomy. The course then explores the various objects seen in the cosmos beginning with a study of the solar system followed by stars, galaxies, and the evolution of the universe itself. 5 lecture hours. Satisfies science distribution area E requirement or specified elective for the AA degree.

## II. Aims and Objectives:

The major aims and objectives of this course are as follows:

- A. To develop an awareness and appreciation of astronomy and the beauty of the night sky.
- B. To develop critical thinking skills and to expose students to the scientific process and the scientific method.
- C. To help provide students the skills needed to continue learning throughout their lives.

## III. Desired Student Abilities:

### 1. Competency in the discipline

This course is designed for nonscience majors. Because of this competency in the discipline is not as overriding in importance as it would be for other courses. However, as noted above, it is hoped that students will learn something about astronomy and gain a greater appreciation of astronomy, our place in the universe and the night sky. The various areas which are studied are noted in the section on course content below. These all relate to this area of desired student abilities.

### 2. Literacy

Several areas of the course relate to this desired ability. While the use of math in this course is not extensive, there are several areas where math is used at the algebra level. These provide students some practice in developing their mathematical skills. In this course the students are expected to create a poster (in groups) and briefly present their results to the class. This exercise gives students practice in organizing and presenting results. In addition, several of the weekly homework assignments involve writing short papers which should help to develop student's writing skills.

### 3. Critical thinking

Of all the desired abilities, critical thinking is perhaps the area which can be best addressed in a science course for nonscience majors. One of the major themes of the course is how the scientific process works and the scientific method. In many ways thinking scientifically is to think critically and thus the study of the scientific process and scientific method provides students exposure to critical thinking. In this course several specific studies of the "scientific method in action" are discussed in the course (examining the origin of the moon, the Copernican revolution and Newtonian mechanics). In addition to these specific examples many areas of the course are organized around a study of the observations of the phenomena followed by the hypotheses and theories which have been proposed to explain what is seen. Indeed, one of the

aspects I like about the textbook used for this course is how it is organized around the scientific method. All of these studies provide examples of examining a phenomenon critically and hopefully will help develop such critical thinking skills in the students. In addition, astronomers must use indirect methods to determine the properties of many astronomical objects. Particularly in the discussion of the properties of stars these various chains of inference which are used to go from what we can measure to what we would like to know are emphasized. I believe this is an excellent example of critical thinking and how various thoughts can be tied together.

#### 4. Social and personal responsibility

In this class students are required to turn in various assignments on time and to be courteous of their fellow students (a small portion of the grade is based on “class citizenship” as noted below). In addition working in a group on the poster session as well as in classroom activities should help develop skills needed to work in groups.

#### 5. Use of resources

Several assignments in this course require students to do some research and find information. The poster session requires that students find information from various sources. In addition, some of the homework assignments require students to find some information on their own.

### **IV. Technique of Instruction:**

This course will meet for 5 one-hour lecture sessions per week. Most classes will be taught using a lecture format. Student questions will be encouraged. However, astronomy is a visual science. Thus, slides will be used in numerous class sessions to show astronomical phenomena. In addition, classroom activities will be performed approximately once a week during class periods. It is hoped that active student participation during these periods (as well as during lecture) will help cement the ideas in students’ minds. A midterm and final will be given. Quizzes are given about once a week and are announced ahead of time.

### **V. Organization of Course Content:**

#### A. The Night Sky

1. Daily motion of the stars
2. Constellations
3. Astronomical coordinate systems and the celestial sphere
4. Motion of the sun
  - yearly motion amongst the stars
  - cause of the seasons
5. Motion of the Moon and Planets
  - Phases of the Moon
  - Eclipses
  - Motion of Inferior Planets
  - Motion of Superior Planets
  - Retrograde Motion

#### B. The Birth of Modern Astronomy and Science—The Copernican Revolution

The Copernican revolution is perhaps the quintessential example of the application of the scientific method. The plan for this unit is to examine the development and use of the scientific method during this time.

1. Greek Astronomy
  - Aristotle and the Greek view of the heavens.
  - Greek evidence used to conclude Earth motionless.
  - Ptolemy and his geocentric model of the universe.
2. Copernicus and the heliocentric model.
3. Tycho Brahe—Naked eye observations

## V. Organization of Course Content Continued:

4. Kepler and Kepler's laws
5. Galileo—First observations of the heavens with a telescope
  - the milky way
  - mountains on the Moon and sunspots on the sun.
  - phases of Venus.
  - moons of Jupiter
  - support of heliocentric model.
6. Newton and his law of gravitation
7. The scientific method in action: Newtonian Mechanics
  - Predictions borne out by Newton's law of gravity
    - Motion of planets and the Moon
    - Periodic return of comets
    - Discovery of Neptune
  - Prediction not borne out: Planet Vulcan
    - Abandonment of theory

### C. The Solar System

The plan for this unit is to expose students to the broad properties of the solar system. The major types of objects (Sun, inner planets, outer planets, smaller objects—asteroids and comets) and their properties. This will be done mostly through the use of slides. These basic observations will then be used to examine theories of the formation of the solar system using the scientific method.

1. Properties of the Planets
2. Formation of the Solar System

### D. Atoms and starlight

Almost all of our knowledge of astronomical objects comes from the radiation we receive from them. It is therefore necessary to discuss the properties of matter and how they relate to light for use in later sections.

1. Structure of atoms: protons, neutrons, electrons
2. Bohr model of the atom—electron energy levels
3. Spectral lines
4. Blackbodies
5. Kirchhoff's laws

### E. The Stars

The plan for this unit is to follow a somewhat historical approach. The unit begins with a discussion of how the basic properties of stars can be determined. This discussion culminates with the classification scheme given in the HR diagram. This forms the first step in the scientific method. Models of stellar evolution are then discussed and compared with our observations of the basic properties of stars. Finally, predictions made by the theories of stellar evolution are discussed and compared to observations in accordance with the scientific method.

1. Determining the distance to stars
  - Trigonometric Parallax
  - Other distance indicators
2. Determining the basic properties of the stars
  - Luminosity
  - Temperature
  - Radius
  - Mass
  - Composition

## V. Organization of Course Content Continued:

### 3. Classifying stars—The Hertzsprung-Russell Diagram

- The Hertzsprung-Russell Diagram
- Types of stars seen in the HR diagram
  - Main Sequence Stars
  - Red Giants
  - Supergiants
  - White Dwarfs

### 4. Stellar Evolution

- The struggle against gravity
- Stellar formation
- Life on the main sequence
- Red Giant Phase
- Death of a star
  - Low mass stars
  - Middle mass stars --> white dwarf stars
  - Massive stars --> Neutron stars or black holes

## F. Galaxies

In this unit we follow through the steps of the scientific process. First we examine the basic observed properties of galaxies and a classification scheme. We then examine how galaxies interact (and observational evidence for this) and theories for the evolution of galaxies which are then compared with the observations.

### 1. Classification of Galaxies

- Elliptical galaxies
- Spiral Galaxies
- Irregular Galaxies

### 2. Interaction of Galaxies

### 3. Galaxy Evolution

## H. Cosmology

### 1. Basis assumptions of cosmology

- Homogeneity
- Isotropy
- Universality
- The cosmological principle

### 2. Hubble's law and the expansion of the universe

### 3. The Big Bang theory

- Alternative hypothesis: the steady state theory
- Evidence for the big bang
  - Expansion of the universe
  - Primordial background radiation
  - Abundance of light elements (hydrogen, deuterium, helium)

### 4. The end of the Universe

- Open universe, expansion forever
- Closed universe, "the big crunch"
- Dependence on density of the universe

### 5. Age of the universe

- estimate from expansion of the universe: the Hubble time
- estimation from age of globular clusters

### 6. Accelerating expansion of the universe

## VI. Methods of Evaluation

The course grade will be determined based on the weekly quizzes, lab assignments, a midterm, final and “class citizenship.” Students will be guaranteed of getting at least the grades corresponding to the following percentage scores, you may be given higher scores:

		82–85%	B+	72–75%	C+	60–65%	D+
90–100%	A	79–82%	B	69–72%	C	50–60%	D
85–90%	A–	75–79%	B–	65–69%	C–		

The rough weight given to each area of the grade is as follows:

**Quizzes(18.5%):** Weekly roughly 20 minute quizzes will be given except during the week of the midterm and the week following the midterm. These will usually be on Mondays (Tuesday if Monday is a holiday—if not the date will be announced ahead of time). The two lowest quiz scores will be dropped. Because the two lowest scores will be dropped no make-ups will be given. Students are allowed to earn an extra credit point for each quiz by submitting a proposed multiple choice question for the quiz by the Friday before the quiz is given.

**Homework Exercises and classroom activities (22%):** It is expected that several classroom activities will be performed in class. Students will be expected to write reports on these activities and turn them in. In addition, several homework assignments will be given. In general assignments will be given a value of 20 points but some shorter assignments may be worth less. If the value is not 20 points, the value of each assignment will be announced. A due date will be announced when these assignments are given. Homework and classroom activity assignments will be accepted up to one day late for 75% credit but will not be accepted after that. The lowest 20 points worth of exercises (on average about one exercise) will be dropped.

**Poster Session (8%):** You will be divided up into groups of roughly 5 students. Each group will then prepare a poster discussing an astronomical topic of current interest which will then be presented to the class near the end of the quarter. Individual students will be graded on their participation in this project by the other members of the group while the presentation of the poster will be graded by the other members of the class and the instructor. You will be provided with detailed instructions for how the posters should be prepared.

**Midterm(18.5%):** One midterm will be given (the exact date will be announced ahead of time). The midterm is closed-book. However, you will be allowed to bring one 4" × 6" note card containing any information you wish to the test. If you cannot make the midterm, arrangements can only be made for a make-up test if you contact me *prior* to the exam. Students can earn up to two extra credit points on the midterm by submitting up to two proposed multiple choice problems for the midterm by the Friday before the midterm is given.

**Final (28%):** The final will be comprehensive (covering all areas in the course). As with the midterm the final is closed-book but you may bring two 4" × 6" note cards containing any information you wish. Students can earn up to two extra credit points on the final by submitting up to two proposed multiple choice problems for the final by the last day of class.

**Office Hour Visit Assignment (1%):** I expect everybody to visit me in my office sometime during the second to third week in order for me to get to know you (and you me) and for me to better understand what you hope to get out of the course and to discuss any difficulties you may be having or suggestions you have to improve the course.

**“Class Citizenship” (4%):** This portion of the grade will depend on a number of factors. First and foremost it is expected that you will be considerate of their fellow students and me. You won’t come to class late, will be prepared when you arrive and won’t engage in behavior which disturbs the class or hinders your fellow students’ ability to learn. In addition it is expected that you will participate in class. If I have to warn you twice during a class to be quiet I will ask you to leave for the day. If I have to warn you three times during the quarter I may ask you to leave the class permanently. Cheating may also result in a loss of class citizenship points (if not more).

## VI. Methods of Evaluation continued:

In addition to the above, cheating will not be tolerated. If you are caught cheating at the very least you can expect to get a zero on the assignment and quite possibly for the course. Depending on the infraction additional disciplinary action may be sought.

Review Problems: During the quarter I will be providing you with review problems on the material we will be covering. I encourage you to examine these as they will be helpful in preparing for the tests and quizzes. As additional incentive, I will collect these often (~2 times per week). While it is possible to get 100% in the course without turning in the review problems, turning these in can only improve your grade and will reduce the importance of the tests and quizzes in this course. For example, if you got 100% on all of these review sheets the total percent of the grade based on tests would be reduced from 65% to 54% with the review sheets accounting for the remaining 11%. Performing less of the exercises will result in a smaller reduction in the importance of the tests. The exact procedure used is described below:

Without the review sheet questions, the average score based on the quizzes, midterm, and final would be given by:

$$\text{Total Test \% Score} = \frac{0.185 \times \%_{Quiz} + 0.185 \times \%_{Midterm} + 0.28 \times \%_{Final}}{0.185 + 0.185 + 0.28}$$

If a student has turned in review sheet questions this average will be calculated as follows:

$$\text{Total Test \% Score} = \frac{0.185 \times \%_{Quiz} + 0.185 \times \%_{Midterm} + 0.28 \times \%_{Final} + 0.28 \times \%_{ReviewSheets}}{0.185 + 0.185 + 0.28 + 0.13 \times (\%_{ReviewSheets} / 100)}$$

In essence work on the review sheets will be averaged into the test and quiz scores as a 100% score worth up to as much as 3/4 the midterm. Let us look at an example: You have done all the review sheets (earning 100% on these) but have unfortunately struggled on the tests (earning an average of 50% on these). In this case your % score on the tests and quizzes would become:

$$\text{Total Test \% Score} = \frac{0.185 \times 50 + 0.185 \times 50 + 0.28 \times 50 + 0.13 \times 100}{0.185 + 0.185 + 0.28 + 0.13} = 58.3$$

The table below shows some further examples. To read the table find the column corresponding to the review sheet score and read down to the row corresponding to the tests & quiz score.

		% Score on Review Sheets				
		0	25	50	75	100
% Score on Tests & Quizzes	50	50.0	52.4	54.5	56.5	58.3
	75	75.0	76.2	77.3	78.3	79.2
	85	85.0	85.7	86.4	87.0	87.5
	100	100.0	100.0	100.0	100.0	100.0

As can be seen the lower one's test and quiz scores the larger the benefit in doing the review sheets.