

# **TRUMBULL PUBLIC SCHOOLS**

**Trumbull, Connecticut**

## **Astronomy Grade 11/12**

**2023**

*A Newly Approved Course*

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**Astronomy**  
**Grade 11/12**

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The Trumbull Board of Education promotes non-discrimination in all of its programs, including educational opportunities and services provided to students, student assignment to schools and classes, and educational offerings and materials.

## CORE VALUES AND BELIEFS

The Trumbull High School community engages in an environment conducive to learning which believes that all students will **read and write effectively**, therefore communicating in an articulate and coherent manner. All students will participate in activities that present **problem-solving through critical thinking**. Students will **use technology as a tool applying it to decision making**. We believe that by fostering self-confidence, self-directed and student-centered activities, we will promote **independent thinkers and learners**. We believe **ethical conduct** to be paramount in sustaining the welcoming school climate that we presently enjoy.

*Approved 8/26/2011*

## INTRODUCTION & PHILOSOPHY

The Trumbull High School Astronomy elective is an extension of the Grade 11 Chemistry and Grade 12 Physics courses. Students will apply the fundamental concepts of Chemistry and Physics to explore the Earth's solar system, the Milky Way galaxy, and beyond. Focus will be how observational science methods lead to conclusions and theories about the nature of the universe. Students in this course will either be currently enrolled in Chemistry or will have completed it the previous school year and will likely be concurrently enrolled in Physics.

The course goals and overarching approach are consistent with the Next-Generation Science Standards (NGSS) and the National Research Council's *Framework for K-12 Science Education* (2012). Both the *Framework* and the NGSS stress the importance of teaching classroom scientific inquiry as practiced by scientists and engineers. The *Framework* provides a vision for American science education in the 21st century, while the NGSS provides grade-level student performance expectations, disciplinary core ideas, and crosscutting concepts. The *Framework* and NGSS indicated a paradigm shift in science education, one in which teachers are to incorporate authentic learning experiences for students that reflect the nature of doing science and engineering.

The *Framework* and NGSS provide clarity to classroom scientific inquiry by stressing the importance of eight practices of science and engineering. The practices were designed to help students understand how scientific knowledge develops, and to stimulate students' interest in and continued study of science. Three-dimensional learning facilitates student engagement with Science and Engineering Practices and Crosscutting Concepts to deepen their understanding of Disciplinary Core Ideas in order to explain phenomena and solve problems. Three-dimensional learning promotes development of student skills in the following areas:

- Knowing, using, and interpreting scientific explanations of the natural world (Disciplinary Core Ideas, and Crosscutting Concepts)
- Generating and evaluating scientific evidence and explanations (Science and Engineering Practices)
- Participating productively in scientific practices and discourse (Science and Engineering Practices)
- Understanding the nature and development of scientific knowledge (Science and Engineering Practices, and Crosscutting Concepts)

The shift of science education reflects the interconnected nature of science as it is practiced in the real world and builds coherently across grades K-12. The NGSS focus on deeper understanding of content as well as application of content with an alignment to the Connecticut Core Standards. A deeper understanding and application of science and engineering practices prepare students for postsecondary success and citizenship in a world fueled by innovations in science and technology. In accordance with the NGSS Science and Engineering Practices, students will be asked to . . .

- ask questions (for science) and define problems (for engineering).
- develop and use models.
- plan and carry out investigations.
- analyze and interpret data.
- use mathematics and computational thinking.
- construct explanations (for science) and design solutions (for engineering).
- engage in arguments from evidence.
- obtain, evaluate, and communicate information.

Astronomy is a non-leveled course available to juniors and seniors who have successfully completed Geometry and Integrated Physical Science, and who have either successfully completed or are concurrently enrolled in Chemistry; for seniors, concurrent enrollment in Physics is preferred and recommended.

## **COURSE GOALS**

The following course goals are from the 2013 Next Generation Science Standards. NGSS goals for individual units of this course are included in the unit outlines.

MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.

MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.

HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.

HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.

HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.

HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

The following course goals are from the 2010 Connecticut Common Core State Standards for English Language Arts and Literacy in History/Social Studies, Science and Technical Subjects and apply to all units:

CCSS.ELA-LITERACY.RST.11-12.1

Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

CCSS.ELA-LITERACY.RST.11-12.2

Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

CCSS.ELA-LITERACY.RST.11-12.3

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CCSS.ELA-LITERACY.RST.11-12.4

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

CCSS.ELA-LITERACY.RST.11-12.5

Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

CCSS.ELA-LITERACY.RST.11-12.6

Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

CCSS.ELA-LITERACY.RST.11-12.7

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

CCSS.ELA-LITERACY.RST.11-12.8

Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

CCSS.ELA-LITERACY.RST.11-12.9

Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible

CCSS.ELA-LITERACY.RST.11-12.10

By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

The following course goals are from the 2016 International Society for Technology in Education (ISTE) Technology Standards and apply to all units::

1.1.c Students use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.

1.2.b Students engage in positive, safe, legal and ethical behavior when using technology, including social interactions online or when using networked devices.

1.2.c Students demonstrate an understanding of and respect for the rights and obligations of using and sharing intellectual property.

1.3.a Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.

1.3.b Students evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.

1.3.c Students curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.

1.4.a Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.

1.4.d Students exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.

1.5.a Students formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.

1.5.b Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

1.5.c Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

1.7.b Students use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints.

## **COURSE ENDURING UNDERSTANDINGS**

Students will understand that...

- scientific knowledge is acquired through inquiry, experimentation, data analysis, and interpretation.
- scientific conclusions and explanations are based on research data, and scientific results may be assessed based on the design of the investigation.
- scientific ideas and concepts evolve over time.
- the credibility of scientific information found in various media can vary.
- mathematical operations and procedures may be used to calculate, analyze, and present data and ideas.
- science and technology affect the quality of our lives.

Also, in accordance with the NGSS Cross-Cutting Concepts, students will work to understand...

- how observed patterns of forms and events guide organization and classification, and prompt questions about relationships and the factors that influence them.
- that events have causes, sometimes simple, sometimes multifaceted and that a major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
- that scale, proportion, and quantity in considering phenomena. It is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
- that defining the system under study – specifying its boundaries and making explicit a model of that system – provides tools for understanding and testing ideas that are applicable throughout science and engineering.

### **COURSE ESSENTIAL QUESTIONS**

- What patterns can we identify in the sky during a single day? During a month? During a year?
- What can we observe about the Moon and the Sun, and what do those observations tell us about the Earth-Moon-Sun system?
- How can we use our observations of the Earth-Moon-Sun system to start to determine the size of the universe?
- What can we observe about the planets in the sky, and what do those observations tell us about the solar system?
- How can we use planetary observations to expand our understanding of the size of the universe?
- What can we observe about stars in the sky, and what do those observations tell us about the stars?
- How can we use stellar observation to further expand our understanding of the size of the universe?
- What can we observe beyond our Milky Way galaxy, and what do those observations tell us about the universe?
- What are the limits on our understanding of the size of the universe?
- What major cosmological questions remain unanswered?

### **COURSE KNOWLEDGE & SKILLS**

Students will know...

- the patterns that occur in the sky over the course of a day, month, and year
- which planets are visible to the naked eye and where they can be found in the sky
- how humans first estimated the sizes of the Earth, Moon, and Sun, and the distances between the Earth and Moon and between the Earth and Sun
- how humans used observations of the sky to refine our understanding of the structure and scale of our solar system
- that the absolute magnitude (luminosity) of star depends on its temperature, and that the apparent magnitude depends on its luminosity and distance from Earth
- that visible light is part of the electromagnetic spectrum
- that different elements emit and absorb light differently
- that astronomers use a variety of phenomenon to determine the distances to other galaxies
- that the “Big Bang theory” is the result of evidence of the motion of distant galaxies along with cosmic microwave background radiation

Students will be able to...

- identify major constellations in the night sky and what time of year they are visible
- make measurements across the sky
- explain why lunar and solar eclipses occur and why they do not happen every month
- compare and contrast the geocentric and heliocentric models of the solar system
- apply trigonometry to observations of the planets to estimate their distances from the Sun
- use a Hertzsprung-Russell diagram to compare and contrast the properties of stars
- use spectroscopy to determine the chemical composition of stars and dust clouds
- explain the life cycle of a Sun-like star
- compare and contrast different techniques used to determine the distances to other stars in the Milky Way galaxy and to other galaxies
- explain what is meant by the term “dark matter” and the evidence of its existence
- explain how light is affected by the Doppler effect, and what conclusions we can draw from this phenomenon
- explain what is meant by the term “dark energy” and the evidence of its existence

# COURSE SYLLABUS

## Course Name

Astronomy

## Level

Non-leveled

## Prerequisites

Successful completion of Geometry and Integrated Physical Science; successful completion of or concurrent enrollment in Chemistry; for seniors, concurrent enrollment in Physics is preferred and recommended; or department chair permission.

## General Description of the Course

This course will focus on the history and methodology of Astronomy and Astrophysics. Starting from fundamental observation of the Earth-Moon-Sun system, students will learn how humans discovered the size and scale of our Solar System, The Milky Way Galaxy, and beyond. Emphasis will be made on the NGSS Science Practices.

## Assured Assessments

Formative assessments can include, but are not limited to:

- individual and group activities
- interactive online activities
- night sky observation journal

Summative assessments:

- End-of-unit assessment with multiple-choice questions, free-response questions, and interpreting/analyzing data
- End-of-semester examination

## Core Texts & Resources

- Chaisson, Eric, McMillan, Steve. *Astronomy Today 9e*. Pearson. Print.
- Fraknoi, Andrew, Morrison, David, Wolff, Sidney. *Astronomy 2e*. OpenStax. <https://openstax.org/details/books/astronomy-2e>. Web.
- Stellarium Labs and Noctua Software Ltd. *Stellarium*. <https://stellarium-web.org/>. Web.

# UNIT 1

## Observations of the Sky

### Unit Goals

At the completion of this unit, students will be able to:

- describe the patterns seen in the sky over the course of a day, month, and year
- identify constellations and when and where they can be found in the night sky
- measure visual distances between objects in the sky in degrees, arcminutes, and arcseconds

### 2013 Next Generation Science Standards Practices

- ask questions.
- **develop and use models.**
- analyze and interpret data.
- **construct explanations.**
- **engage in arguments from evidence.**
- obtain, evaluate, and communicate information.

### Unit Essential Question(s)

- What patterns can we identify in the sky during a single day? During a month? During a year?

### Unit Essential Vocabulary

- Right Ascension/Declination
- Altitude/Azimuth
- Ecliptic
- Zodiac
- Solstice
- Equinox

### Scope and Sequence

1. observing motion during the course of one day
2. making measurements across the sky
3. observing motion during the course of one month (both sidereal and synodic)
4. identifying the ecliptic and the zodiac constellations
5. observing motion during the course of one year (both sidereal and tropical)
6. identifying and locating major seasonal constellations
7. identifying planets and other celestial objects visible to the naked eye

### Assured Assessments

Formative Assessment:

- Online interactive activities using Stellarium (individual and group)
- Online interactive activities using Pivot (individual and group)
- Vocabulary and constellation identification assessments (individual)
- Measurement assessment (individual)
- Night sky observations journal (individual)

Summative Assessment:

- Students will complete an assessment consisting of multiple-choice questions and free-response

questions, related to observations of the sky.

## Resources

Core:

- Chaisson, Eric, McMillan, Steve. *Astronomy Today 9e*. Pearson. Print.
- Stellarium Labs and Noctua Software Ltd. *Stellarium*. <https://stellarium-web.org/>. Web.

Supplemental:

- Pivot Interactives, SBC. <https://app.pivotinteractives.com/>. Web.
- Fraknoi, Andrew, Morrison, David, Wolff, Sidney. *Astronomy 2e*. OpenStax. <https://openstax.org/details/books/astronomy-2e>. Web.

## Time Allotment

- 3 weeks

## UNIT 2

### The Earth-Moon-Sun System

#### Unit Goals

At the completion of this unit, students will be able to:

- explain and predict the appearance of the Moon in the sky, both in terms of its phase and where/when it is visible
- explain the conditions under which lunar and solar eclipses occurs, and why one does not occur every month
- use Eratosthenes's method to estimate the size of the Earth
- explain how humans first estimated the sizes of/distances to the Moon and the Sun

#### 2013 Next Generation Science Standards & Practices

**MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.**

MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.

HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

- ask questions.
- develop and use models.
- plan and carry out investigations.
- analyze and interpret data.
- use mathematics and computational thinking.
- construct explanations.
- engage in arguments from evidence.
- obtain, evaluate, and communicate information.

#### Unit Essential Question(s)

- What can we observe about the Moon and the Sun, and what do those observations tell us about the Earth-Moon-Sun system?
- How can we use our observations of the Earth-Moon-Sun system to start to determine the size of the universe?

#### Unit Essential Vocabulary

- orbit
- Sidereal month
- Synodic month
- Sidereal year
- Tropical year
- moon phases
  - waxing vs. waning
  - crescent vs. gibbous

- new vs. quarter vs. full
- lunar eclipse
- solar eclipse
- umbra
- penumbra

### Scope and Sequence

1. observations of the Moon and its phases
2. solar and lunar eclipses
3. Eratosthenes and the size of the Earth
4. Aristarchus and the size of the Moon
5. the distances to the Moon and Sun

### Assured Assessments

#### Formative Assessment:

- Online interactive activities using Stellarium (individual and group)
- Online interactive activities using Pivot (individual and group)
- Calculating the size of the Earth activity (group)
- Moon motion and phases assessment (individual)
- Night sky observations journal (individual)

#### Summative Assessment:

- Students will complete an assessment consisting of multiple-choice questions and free-response questions, related to the Earth-Moon-Sun system.

### Resources

#### Core:

- Chaisson, Eric, McMillan, Steve. *Astronomy Today 9e*. Pearson. Print.
- Stellarium Labs and Noctua Software Ltd. *Stellarium*. <https://stellarium-web.org/>. Web.

#### Supplemental:

- Pivot Interactives, SBC. <https://app.pivotinteractives.com/>. Web.
- Fraknoi, Andrew, Morrison, David, Wolff, Sidney. *Astronomy 2e*. OpenStax. <https://openstax.org/details/books/astronomy-2e>. Web.

### Time Allotment

- 2.5 weeks

## UNIT 3

### Motion of the Planets

#### Unit Goals

At the completion of this unit, students will be able to:

- identify planets in the sky based on their location and visual appearance
- differentiate between the geocentric and heliocentric models for the solar system
- describe and apply Kepler's laws of planetary motion
- describe and apply Newton's laws of motion to the solar system

#### 2013 Next Generation Science Standards & Practices

MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.

**HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.**

- ask questions.
- develop and use models.
- plan and carry out investigations.
- analyze and interpret data.
- use mathematics and computational thinking.
- construct explanations.
- engage in arguments from evidence.
- obtain, evaluate, and communicate information.

#### Unit Essential Question(s)

- What can we observe about the planets in the sky, and what do those observations tell us about the solar system?
- How can we use planetary observations to expand our understanding of the size of the universe?

#### Unit Essential Vocabulary

- geocentric model
- epicycle
- heliocentric model
- ellipse
- focus
- eccentricity
- major axis and minor axis

#### Scope and Sequence

1. origins of the geocentric model (Aristotle)
2. refining the geocentric model (Ptolemy)
3. rise of the heliocentric model (Copernicus)

4. refining the heliocentric model and Kepler's Laws (Galileo, Brahe, Kepler)
5. Newton's *Principia* and gravity

### Assured Assessments

#### Formative Assessment:

- Online interactive activities using Stellarium (individual and group)
- Online interactive activities using Pivot (individual and group)
- Comparing the geocentric and heliocentric models assessment (individual)
- Drawing planetary orbits activity (group)
- Night sky observations journal (individual)

#### Summative Assessment:

- Students will complete an assessment consisting of multiple-choice questions and free-response questions, related to the motion of the planets.

### Resources

#### Core:

- Chaisson, Eric, McMillan, Steve. *Astronomy Today 9e*. Pearson. Print.
- Stellarium Labs and Noctua Software Ltd. *Stellarium*. <https://stellarium-web.org/>. Web.

#### Supplemental:

- Pivot Interactives, SBC. <https://app.pivotinteractives.com/>. Web.
- Fraknoi, Andrew, Morrison, David, Wolff, Sidney. *Astronomy 2e*. OpenStax. <https://openstax.org/details/books/astronomy-2e>. Web.

### Time Allotment

- 3.5 weeks

## UNIT 4

### Stars & Stellar Evolution

#### Unit Goals

At the completion of this unit, students will be able to:

- explain the difference between apparent and absolute magnitude for the brightness of stars
- identify how stars are classified based on surface temperature and luminosity
- explain how emission/absorption lines tell us about the chemical composition of stars and dust
- describe the life cycle of main-sequence stars

#### 2013 Next Generation Science Standards & Practices

**HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.**

**HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.**

- ask questions.
- develop and use models.
- plan and carry out investigations.
- analyze and interpret data.
- use mathematics and computational thinking.
- construct explanations.
- engage in arguments from evidence.
- obtain, evaluate, and communicate information.

#### Unit Essential Question(s)

- What can we observe about stars in the sky, and what do those observations tell us about the stars?
- How can we use stellar observation to further expand our understanding of the size of the universe?

#### Unit Essential Vocabulary

- apparent magnitude
- absolute magnitude/luminosity
- giant, dwarf, and main-sequence stars
- spectroscopy
- emission spectrum
- absorption spectrum

#### Scope and Sequence

1. observations of the Sun and other stars
2. brightness: apparent magnitude vs. absolute magnitude
3. the Hertzsprung-Russell diagram
4. light and the electromagnetic spectrum

5. spectroscopy and spectral lines
6. life cycle of a Sun-like star

### **Assured Assessments**

#### Formative Assessment:

- Online interactive activities using Stellarium (individual and group)
- Online interactive activities using Pivot (individual and group)
- Apparent vs. absolute magnitude assessment (individual)
- Categorizing stars activity (group)
- Identifying elements by spectrum activity (group)
- Life-cycle of a main-sequence star assessment (individual)
- Night sky observations journal (individual)

#### Summative Assessment:

- Students will complete an assessment consisting of multiple-choice questions and free-response questions, related to our understanding of stars and stellar evolution.

### **Resources**

#### Core:

- Chaisson, Eric, McMillan, Steve. *Astronomy Today 9e*. Pearson. Print.
- Stellarium Labs and Noctua Software Ltd. *Stellarium*. <https://stellarium-web.org/>. Web.

#### Supplemental:

- Pivot Interactives, SBC. <https://app.pivotinteractives.com/>. Web.
- Fraknoi, Andrew, Morrison, David, Wolff, Sidney. *Astronomy 2e*. OpenStax. <https://openstax.org/details/books/astronomy-2e>. Web.

### **Time Allotment**

- 4.5 weeks

## UNIT 5

### Our Galaxy & Beyond

#### Unit Goals

At the completion of this unit, students will be able to:

- compare and contrast our Milky Way galaxy to other galaxies
- describe methods scientists use to determine the distance to other galaxies
- explain what is meant by the term dark matter
- explain what is meant by the term dark energy

#### 2013 Next Generation Science Standards & Practices

MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

HS-ESS1-2. **Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.**

- ask questions.
- develop and use models.
- plan and carry out investigations.
- analyze and interpret data.
- use mathematics and computational thinking.
- construct explanations.
- engage in arguments from evidence.
- obtain, evaluate, and communicate information.

#### Unit Essential Question(s)

- What can we observe beyond our Milky Way galaxy, and what do those observations tell us about the universe?
- What are the limits on our understanding of the size of the universe?
- What major cosmological questions remain unanswered?

#### Unit Essential Vocabulary

- galaxy types: spiral, barred-spiral, elliptical, irregular
- Cepheid variables
- Doppler shift
- dark matter
- dark energy

#### Scope and Sequence

1. observations of the Milky Way galaxy
2. categorizing galaxies
3. measuring distances to other galaxies
4. the mystery of dark matter
5. Hubble's Law and its implications
6. cosmic microwave background radiation and its implications

## Assured Assessments

### Formative Assessment:

- Online interactive activities using Stellarium (individual and group)
- Online interactive activities using Pivot (individual and group)
- Categorizing galaxies assessment (individual)
- Night sky observations journal (individual)

### Summative Assessment:

- Students will complete an assessment consisting of multiple-choice questions and free-response questions, related to our understanding of galaxies and the universe.

## Resources

### Core:

- Chaisson, Eric, McMillan, Steve. *Astronomy Today 9e*. Pearson. Print.
- Stellarium Labs and Noctua Software Ltd. *Stellarium*. <https://stellarium-web.org/>. Web.

### Supplemental:

- Pivot Interactives, SBC. <https://app.pivotinteractives.com/>. Web.
- Fraknoi, Andrew, Morrison, David, Wolff, Sidney. *Astronomy 2e*. OpenStax. <https://openstax.org/details/books/astronomy-2e>. Web.

## Time Allotment

- 4.5 weeks

## **COURSE CREDIT**

0.5 credits in science  
One class period for one semester (half-year)

## **ASSURED STUDENT PERFORMANCE RUBRICS**

- Trumbull High School School-Wide Writing Rubric
- Trumbull High School School-Wide Problem-Solving Rubric
- Trumbull High School School-Wide Independent Learning and Thinking Rubric

## **TPS VISION OF THE GRADUATE SKILLS AND DISPOSITIONS**

Awaiting official adoption

## Trumbull High School School-Wide Problem Solving Through Critical Thinking Rubric

Category/ Weight	Exemplary 4	Goal 3	Working Toward Goal 2	Needs Support 1-0
Understanding X _____	<ul style="list-style-type: none"> <li>Student demonstrates clear understanding of the problem and the complexities of the task</li> </ul>	<ul style="list-style-type: none"> <li>Student demonstrates sufficient understanding of the problem and most of the complexities of the task</li> </ul>	<ul style="list-style-type: none"> <li>Student demonstrates some understanding of the problem but requires assistance to complete the task</li> </ul>	<ul style="list-style-type: none"> <li>Student demonstrates limited or no understanding of the fundamental problem after assistance with the task</li> </ul>
Research X _____	<ul style="list-style-type: none"> <li>Student gathers compelling information from multiple sources including digital, print, and interpersonal</li> </ul>	<ul style="list-style-type: none"> <li>Student gathers sufficient information from multiple sources including digital, print, and interpersonal</li> </ul>	<ul style="list-style-type: none"> <li>Student gathers some information from few sources including digital, print, and interpersonal</li> </ul>	<ul style="list-style-type: none"> <li>Student gathers limited or no information</li> </ul>
Reasoning and Strategies X _____	<ul style="list-style-type: none"> <li>Student demonstrates strong critical thinking skills to develop a comprehensive plan integrating multiple strategies</li> </ul>	<ul style="list-style-type: none"> <li>Student demonstrates sufficient critical thinking skills to develop a cohesive plan integrating strategies</li> </ul>	<ul style="list-style-type: none"> <li>Student demonstrates some critical thinking skills to develop a plan integrating some strategies</li> </ul>	<ul style="list-style-type: none"> <li>Student demonstrates limited or no critical thinking skills and no plan</li> </ul>
Final Product and/or Presentation X _____	<ul style="list-style-type: none"> <li>Solution shows deep understanding of the problem and its components</li> <li>Solution shows extensive use of 21<sup>st</sup>-century technology skills</li> </ul>	<ul style="list-style-type: none"> <li>Solution shows sufficient understanding of the problem and its components</li> <li>Solution shows sufficient use of 21<sup>st</sup>-century technology skills</li> </ul>	<ul style="list-style-type: none"> <li>Solution shows some understanding of the problem and its components</li> <li>Solution shows some use of 21<sup>st</sup>-century technology skills</li> </ul>	<ul style="list-style-type: none"> <li>Solution shows limited or no understanding of the problem and its components</li> <li>Solution shows limited or no use of 21<sup>st</sup>-century technology skills</li> </ul>

## Trumbull High School School-Wide Writing Rubric

Category/ Weight	Exemplary 4 Student work:	Goal 3 Student work:	Working Toward Goal 2 Student work:	Needs Support 1-0 Student work:
Purpose X_____	<ul style="list-style-type: none"> <li>• Establishes and maintains a clear purpose</li> <li>• Demonstrates an insightful understanding of audience and task</li> </ul>	<ul style="list-style-type: none"> <li>• Establishes and maintains a purpose</li> <li>• Demonstrates an accurate awareness of audience and task</li> </ul>	<ul style="list-style-type: none"> <li>• Establishes a purpose</li> <li>• Demonstrates an awareness of audience and task</li> </ul>	<ul style="list-style-type: none"> <li>• Does not establish a clear purpose</li> <li>• Demonstrates limited/no awareness of audience and task</li> </ul>
Organization X_____	<ul style="list-style-type: none"> <li>• Reflects sophisticated organization throughout</li> <li>• Demonstrates logical progression of ideas</li> <li>• Maintains a clear focus</li> <li>• Utilizes effective transitions</li> </ul>	<ul style="list-style-type: none"> <li>• Reflects organization throughout</li> <li>• Demonstrates logical progression of ideas</li> <li>• Maintains a focus</li> <li>• Utilizes transitions</li> </ul>	<ul style="list-style-type: none"> <li>• Reflects some organization throughout</li> <li>• Demonstrates logical progression of ideas at times</li> <li>• Maintains a vague focus</li> <li>• May utilize some ineffective transitions</li> </ul>	<ul style="list-style-type: none"> <li>• Reflects little/no organization</li> <li>• Lacks logical progression of ideas</li> <li>• Maintains little/no focus</li> <li>• Utilizes ineffective or no transitions</li> </ul>
Content X_____	<ul style="list-style-type: none"> <li>• Is accurate, explicit, and vivid</li> <li>• Exhibits ideas that are highly developed and enhanced by specific details and examples</li> </ul>	<ul style="list-style-type: none"> <li>• Is accurate and relevant</li> <li>• Exhibits ideas that are developed and supported by details and examples</li> </ul>	<ul style="list-style-type: none"> <li>• May contain some inaccuracies</li> <li>• Exhibits ideas that are partially supported by details and examples</li> </ul>	<ul style="list-style-type: none"> <li>• Is inaccurate and unclear</li> <li>• Exhibits limited/no ideas supported by specific details and examples</li> </ul>
Use of Language X_____	<ul style="list-style-type: none"> <li>• Demonstrates excellent use of language</li> <li>• Demonstrates a highly effective use of standard writing that enhances communication</li> <li>• Contains few or no errors. Errors do not detract from meaning</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrates competent use of language</li> <li>• Demonstrates effective use of standard writing conventions</li> <li>• Contains few errors. Most errors do not detract from meaning</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrates use of language</li> <li>• Demonstrates use of standard writing conventions</li> <li>• Contains errors that detract from meaning</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrates limited competency in use of language</li> <li>• Demonstrates limited use of standard writing conventions</li> <li>• Contains errors that make it difficult to determine meaning</li> </ul>

## Trumbull High School School-Wide Independent Learning and Thinking Rubric

Category/ Weight	Exemplary 4	Goal 3	Working Toward Goal 2	Needs Support 1-0
Proposal X_____	<ul style="list-style-type: none"> <li>• Student demonstrates a strong sense of initiative by generating compelling questions, creating uniquely original projects/work</li> </ul>	<ul style="list-style-type: none"> <li>• Student demonstrates initiative by generating appropriate questions, creating original projects/work</li> </ul>	<ul style="list-style-type: none"> <li>• Student demonstrates some initiative by generating questions, creating appropriate projects/work</li> </ul>	<ul style="list-style-type: none"> <li>• Student demonstrates limited or no initiative by generating few questions and creating projects/work</li> </ul>
Independent Research & Development X_____	<ul style="list-style-type: none"> <li>• Student is analytical, insightful, and works independently to reach a solution</li> </ul>	<ul style="list-style-type: none"> <li>• Student is analytical, and works productively to reach a solution</li> </ul>	<ul style="list-style-type: none"> <li>• Student reaches a solution with direction</li> </ul>	<ul style="list-style-type: none"> <li>• Student is unable to reach a solution without consistent assistance</li> </ul>
Presentation of Final Product X_____	<ul style="list-style-type: none"> <li>• Presentation shows compelling evidence of an independent learner and thinker</li> <li>• Solution shows deep understanding of the problem and its components</li> <li>• Solution shows extensive and appropriate application of 21<sup>st</sup>-century skills</li> </ul>	<ul style="list-style-type: none"> <li>• Presentation shows clear evidence of an independent learner and thinker</li> <li>• Solution shows adequate understanding of the problem and its components</li> <li>• Solution shows adequate application of 21<sup>st</sup>-century skills</li> </ul>	<ul style="list-style-type: none"> <li>• Presentation shows some evidence of an independent learner and thinker</li> <li>• Solution shows some understanding of the problem and its components</li> <li>• Solution shows some application of 21<sup>st</sup>-century skills</li> </ul>	<ul style="list-style-type: none"> <li>• Presentation shows limited or no evidence of an independent learner and thinker</li> <li>• Solution shows limited or no understanding of the problem and its components</li> <li>• Solution shows limited or no application of 21<sup>st</sup>-century skills</li> </ul>