

## Honors Astronomy: Solar and Galactic Syllabus

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### Introduction

You can't play a game if you don't know the rules, and the more you know the rules the more you enjoy the game. Astronomy is a science that offers you the chance to learn the "rules" from an all-encompassing point-of-view, from the atoms within our cells to the motions of galaxies and the energies in distant quasars! So, to learn Astronomy is to learn about ourselves and the arena of physical and natural laws that govern all aspects of our lives.

This course will also teach you to become critical thinkers and develop analytical reasoning that will give you problem-solving skills that apply across all disciplines. To that end, an inquiry-based instructional environment is utilized, one in which the traditional practice of "I do-we do-you do" is reversed. There will be many practice problems, assessments, and homework assignments – it is imperative that you complete all work to the best of your ability. Science is learned by doing, not by watching.

So let's get ready to learn about "our place in space."

### Pre-requisite Skills

Students are sometimes surprised to learn that Astronomy, by being a branch of physics, does involve some mathematical skills. As we move from our planet outward, we must consider distances, mass, energies, orbital dynamics, gravitational influences, and much more. It is assumed you are comfortable with:

- Multivariable Algebra
- Creating and reading data tables and graphs
- Basic trigonometric functions – sine, cosine, tangents, and triangulation
- Interpreting geometric equations
- Basic computer and Microsoft skills (Word and PowerPoint)

Since Honors Astronomy S/G is, at minimum, a third-year science course, you are also expected to be familiar with:

- Metric prefixes
- Power of ten notation
- Unit conversions
- Understand logarithms, some statistical interpretation, and work in 3-dimensions (x, y, z)

Some review will be provided as the course progresses, but there will be no formal lessons in these topics.

## **Course Website**

The course has a website, which you may access at:

[www.physics-is-phun.org/home](http://www.physics-is-phun.org/home)

Once there, select “Honors Astronomy” from the main menu. Assessments, textbooks, classroom materials, a calendar, and other tools are there for you to utilize. A password is required to enter the Honors Astronomy section, which will be provided.

## **Supplies Needed**

- Binder with Tabs
- Protractor and Drafting Compass
- A Cardinal Compass (may be an app on your phone – see below)
- Graphing Paper
- Standard Twelve-inch ruler (wood or plastic)
- Scientific Calculator (it does not need to be a graphing calculator!) For example, Office Max in Oakleaf Town Center sells a Casio fx-300MS Plus calculator for under \$10.

## **Cell Phone Policy**

No cell phones, tablets, or earbuds are allowed in the classroom – keep them quiet and put away! There is a space in the classroom where phones and other devices will be stored if phone use becomes an ongoing problem. Anyone caught using a cell phone will face the following discipline, as outlined in the Student Planner:

1<sup>st</sup> Offense: 1 day ISS/2 days lunch detention      2<sup>nd</sup> Offense: 2 days ISS or 1 day OSS      3<sup>rd</sup> Offense: 2 days OSS

## **Grading**

Formative Assessments: 20%      Lab/Observing Work: 25%      Summative Assessments: 55%

## **Honors Astronomy Late Work and Missed Test Policies**

- Work is expected to be turned in on the due date. In the case of an excused absence, assignments are due the day you return. Late work is subject to a 25% penalty and must be accompanied with a completed Late Work Request Form. No work will be accepted after a unit test.
- If you miss a laboratory exercise with an excused absence, you may be exempted from the work (to be determined by the instructor).
- If you miss a summative assessment (test or exam) and have an excused absence, you have one week to make up that test. Make-up time is by appointment only and will not happen during class time.

### **General Classroom Guidelines**

- We practice and expect respect at all times – to our teacher, our classmates, and ourselves.
- We come to class prepared and excited to learn.
- We appreciate the value of education.
- We work to maintain a positive learning environment.
- We strive to do our best.
- We believe in academic integrity.
- We will keep our classroom and supplies neat.

### **General Classroom Procedures**

- We arrive to class on time, enter in a respectful way, and begin any bell work.
- We raise our hands to be recognized.
- We do not leave our seats unless given permission.
- We do not leave our trash on the floor. Trash is to be thrown out at the end of class.
- We do not eat, drink, or chew gum in this classroom.
- No cell phones or tablets!

### **General Classroom Policies**

- Work is to be turned in on the due date.
  - No work will be accepted after the unit test.
  - A missed test with an excused absence must be made up within one week – Not during class. If the absence is excused, full credit may be earned; if unexcused, a maximum score of 75% may be earned.
  - You are responsible for work from any absence
  - Any act of cheating results in a grade of 0.
  - Do not arrive late for class. Four tardies per quarter yields a referral.
  - Behavior that is not compliant with the student handbook will be addressed by the procedures outlined in the handbook.
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## **AND NOW THE FUN STUFF!**



### **Personal Technology Use and Policies**

Cell phone/tablet use is prohibited during lesson/lecture times. However, there are some great apps that we can use to make the learning of Astronomy more interactive and visual. Please download the following free apps to your smart phone or device.

- Star Walk 2 Free
- Just a Compass (Free & No Ads)
- CamSextant

Note: Scientific calculators are available for smart phones and tablets; however, you may not use your smart device during a test!

## Projects and Activities

Astronomy is a wonderful science in that there can be so much to learn just by going outside at night and gazing at a starlight night. To that end, there will be many homework projects that you are expected to complete by making your very own observations. It is up to you to be responsible and be able to work unsupervised. Many grades will come from your observing logs and graphs.

Every student is also expected to maintain a “Constellation Notebook.” This can be separate from your class binder or simply be a tab in the back of it. However, students will learn about constellations from peers: Every student will be assigned a constellation and be expected to give a presentation to the class. More instructions will be given after the first few weeks. You are expected to be respectful and diligent as your peers present – quiz and test questions will come from these discussions.

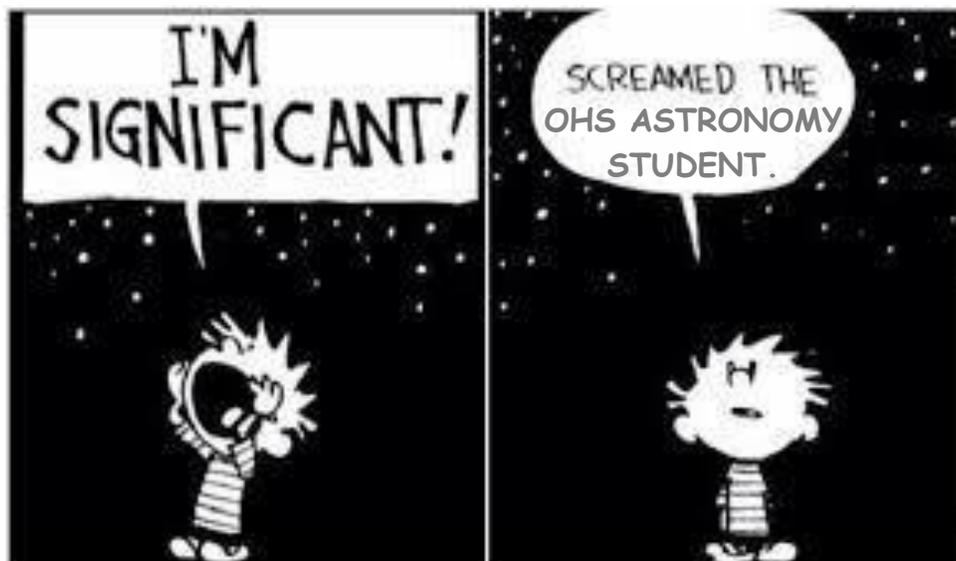
## Nighttime Observing

What fun is an Astronomy course if you don’t look at the beauty of the heavens with a telescope? You will have the opportunity to do some solar observing during class (don’t EVER look at the Sun with your naked eyes!) and learn the basics of the different types of telescopes and how to use them. There will be several viewing sessions offered in the evening, at you are expected to attend one. There are also several outreach opportunities you may be interested in – more to come as the class progresses.

Remember that our telescopes are delicate (and expensive!) instruments and not toys. You are responsible for the equipment when you are using it. Do not horseplay, rough-house, or misuse the instruments. If you have any questions, it is better to ask than risk damaging the equipment or yourself.

## Final Thoughts

While the notion of learning about the entire universe may seem intimidating at first, it will be a fun and rewarding journey. Come to class, do the work and projects as they are assigned, and listen carefully in the lessons and you will a “stellar” time with the class. Do not be afraid of astronomy – it is over everyone’s heads!  
*\*Rimshot\**



## Course Topics Semester One

- I. Introducing Astronomy
- II. Astronomy and the Scientific Method
- III. Astronomer use angles to denote the positions and apparent sizes of objects in the sky
- IV. Scale of the Universe – powers of ten notation
- V. Astronomical Distances
  - a. Astronomical Unit
  - b. Light-year
  - c. Parsec
- VI. Why Astronomy?
- VII. Early Astronomy: Myth and Science
- VIII. Celestial Sphere – geocentric model
- IX. Early Greek Astronomy
- X. Later Greek Astronomy
- XI. Ptolemy and His Geocentric Cosmological Legacy
- XII. Copernicus and the Heliocentric Hypothesis
- XIII. Tycho
- XIV. Kepler
  - a. Conic Sections
  - b. The orbit of Mars
  - c. Kepler's Three Laws
- XV. Galileo
  - a. Experiments in Kinematics
  - b. Heliocentric Cosmology
  - c. Observations
- XVI. Fundamentals of Astrophysical Concepts
  - a. Isaac Newton
  - b. The Two-body problem
  - c. Newton's Modifications of Kepler's Third Law
  - d. Determination of the Masses of Planets and Stars (Kepler's Third Law)
  - e. Tides
  - f. Modern Description of Gravity
  - g. The Four Fundamental Forces of Nature
  - h. The Five States of Matter
- XVII. The Celestial Clockwork
  - a. The Foucault Pendulum
  - b. The Coriolis Effect
  - c. Astronomical Coordinate Systems
    - i. Altitude-Azimuth
    - ii. Right Ascension-Declination
  - d. Seasons
  - e. Time
  - f. Calendars
- XVIII. Eclipses
  - a. Solar Eclipses
  - b. Lunar Eclipses
- XIX. The Nature of Light and Matter (K)

- a. The Speed of Light
  - b. Electromagnetic Radiation
  - c. Wave-Particle Duality
  - d. The Electromagnetic Spectrum
  - e. Radiation and Temperature
  - f. Spectroscopy
  - g. The Doppler Effect
- XX. Telescopes and Optics
- a. Light-gathering Power
  - b. Refracting telescope (K)
  - c. Reflecting Telescope
  - d. Types of Mounts
  - e. Astrophotography and CCDs
  - f. Spectroscopy
  - g. Telescopes of Other Wavelengths
  - h. Light Pollution
  - i. Arecibo
  - j. Mauna Kea

## Semester Two

(More Details will be Provided in January)

- I. Absolute and apparent magnitude, standard candles
- II. Fundamentals of astrophysical concepts
- III. Overview of our Solar System
  - a. Formation
  - b. Layout
  - c. Terms (Pluto),
  - d. Other solar systems
- IV. Earth as a planet
- V. Earth-Moon-Sun
  - a. Origin of the Moon
  - b. Eclipses
  - c. The Apollo Program
- VI. Our Sun, a Star
  - a. Temperature and heat transfer
  - b. Structure
  - c. Mass loss
  - d. Nuclear reactions 1
- VII. The Inner Solar System
- VIII. The Outer Solar System
- IX. Solar System Interlopers
  - a. Asteroids
  - b. Comets
- X. Stars
  - a. Absolute and apparent magnitude
  - b. Formation
  - c. H-R diagram

- d. The life cycle of stars
  - e. Nuclear reactions 2
  - f. Classification of stars
  - g. White dwarfs, neutron stars, and black holes
- XI. Nebulae
- XII. Star Clusters
- a. Open
  - b. Globular
- XIII. The Milky Way Galaxy
- XIV. Extragalactic Galaxies
- a. Hubble classification (tuning fork)
  - b. Galactic cores
  - c. Quasars
- XV. Cosmology and the early universe
- a. Hubble's constant
  - b. Age of the universe
  - c. The Big Bang
  - d. String theory and cosmology

## Acknowledgements

Please read and fill out this acknowledgement page and return to Mr. Webber.

I, \_\_\_\_\_, have read the syllabus for Honors

Name of Student

Astronomy S/G. I understand Mr. Webber's Guidelines, Procedures, and Policies, including the use of cell phones and tablets, and the expectations of me, including the time and work expected outside of class. I also understand the discipline and academic consequences for not living up to those expectations. I recognize that the course will require discipline, planning, and studying on my part.

\_\_\_\_\_  
Signature of Student

\_\_\_\_\_  
Date

As the parent(s)/guardian(s) of the above named student, I/we also understand the Guidelines, Procedures, and Policies of Mr. Webber's class. In addition, I/we understand the academic demands of the course and will provide support to our student, Mr. Webber and the class as a whole.

\_\_\_\_\_  
Signature of Parent/Guardian

\_\_\_\_\_  
Date

\_\_\_\_\_  
Parent/Guardian Email

\_\_\_\_\_  
Phone