

SYLLABUS

ASTR 1023 (N): Stars, Galaxies, and the Universe

2020 Spring Semester

1 OVERVIEW

Purpose

Welcome! This course examines the greater Universe beyond the Solar System, the plausibility of interstellar travel, and the search for extraterrestrial intelligence. You will also be introduced to astronomical observing, and the practice of science.

Lectures

Physical Sciences Room PS 141

TR 2:00p–3:15p

Coursework Return

Graded projects and exams will be returned in class the first week after they were due or administered. After that week, contact the astronomy Teaching Assistants to obtain your papers. Keep your graded projects until final grades have been posted to Self Service.

Astro Web Page

Announcements, TA information, and point totals and test results for the class as a whole will be posted on the Astro Web Page at <http://physics.okstate.edu/shull/courses>. Check it often! Copies of the *free* textbook, course handouts, and study aids are also downloadable from there. As a convenience, your individual numerical scores for each project and exam will be posted on Canvas at <http://canvas.okstate.edu>. **Disregard all other score information about this course that is on Canvas.**

Professor

Dr. Peter Shull

pos@okstate.edu

405-744-5785

Office Hours: in PS 150, TR 10:00a–11:30a, or by appointment

Teaching Assistants

The TAs' names, email addresses, and office hours are posted on the Astro Web Page. They are also available by appointment. They can help you with your weekly projects.

Required Texts

Exploring the Universe with Voyager 4, 3rd edition, by Monson and Shull (ISBN 978-1-5249-4980-8). Buy only a new copy of this workbook, to ensure you will have all the removable pages you will need to submit later. Its OSU bookstore price is \$79.25.

Former ASTR 1013 students may use earlier editions purchased then. A printed or ebook version may be ordered directly at <https://he.kendallhunt.com/shull-monson>.

Astronomy, a **FREE** PDF textbook. Download it from the Astro Web Page. An **optional**, full-color, hardcover, printed version (ISBN 978-1-938168-28-4) is available for \$43.50 used at the OSU bookstore. The bookstore uses "OpenStax" as the author's name.

Books and Magazines of Interest

Norton's Star Atlas, any edition (great star charts)

Observer's Handbook 2020, ed. James Edgar (the year's events)

Astronomy and Sky & Telescope (popular, monthly magazines)

2 GRADING

Point Values

Up to 1000 points can be earned as listed below. Unannounced, extra-credit quizzes may

be given from time to time. Note that we drop the lowest two of the twelve projects.

Comprehensive final exam	300 pts
3 one-hour exams @ 150 pts each	450 pts
Top 10 of 12 weekly projects @ 25 pts each	250 pts

Grading Scale

Semester grades will be assigned according to a point scale similar to the preliminary one below. These grade "floors" may be shifted slightly downward for fairness.

A: 750 pts	B: 650 pts	C: 550 pts	D: 450 pts
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Project and test scores are reported as percentages. It is easy to convert percentages to points. For example, 60% on a project equals $60\% \times 25 \text{ pts} = 0.60 \times 25 \text{ pts} = 15 \text{ pts}$.

To predict your semester grade at any time, use the equation below to predict your semester point total, then refer to the point scale above.

$$\text{Point prediction} = (\text{average project } \%) \times (250 \text{ pts}) + (\text{average exam } \%) \times (750 \text{ pts})$$

For example, if your project average is 80% and your exam average is 60%, your point estimate is 650 points, which is a B. Students who earn semester grades of "C" or higher typically do most of the projects and score at least 45% on their tests.

Policy for Missed Projects and Exams

NO MAKE-UP EXAMS OR EXTRA-CREDIT ASSIGNMENTS WILL BE GIVEN. If you anticipate a problem not covered by the following provisions, see Dr. Shull *well in advance*.

- (1) Your lowest two of the twelve project scores, including zeroes, are automatically dropped.
- (2) Project Reports may be submitted early to the Physics Office staff in PS 145.
- (3) If a sudden emergency makes you miss an exam, contact Dr. Shull immediately. If you present documentation acceptable to him (such as a physician's note), your exam score will be set equal to the weighted average of your other three exam scores. This can be done only once. Any additional missed exams will be assigned zeroes that will be included in the semester grade calculation. Personal travel plans do not qualify.

3 EXAMS

Exams consist of multiple-choice questions evenly covering the relevant lectures. Some lecture topics are not in the textbook. Readings reinforce the lectures. The **hour exams** have 25 questions each. Expect about three questions per lecture. The **final exam** has 25 questions over the newest topics, plus 25 *new* questions over the topics of the previous three exams. Exam dates are in the Course Schedule on page 7. Bring erasers and pencils to every exam.

A few questions on each exam may involve simple arithmetic or algebra, but calculators are neither necessary nor permitted. The Mathematics Learning Success Center on the fifth floor of the Edmon Low Library can help you. Or, just *google* math topics of interest.

Study tips:

1. Attend every lecture. Some lecture topics are not in the textbook. Listening and taking notes by hand makes you learn better. And don't play with your devices!
2. Study every day! Lectures only highlight course topics. It may help to write down in your notes the corresponding textbook page numbers. According to OSU's academic

regulations, you should study six hours per week for this course.

3. During the first week, read the "Chapter Outline" and "Thinking Ahead" sections at the beginning of each chapter we will cover. Skim each week's reading assignment *before* Tuesday's lecture. Read each assignment at least twice, including the illustrations, diagrams, and their captions. It is normal to have to read scientific material several times to fully comprehend it.
4. Use Voyager 4 to visualize and understand the astronomical phenomena we study.
5. Start studying for exams a week in advance. Cramming will not work. Look at the "Chapter Review" section at the end of each chapter. Some exam questions will require the *recollection* of facts. Others will require the *application* of what you *understand* about natural phenomena (i.e., the answers are not explicitly in your notes or text).
6. Sample exam questions can be downloaded from the Astro Web Page, as well as a list of lecture topics that will help you organize your notes. It also pays to figure out the correct answers to any questions you missed on previous exams.
7. Form a study group (via social media?) with classmates for studying and comparing notes. Copies of notes for missed lectures will not be provided.
8. Download the "Syllabus Attachment", which answers general academic questions often asked by OSU students, at <http://academicaffairs.okstate.edu/content/resources-students>.

4 VOYAGER PROJECTS

Read this entire section (pages 3–6) before doing your first project! All projects utilize the fantastic Voyager 4 sky simulator program, which is accessible in these OSU computer labs: (1) Classroom Bldg CLB 407–408 (2) Math Sciences MS 108 (3) Physical Sciences PS 102

General Project Information

1. Each week you will complete one Project Report in the *Exploring the Universe with Voyager 4* project book. ***They are not always due in numerical order!*** The pages are perforated for easy removal. Reports are due at the beginning of class on the dates listed in the schedule on page 7. You may submit Reports ahead of time in room PS 145. ***If Project 3 is due this semester, start early on it, because it requires observing the sky!***
2. Do the projects on your own schedule. Labs are usually open every day, as posted weekly at each lab's entrance. The MS 108 lab is always open.
3. Voyager 4 orientation will be held in class on the date listed in the Course Schedule.
4. For all Projects involving Stillwater locations: Stillwater is listed on the pull-down menu for the "Chart/Set Location..." command.
5. If you have already taken ASTR 1013, we will re-use your Project 1 and 2 scores. When Project 1 is due, submit a sheet of paper with your name, e-mail address, and a phrase like "Please re-use my Project 1 and 2 scores from the Fall semester of 20__".
6. Ask the TAs or Dr. Shull whenever you have questions about the projects. Any signs of copying, etc., on a project will lead to severe penalties (see Tip #8 above).

Computer Lab Information

1. The PS 102 lab has Mac computers ☺, the others have Windows computers.

2. You may need your student ID card to enter the labs.
3. Knowing about Voyager 4 is not part of the lab monitors' duties. Contact Dr. Shull or a TA whenever you have questions concerning the program.

Starting Up the Voyager 4 Program

In case of computer hardware malfunctions, please advise the lab monitor, then go to another computer or lab.

OSU's site license allows only 60 copies of Voyager 4 to run simultaneously.

To ensure the correct program settings are loaded, **always launch Voyager 4 yourself.**

Instructions for Mac computer lab in PS 102:

1. Go to one of the 15 Macs and log on with your user name (OSU email address) and password.
2. Wait for the desktop screen to appear. Then...
3. In the "dock" at the screen's left edge, click on the "Voyager 4.5" icon (looks like Saturn).
4. If a message window appears about updating or registering things, click on "Cancel".

Instructions for Windows computer labs:

1. Find a PC and log on with your user name (OSU email address) and password. A lab monitor can help.
2. Click on the "Voyager 4.5" icon on the desktop of the screen (looks like Saturn).

Printing Sky Charts

1. **Exactly** follow all the instructions in the section titled "Printing Sky Charts" on page 5 of *Exploring the Universe with Voyager 4*. You must use the "**landscape**" page layout to make the printout match the screen. Exceptions: For Projects 1, 7, 17, 18, 23 and 24, maps of the entire sky (round outline) may come out better with the "**portrait**" layout.
2. If your output doesn't seem to appear at the printer, make sure you are checking the correct printer, and that it is working. Again, the lab monitor can help.
3. You may occasionally find it convenient to save your sky charts as PDF files that you can copy to a jump drive and print out later. This can also be useful for printout that does not come out looking exactly the way you want it to.

Mac users: issue the "Print Sky Chart..." command, then click the PDF button in the window that opens.

Windows users: issue the "Print Sky Chart..." command, then select "PDF Creator" from the printer list near the top of the window that opens.

4. IMPORTANT TIPS FOR WINDOWS USERS:

TIP #1: Before printing a Sky Chart, click the "Reduce Down" button at the top right of the window to make it smaller. This seems to help keep the program from crashing (due to lab network overload) when you make a printout. Click the button again to restore the window's original size.

TIP #2: To print the charts generated by the "Print Satellite Map...", "Print Solar

Neighborhood...", and "Print Binary Orbit..." commands in *Projects 13, 19, and 21*, respectively, do the following:

- Press the "Screen Print" button (often ScrPnt) near the keyboard's top right corner to copy the screen.
- Create and open a blank Word document file.
- Right-click on the open Word document to see a list of options that includes a Paste option. Click that to paste the screen copy into the document.
- Print the Word file.

Shutting Down the Program

Mac users: Log out via the Apple icon menu at the left end of the top menu bar.

Windows users: Log out via the "Logout and Reboot" button at the lower left of the screen.

Rules for Doing the Projects

1. Start your projects at least two days in advance! You will enjoy them more, and protect yourself against difficulties. Check lab hours in advance of holidays to avoid surprises.
2. Always work independently. *Never* copy someone else's work, data, cursor readings, etc. Do all your work yourself. When in doubt, consult an astronomy TA or Dr. Shull.

Exception: it is all right to show a classmate *how* to do a general task, or to explain a scientific principle. For example, it's okay to help someone learn to print a star chart or understand equatorial coordinates. However, do not use a Project's actual situations or numbers when doing so. List on your Reports the names of any people who helped you.

3. Submit only the perforated Project Report pages from your project book and any required printouts. Submissions not using the perforated Report pages from your project book will not be graded (photocopying them is illegal). Do not email scans or photos of your Report pages!
4. On the first page of every Report, in the "Goal:" area below your name, copy or paraphrase the "Goal" from the first page of the Project.
5. Staple Report pages in order, printouts last. Points may be deducted otherwise.
6. *Show all calculations*, even simple ones. Write in the margins if you need extra space. Answers not showing the supporting math, even if correct, will receive zeroes.
7. In the "Conclusions" section, use a few *complete sentences* to briefly describe what you learned. Grading criteria are primarily spelling and grammar.
8. Write legibly, especially your name. The easier your Report is to read, the more generously the TAs will grade! You might want to initially write your answers on scratch paper, and later transfer them to the Report.
9. Express yourself clearly. Answers that cannot be easily understood will receive zero credit. You may use *clearly labeled* graphs and drawings.
10. Please advise Dr. Shull if you have a medical condition, e.g., color blindness, that may adversely affect your ability to do certain Projects.

5 ASTRONOMY WEBSITES OF INTEREST

Visit the sites below for the latest images of astronomical objects. You can also *google* the

names of specific objects, observatories, and space missions.

Hubble Space Telescope: <http://heritage.stsci.edu>

National Optical Astronomy Observatory: http://www.noao.edu/image_gallery

European Southern Observatory: <http://www.eso.org/public/images>

Learn about OSU's research observatory at <http://www.physics.okstate.edu/observatory>.

Join the Planetary Society to support Solar System exploration and receive a great magazine:
<http://planetary.org>.

Find information on careers or summer jobs in astronomy at the American Astronomical Society's website: <http://aas.org>.

6 TAKE ASTR 1013 IN A FUTURE FALL SEMESTER!

ASTR 1013 (N) – The Solar System. The latest about the Sun, planets, moons, asteroids, meteoroids, and comets; formation and future of the Solar System; interplanetary travel, colonizing and terraforming Mars, and the search for extraterrestrial life. No prerequisites.

ASTR 1013 and ASTR 1023 both...

- meet TR in PS 141 (but ASTR 1013 meets at 10:30a–11:45a)
- use the same two books
- carry 3 hours of general education "N" credit

LECTURE TOPICS, READING, AND IMPORTANT DATES

Abbreviations: Ch 2.4 means Chapter 2, Section 4, in your textbook titled Astronomy

The projects are not always due in numerical order, and sometimes there are gaps!

Lecture numbers are preceded by the # sign.

- Required reading for this week: Ch 1.1–1.3, 1.5–1.9, 2.3, 19.1
- Jan 14 #1 Cosmic Overview; the Nature of Science
Jan 16 #2 What Science Isn't; How to Use the Voyager 4 program
- Required reading: Ch 1.4, 2.1–2.2, 2.4, 3.1, 4.1, 17.1, 19.1, 26.1, App. C & D
- Jan 21 #3 The Terrestrial Coordinate System; Apparent Magnitudes; Neat Math
Jan 23 #4 Celestial Coordinate Systems; Evolving Models of the Universe
- Required reading for this week: Ch 3.2–3.3, 16.2, 24.1–24.2, 24.4
- Jan 28 #5 Evolution of the Classical Theory of Gravity; Special Relativity
Project 1 due: Introduction to Voyager 4
- Jan 30 #6 Special Relativity (cont.); General Relativity & Gravity
- Required reading for this week: Ch 6.1–6.2, 24.3, 24.7
- Feb 04 #7 Tests of Special & General Relativity; Light
Project 2 due: Celestial Coordinates
- Feb 06 #8 Optical Telescopes; Observing with the Eye, Binoculars & Telescope
- Required reading for this week: Ch 5.1–5.5, 6.3–6.6
- Feb 11 #9 Telescope Instruments; Radio & Flying Telescopes; Atoms; Continuous Spectra
Project 13 due: Earth Satellites
- Feb 13** #10 Line Spectra
Exam on Lectures 1 – 8
- Required reading for this week: Ch 5.6, 15.1–15.4, 16.4, 17.4, 19.2
- Feb 18 #11 Uses of Spectra in Stellar & Galactic Astronomy; the Quiet Sun
Project 17 due: Stellar Magnitudes and Light Pollution
- Feb 20 #12 The Active Sun; Distances & Motions of Nearby Stars
- Required reading for this week: Ch 17.1–17.4, 18.1–18.4, 19.4
- Feb 25 #13 Stellar Luminosities, Magnitudes & Radii; Classification of Stars
Project 18 due: Proper Motion
- Feb 27 #14 The Hertzsprung-Russell Diagram; Visual Binary Stars & Stellar Masses
- Required reading for this week: Ch 18.2–18.4, 20.1–20.3, 21.1
- Mar 03 #15 Other Binary Stars; Stellar Mass & Density Trends; Interstellar Gas & Dust
Project 19 due: The Sun's Stellar Neighbors
- Mar 05** #16 Interaction of Interstellar Gas & Dust with Light; Star Formation
Exam on Lectures 9 – 15

- Required reading for this week: Ch 16.1–16.3, 19.3, 21.2, 22.1–22.4, 23.1
- Mar 10 #17 Normal Stars: Energy Production, Structure & Life Spans
Project 20 due: The Hertzsprung-Russell Diagram
- Mar 12 #18 Stellar Evolution: Red Giants, White Dwarfs & Planetary Nebulae
- Mar 16–20 Students' Spring Break
- Required reading for this week: Ch 20.4, 22.5, 23.2–23.5
- Mar 24 #19 Stellar Evolution: Supernovae & Supernova Remnants
Project 21 due: Binary Stars
- Mar 26 #20 Novae & Supernovae in Binary Star Systems; Neutron Stars & Pulsars
- Required reading for this week: Ch 19.3, 20.4, 20.6, 24.5–24.6, 25.1–25.5, 26.2–26.4
- Mar 31 #21 Black Holes; Our Milky Way Galaxy
Project 22 due: A Star Cluster in Three Dimensions
- Apr 02 #22 Our Milky Way Galaxy (cont.); Types & Distances of Galaxies
- Required reading for this week: Ch 26.3–26.5, 28.1, 28.5
- Apr 07 #23 Sizes & Masses of Galaxies; Clustering of Galaxies; Galaxy Collisions
Project 23 due: The Milky Way
- Apr 09 #24 Formation of Galaxies
Exam on Lectures 16 – 23
- Required reading for this week: Ch 27.1–27.3
- Apr 14 #25 Active Galaxies and their Central Black Holes
Project 24 due: The Hubble Law
- Apr 16 #26 Kinematic & Cosmological Redshifts; Quasars
- Required reading for this week: Ch 28.4, 29.1–29.6
- Apr 21 #27 Cosmology & the Big Bang; the Shape of the Universe
Project 3 due: Learning the Night Sky
- Apr 23 #28 Age & Size of the Universe; Its Very Beginnings & Possible Futures
- Required reading for this week: Ch 21.3–21.5, 30.3–30.4
- Apr 28 #29 Beyond the Solar System: Prospects for Life & the Search for Intelligence
- Apr 30 #30 Interstellar Travel by Space Probes & Humans; Plausible Starship Engines
- May 01 **Last day to resolve grading-related issues**
- May 05 (Tues) Comprehensive Final Exam** (PS 141, 2:00p – 3:50p)
The answer key will be posted on the Astro Web Page (after the test!).
See the "Exams" section on page 2 for details about exam topics.