



# Galactic Astronomy (ASTRO 120)

Spring 2024

SCI 04407/L



BALL STATE  
UNIVERSITY

## Instructor



(Myself & husband in the back. My two nieces with SIL and her husband)

### Krista Hook

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Office: Elliot Hall – B027A

Indiana Academy for Science,  
Mathematics, and Humanities,  
Ball State University  
Muncie, IN 47306

### Office Hours:

Monday: 2pm – 5pm

Tuesday: By Appointment

Wednesday: 2pm – 5pm

Thursday: 12pm – 3pm

Friday: 2pm – 5pm

Email me for alternative meeting arrangements.

### Required Materials

- Astronomy – OpenStax (Online Text)
  - <https://openstax.org/details/books/astronomy>
- Bennett et al., The Essential Cosmic Perspective, 8th Edition
- Computer Access w/ Internet and Microsoft Excel (or equivalent)
- 1 three-ring binder
- Scientific Calculator (example: TI-30)

### Meeting Times

MWF: 1PM – 2PM (Class)

T: 6PM – 8PM (Lab)

### BSU Credits

**Ball State University:**

College of Science and Humanities: Department of Physics and Astronomy

**Course Credits: 3**

**Course Name: ASTRO 100**

### Course Requirements and Specifications

**Prerequisite:** Algebra I

**Co-requisite:** Galactic Astronomy Lab (SCI4407L)

**Credit:** 1.5 credits

**Offered:** Spring

## Course Content Overview

Welcome to Galactic Astronomy!

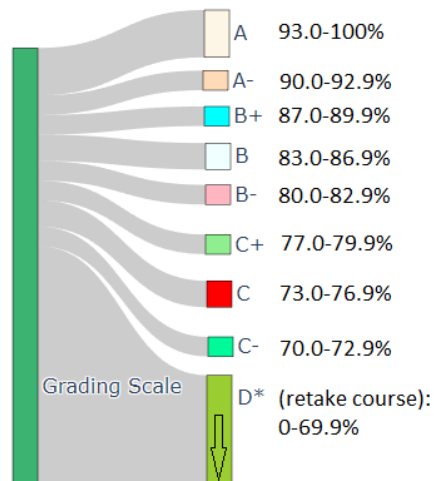
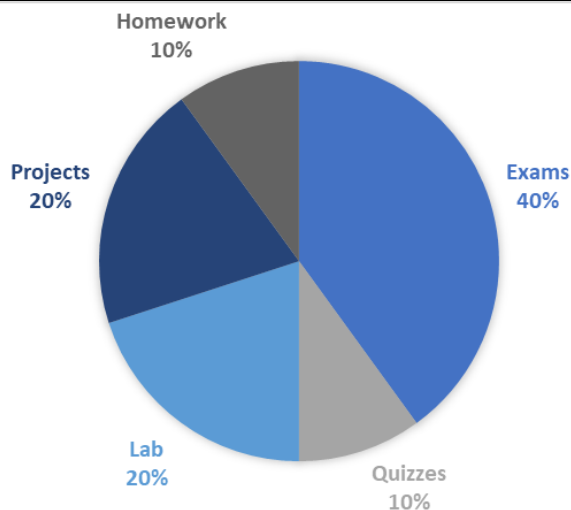
Galactic Astronomy is the second semester of a two-semester introductory course in Astronomy.

This course introduces students to modern astronomy, its historical roots, and its place as a branch of modern physics. Physics topics include gravitation and the motion of celestial bodies, the relation of electromagnetism to light and thermodynamics and their application to astronomy, modern telescopes and their historical roots. Other topics include the structure of the sun and stars, binary stars, the distance to stars, the birth life and death of stars, neutron stars, black holes, the Milky Way, other galaxies, cosmology and the “Big Bang” theory.

Note: In this class, we will not discuss the Solar System or any of the planets in the Solar System. These topics were discussed the fall course Solar System Astronomy. You are not required to take Solar System Astronomy before taking Galactic Astronomy. They may be taken in any order.

\* Ball State University offers 3 college credit hours to students in ASTRO 120 to students who complete this course. Refer to the Dual Credit section for details on enrollment and fees.

# Grade Calculation & Scale



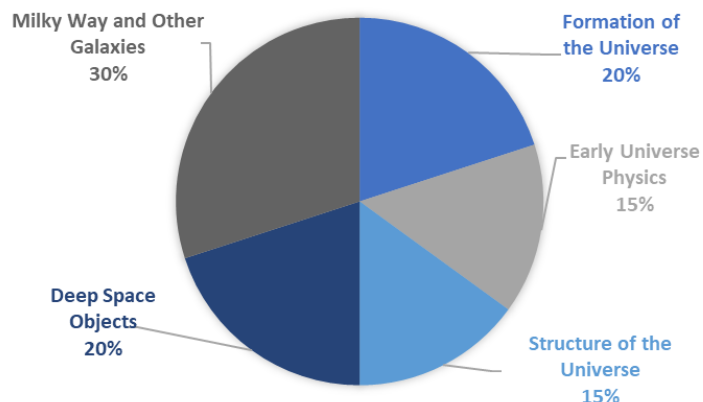
## Course Content & Mastery Goals for Exams

Exams, including the final exam, will be parsed into mastery goals for grade calculations. These parsed categories are listed below for the first and second quarters of the semester, respectively. The benefit of assessing and grading in this way is to afford students the opportunity to provide evidence of learning of a concept (such as Spectroscopy) multiple times and not allow previous, less successful attempts to haunt their final grade for the course. A final grade should reflect what a student KNOWS, independent of their journey to get there.

### Quarter 1 Concepts

Formation of the Universe	20%
Earth Universe Physics	15%
Structure of the Universe	15%
Deep Space Objects	20%
Milky Way and Other Galaxies	30%
	100%

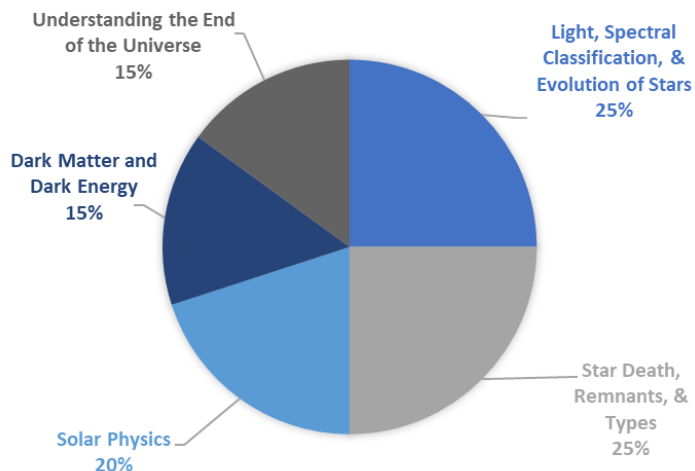
### QUARTER 1



### Quarter 2 Concepts

Light, Spectral Classifications, & Evolution of Stars	25%
Star Death, Remnants, & Types	25%
Solar Physics	20%
Dark Matter and Dark Energy	15%
Understanding the End of the Universe	15%
	100%

### QUARTER 2



# Spring 2023 Tentative Semester Schedule\*

\*When Telescope Astronomy (Weather Permitting) Lab Times are not permitted by weather, the class will still meet in usual room

Week	Lecture	Lab
1 Jan 4 – 5	Unit 1: Formation of the Universe: Big Bang	The Universe's Timeline Project (Start)
2 Jan 8 – 12	Unit 2: Early Universe Physics: Quantum & Macroscopic (Early Galaxies and Population I, II, and III stars)	The Universe's Timeline Project (Work Time)
3 Jan 15 – 19	Unit 3: Structure of the Universe (Hubble's Law)	No Class Monday 01/15/2024 (MLK Jr Day)
4 Jan 22 – 26	Unit 4: Galactic Classifications & Types	Galaxy Modeling Lab
5 Jan 29 – Feb 2	REVIEW Unit 1 – 4	Exam 1: Unit 1 – 4
6 Feb 5 – 9	Unit 5: Dark Matter & Dark Energy (Orbital Motion (Kepler/Newton/Einstein)) (Doppler Shift & Gravitational Lensing)	No Class Monday 02/05/2024 (Extended Weekend)
7 Feb 12 – 16	Unit 6: Deep Space Objects: (Quasars, Blazars, Dust/Gas Clouds, Clusters (open & globular))	
8 Feb 19 – 23	Unit 6: Deep Space Objects: (Planetary Nebula, Magnetars, Supermassive Black Holes, JuMBOs)	
9 Feb 26 – Mar 1	REVIEW Unit 5 – 6  Mastery Exam Available for Units 1 – 4	Parent/Teacher Conferences 03/01/2024 Exam 2: Unit 5 – 6
10 Mar 4 – 8	<b>SPRING BREAK</b>	<b>No Lab (SPRING BREAK)</b> <b>No Class (SPRING BREAK)</b>
11 Mar 11 – 15	Unit 7: Light & Spectra (Interstellar Medium and Star Formation) (Lyman, Balmer, Paschen, and Brackett Series)	Naked Eye Astronomy (Weather Permitting)*
12 Mar 18 – 22	Unit 8: Stellar Physics (Nuclear Physics: P-P, CNO, radiation)	
13 Mar 25 – 29	Unit 9: Blackbodies and Star Classification	
14 Apr 1 – 5	Unit 9: Eclipsing Binaries & Planetary Systems	No Class Monday 04/01/2024 (Extended Weekend) Astronomical Data Lab
15 Apr 8 – 12	REVIEW Unit 7 – 9  Mastery Exam Available for Units 1 – 6	No Class Monday 04/08/2024 (Solar Eclipse) Exam 3: Unit 7 – 9
16 April 15 – 19	Unit 10: Star Life & Death (Low, Medium, High, and Super mass stars) Remnants & Exotic Behaviors	Telescope Astronomy (Weather Permitting)*
17 Apr 22 – 26	Unit 11: Future of Universe and The End? (What it might be – If there is one)	No Class Friday 04/26/2024 (Extended Weekend) Telescope Astronomy (Weather Permitting)*

18 Apr 29 – May 3	REVIEW FOR FINAL	Extra Credit Due – May 3rd ALL assignments & makeups DUE – May 3rd
19 May 6 – 10	FINALS WEEK	TBA

## Spring 2023 Astronomical Calendar

Week	Event Date	Event Description
1 Jan 4 – 5	Jan 3/4: Quadrantids Meteors	The first major meteor shower of 2024, the Quadrantids, peaks on the night of January 3 and the early morning hours of January 4.
2 Jan 8 – 12	Jan 12: Mercury at Greatest Elongation West	This might be a good time to try and spot Mercury: the planet appears at its farthest distance from the Sun in the morning sky.
3 Jan 15 – 19		
4 Jan 22 – 26	Jan 25: Wolf Moon	The first Full Moon of the year is colloquially known as the Wolf Moon in many northern cultures.
5 Jan 29 – Feb 2		
6 Feb 5 – 9		
7 Feb 12 – 16		
8 Feb 19 – 23	Feb 24: Snow Micromoon	February's Full Moon is also known as the Snow Moon in many Northern Hemisphere cultures. In 2024, this is a Micromoon.
9 Feb 26 – Mar 1		
10 Mar 4 – 8	<b>SPRING BREAK</b>	<b>No Lab (SPRING BREAK)</b> <b>No Class (SPRING BREAK)</b>
11 Mar 11 – 15		
12 Mar 18 – 22	Mar 20: March Equinox	The March equinox is the first day of spring in the Northern Hemisphere and the start of fall in the Southern Hemisphere, by astronomical definitions.
	Mar 22: Comet 12P/Pons-Brooks	Comet 12P/Pons-Brooks is 30 days from reaching perihelion, its closest approach to the Sun. The comet might become visible with the naked eye—it might even be visible during the total solar eclipse on April 8.
	Mar 24: Mercury at Greatest Elongation East	This might be a good time to try and spot Mercury: the planet appears at its farthest distance from the Sun in the evening sky.

13 Mar 25 – 29	Mar 24/25: Penumbral Lunar Eclipse	The first eclipse of 2024 is a penumbral lunar eclipse of the Worm Moon visible across North and South America. The Full Moon in March is traditionally called the Worm Moon, after earthworms that tend to appear around this time in many locations in the Northern Hemisphere. For the second month in a row, this is a Micromoon.
14 Apr 1 – 5		
15 Apr 8 – 12	Apr 8: Total Solar Eclipse	A total solar eclipse takes place across Mexico, the USA, and Canada. Roughly 45 million people live along the path of totality for this eclipse.
16 April 15 – 19	Apr 21/22: Lyrid Meteor Shower	The Lyrid meteor shower is expected to peak around April 21 and 22, depending on your location.
17 Apr 22 – 26	Apr 23: Pink Moon	April's Full Moon is traditionally known as the Pink Full Moon.
18 Apr 29 – May 3	May 4/5: Earthshine Mornings	The Waxing and Waning Crescent Moon phases in April and May are the best time to see Earthshine, where the unlit part of the Moon becomes visible. It is also known as Da Vinci glow.
19 May 6 – 10	May 5/6: Eta Aquarid Meteors	Meteor Shower from the Eta Aquarids.

## Classroom Policies\*

\*Subject to change as the need arises.

### Computer/Tablet/Phone Policy

Laptops or tablets are required for lab sessions.

Laptops or tablets are also required for some homework, quizzes, and other activities.

Laptops or tablets are permitted but not required during class for note-taking or other class-related needs.

No game-playing, movie-watching, e-mail, or IM'ing allowed in class -- doing so will result in a recorded absence for that day.

Laptops/iPads, if available, should be brought to class and lab-time. This is so you can record, graph, and analyze your data in real-time and work on assignments on designated "work days" as I plan them.

Use of electronic devices during lecture is forbidden without prior agreement with the instructor.

While in class or lab, please keep computer use restricted to classroom-relevant tasks.

### Withdrawal Deadlines

If you wish to drop your class(es), you must do so by the deadline.

The withdrawal deadline will be announced once published by the University Registrar.

Dropping/Withdrawing from a class at your high school does not drop/withdraw you from your BSU Dual Credit class. Instructions for dropping/withdrawing can be found in the Dual Credit Student and Parent Handbook.

## Attendance Policy

You have made a commitment toward academic achievement by attending the Academy – both attendance and integrity are essential components to that success.

Class attendance is mandatory. An unexcused absence on the day of a lab or test will result in an automatic zero for that lab or test. Missing homework, quizzes and/or tests during an excused absence must be made up as soon as possible. It is the student's responsibility to make arrangements with the teacher.

It is also important that your brain be here as well as your body. Students who fall asleep in class (I'm not \*that\* boring!) will receive either a 'tardy' or an 'absent' mark from the instructor, depending on circumstances. Make sure you avoid this by getting enough sleep the night before!

Late arrivals after 15 minutes into class-time will result in an absence for that day. No exceptions. Excused absences must be arranged before class starts, the paperwork must be filed with Ms. Drumm, Attendance Coordinator.

Students arriving after the start of class may receive a Tardy.

Student is responsible for all information missed due to not being present.

## Late Work Policy

Late work is defined as work that is submitted more than 24 hrs late. Any work not submitted automatically is scored as a zero (0 pts.).

If work is submitted but it has been more than 24 hrs since it was due, the work will be graded with a 50% deduction of points in the gradebook, regardless of delay or reason.

Last day to submit late work will be the Friday BEFORE finals week. After this time, all zeroes (0 pts.) will remain and cannot be made-up or submitted for points.

## Make-up Policies

Make-up exams may only be taken if the student received an excused absence for the missed test.

There are no make-ups for Labs. The lowest Lab grade will be exempted at the end of the semester

## Additional Points

Email me one, school-appropriate, cute photo of a pet (if pet is not your pet, please acquire permission to photograph and submit before doing so). These photos will be presented to the class during the in-class final exam review. Deadline: The Friday BEFORE finals week each semester. Worth: +1% on any mastery exam category of the student's choice at the end of each semester.

## Student Accommodation Policy

Students possessing an educational 504 or IEP should contact the instructor as soon as possible to arrange for any accommodations that may be needed. Likewise, if you feel that you could benefit from an educational 504 or IEP, feel free to contract the instructor to this regard.

I am willing to help students succeed, so feel free to request accommodations with or without the above criteria.

## Lab Reports

Data collection will be done during class only and no make-up labs will be permitted.

Labs will be conducted as a small group, 2 – 3 people per group.

Lab Reports are due each week by each member of the group. Each report is to be written separately but collaboratively discussed.

This means you are writing your own report, but you are free to discuss and compare each other's work before submission.

(Be careful to not plagiarize. Discussions should be consultations only.)

Lab Reports must be submitted digitally on Canvas as a PDF or .DOCX file and data as .JPEG, .PNG, or .XLSX. Data analysis must be submitted as a .XLSX (other formats do not open in Canvas).

Lab reports focus on writing skills, an essential aspect of any professional skillset.

## Resources Available to You

### The Writing Center

All writers improve with practice and feedback, so as a student in this course, you are encouraged to use the Writing Center (in Robert Bell 295, Bracken Library, or online) to get additional feedback on your writing. To schedule a free appointment to discuss your writing, go to [www.bsu.edu/writingcenter](http://www.bsu.edu/writingcenter).

Online and in-person appointments are available seven days a week; however, plan ahead because appointments book quickly!

### The Learning Center

The Learning Center offers free Tutoring and Academic Coaching for many courses at Ball State. Students can make appointments for online (Zoom) or in-person (NQ 350) appointments.

To make an appointment, visit [my.bsu.edu](http://my.bsu.edu) and click on "TutorTrac" in the Additional Tools section, or just go directly to <https://ballstate.go-redrock.com>.

Testing accommodations for students with disabilities are available for students who have received the appropriate documentation from Disability Services. Tests may be administered in the Learning Center.

Supplemental Instruction is available in select courses. If you have an SI leader for your course, that person will provide students with information the first week of school regarding weekly study sessions.

For more information about all of our programming, visit <https://bsu.edu/learningcenter> or call (765) 285-1006.

## Important Information You May Need to Know

### Dual Credit-High School Credit Policy Statement

Students may choose to enroll in Ball State's Dual Credit Program to earn college credit for ASTR 120, the Sun and Stars, from Ball State at a reduced rate of tuition (\$250 flat rate). Students who are eligible for free or reduced lunch this academic year may enroll at no charge if verified by the school.

To enroll in Ball State's Dual Credit Program, students should have a 3.0 GPA on a 4.0 scale and complete the application & registration process before the given deadline. Ball State will bill students via postal mail; no money should be submitted to the high school. College credit can only be earned during the semester (or, in the case of year-long classes, during the academic year) in which the student is enrolled. Late enrollments are not permitted.



Whether college credit earned through dual credit courses will be accepted by another institution of higher education is determined by the college or university to which a student is seeking admission. Before enrolling through Ball State's Dual Credit Program, students should check directly with that institution to determine if a course will be accepted and how it will be counted toward graduation requirements. Refunds will not be issued if Ball State credits are not able to be transferred. In most cases, students will need to earn a C or better to transfer credit from Ball State to another institution. Grades of D or lower earned in Ball State Dual Credit courses are recorded on a student's Ball State transcript but may not be able to transfer.

The rigor of this course will be periodically reviewed by Ball State University faculty in an effort to maintain the high quality of education that each student receives. To learn more about Ball State's Dual Credit Program, visit [bsu.edu/dualcredit](https://bsu.edu/dualcredit), call 765-285-1581 or email [dualcredit@bsu.edu](mailto:dualcredit@bsu.edu).

## **Indiana Academy Diversity Statement**

The Indiana Academy for Science, Mathematics, and Humanities is committed to being an inclusive educational community that values diversity in policy and practice. We aim to foster an educational environment where students, faculty, and staff exchange ideas freely, engage in critical thinking, and reexamine their personal perspectives. To create an environment where this respectful and productive dialogue is possible, we do not allow discrimination on the basis of race, ethnicity, sex, geographic origin, gender, gender identity, sexual orientation, disability, religion, age, or nationality. The affirmation, appreciation, and inclusion of multiple cultures ensures that all students, faculty, staff, and the wider Indiana Academy community will be able to thrive in our multicultural academic and residential environment.

Ball State University aspires to be a university that attracts and retains a diverse faculty, staff and student body. We are committed to ensuring that all members of the community are welcome through valuing the various experiences and worldviews represented at Ball State and among those we serve. We promote a culture of respect and civil discourse as expressed in our Beneficence Pledge. For Bias Incident Response information or to report a bias-based incident, please click here or e-mail [reportbias@bsu.edu](mailto:reportbias@bsu.edu).

## **BSU Student Rights and Responsibilities**

While enrolled in Ball State's Dual Credit Program, you are expected to abide by the academic rules of behavior befitting a university student. You should read the Dual Credit Student and Parent Handbook, located at <https://bsu.edu/dualcredit>

In particular, review the Code of Student Rights and Responsibilities, focusing on the policies regarding student rights and responsibilities, behavior, academic integrity, and related procedures.

The Dual Credit Student and Parent Handbook includes information regarding student qualifications, prerequisites, available courses, responsibilities, financial aid stipulations, transferability, withdrawal, refund and billing policies and more. It is important that you review the information contained in it.

## **Inclusion Policy**

Ball State University aspires to be a university that attracts and retains a diverse faculty, staff, and student body. We are committed to ensuring that all members of the community are welcome, through valuing the various experiences and worldviews represented at Ball State and among those we serve. We promote a culture of respect and civil discourse as expressed in our Beneficence Pledge and through university resources found at [cms.bsu.edu / campus life / multicultural center](https://cms.bsu.edu/campus-life/multicultural-center).

I truly believe in this policy, and endeavor to go above and beyond in our classroom setting. If you see any behavior that goes against the above policy (even if it's mine!), please bring it to my attention (or have someone you trust do so if you are hesitant). Alternatively, you can find the Bias-Incident form at [academy.bsu.edu/forms](https://academy.bsu.edu/forms) to report the incident directly to your DEI Coordinator.



## **Policy on the Americans with Disabilities Act (ADA)**

If you need course adaptations or accommodations because of a disability, please contact the Office of Disability Services. The Office of Disability Services coordinates services for students with disabilities; documentation of a disability needs to be on file in that office before any accommodations can be provided. Disability services can be contacted at 765-285-5293 or [dsd@bsu.edu](mailto:dsd@bsu.edu).

## **Title IX – Sexual Misconduct**

Ball State University is committed to establishing and maintaining an effective, safe, and nondiscriminatory educational environment in which all individuals are treated with respect and dignity. For information about Ball State University's Interim Title IX Policy and Procedures, please visit our website. Please note that the University's policy and procedures have undergone significant revisions starting with the 2020-21 school year and ongoing.

Consistent with the University's Notice of Nondiscrimination and in accordance with the U.S. Department of Education's implementing regulations for Title IX of the Education Amendments of 1972 ("Title IX"), Ball State University prohibits sexual harassment that occurs within its education programs and activities.

This prohibition extends to all applicants for admission or employment and to all students (any status) and all employees (any status). An individual who is found to have committed sexual harassment in violation of this policy is subject to the full range of University discipline, up to and including termination of employment or expulsion. The University will provide persons who have experienced sexual harassment with ongoing remedies as reasonably necessary to restore or preserve access to the University's education program and activities.

Inquiries concerning the specific application of Title IX at Ball State should be directed to Ms. Katie Slabaugh, Associate Dean of Students/Title IX Coordinator in the Frank A. Bracken Administration Building, room 238, 765-285-1545, [kslabaugh@bsu.edu](mailto:kslabaugh@bsu.edu). Persons can also contact the U.S. Department of Education Office for Civil Rights, Washington, D.C. 20202-1328, 1-800-421-3481, [ocr@ed.gov](mailto:ocr@ed.gov).

## **Student Academic Ethics Policy**

Actions which include but are not limited to cheating, plagiarism, falsely claiming to have completed work, cooperating with another person in academic dishonesty, knowingly destroying or altering another student's work, or attempting to commit an act of academic dishonesty that violates the Student Academic Ethics Policy (<http://www.bsu.edu/associateprovost/academicethics>).

The consequences of academic dishonesty are determined on a case-by-case basis by each instructor and may include but are not limited to one or more of the following academic sanctions: informal meeting, removal from dual credit course, dismissal from the university, or other appropriate consequence.

## **Academic Dishonesty Policy**

It is imperative to your continued success that you exhibit academic integrity at all times. This entails:

- never submitting another person's work as your own; this includes LLM and other AI generated information (see: LLM and other AI Fair-Use Policy, below)
- never engage in "drylabing." (artificially manufacturing lab data and submitting it as part of a lab report)
- never cheating on quizzes and/or tests.
- following all ethical standards as described in your student handbook (see "Academic Dishonesty")

**IMPORTANT:** If you feel you have been unfairly accused of failing an academic integrity standard, you have the option and right to appeal to the Indiana Academy Academic Integrity board.

## **LLM and other AI Fair-Use Policy**

Basic AI tools (spell-check, word-count, grammar, etc.) that assist with correcting errors and gathering information about your own work is not only accepted, but also encouraged!

More advanced AI tools such as LLMs (ChatGPT, LLaMa, Phi-1, etc.) that generate information or code may be used as a starting point for research or creative projects, but generated material should not (for several reasons!) be turned in as your own work. Using these LLMs can be very useful in helping you create a project and/or learn complex topics, but diligence is required to:

- **\*Completely\*** verify that all information provided by the LLM is accurate (this is a major problem, especially in the sciences!). Remember that these models pull non-vetted information from the internet, which will include non-expert, and sometimes malicious, sources.
  - You (and your grades) are responsible for any and all errors gathered in this manner.
- resist turning in LLM produced material as your own work. The point of being at the Academy is to use provided information as a spring-board for your own intellect and creativity. Using these tools to help you gather ideas, or to find alternate ways to express your ideas, is both welcomed and encouraged. But make sure that you are not falling for temptation to use likely-erroneous data or logic that LLMs often provide. In other words, treat LLM generated material as you would other non-expert sources of material.
  - Presenting AI-generated material as your own will count as plagiarism, and will be dealt with accordingly (see Academic Dishonesty Policy, above)

## **Mask Policy**

There is currently no campus wide mask-mandate, but if the CDC declares another health-emergency, and BSU puts a mask-mandate in place, this policy may change. If and when masks are required by BSU campus, the Indiana Academy will then follow the same procedure.

## **In case of extreme COVID-19, break glass for online policy**

As it is possible that we may have to re-face pandemic conditions this year, there may be periods when some (or all) of us return to masks and/or are moved to online learning due to necessity or mandate. All of the below rules apply during e-learning, but some information may be useful:

Zoom Link: <https://bsu.zoom.us/j/7784148468>, if a password is required, please use “CptHook1”.

Lectures: Classes will be provided on Canvas with the same frequency and schedule of the normal school year. It is your responsibility to view these videos w/o 24hours of their posting. It is vitally important to watch them \*in order\*.

Homework: Homework can easily be scanned or photographed and submitted on Canvas by the due-date required.

Laboratory: Labs will be designed to be done either in a discussion format on Zoom or using simulators (PocketLabs). Any documentation (journals, reports, etc) expected can be returned to me using the same procedure as HW.

Testing: Tests will be “given” and “collected” at very specific times (TBA). Future circumstances may require different methods, but currently the procedure is as follows:

- The test will be released on Canvas at a very specific day/time that will be announced several days in advance.
- You will have a set amount of time to complete your exam (will be announced on test day, and is tied to the length of that particular test).
- Returning your test to me will be as simple as scanning or photographing your exam and emailing it back to me before the given time has expired. 504/IEP accommodations (see below) will be honored.

## **Syllabus Change Policy**

This syllabus is a guide to the course and may be subject to change with reasonable advanced notice as course needs arise.