

Student Science Journal. Make a CLOSE-UP drawing of the sun!

You should NEVER look up at the Sun with your eyes or with a telescope! Astronomers use special equipment to learn about the Sun. Today, we will study the sun safely. Look closely at the images on your screen, and make your own drawing.

Remember, a good scientist makes careful investigations. Draw the feature as you see it.



Special STEM Note: The equipment used today does not represent scientific accomplishments. The telescope, HD video cameras, filters, computers, the internet, and the dome represent engineering and technological achievements. At McDonald Observatory, science, technology, engineering and mathematics together enable us to explore the universe.



- 1: The dome protects and houses the telescope and equipment.
- 2: Inside the dome are three telescopes you will use during the videoconference, listed below.
- 3: The digital video camera takes electronic images of Venus and the Sun. The solar filter makes the view safe.

Equipment and hardware pictured above was used during your videoconference today:

3 Telescopes: 2a: 400 mm (16-inch) Ritchey Chretien Optical System reflecting telescope used to observe Venus.

2b: 100 mm (4-inch) Skylight refracting telescope used to observe the Sun's chromosphere.

2c: 80 mm (3-inch) Explore Scientific refracting telescope used to observe the Sun's photosphere.

Cameras: 3a: Two Point Grey Research "Chameleon" 1.3 megapixel grayscale HD cameras.

Solar filters: 3b: DayStar Hydrogen-Alpha (656-nm) wavelength filter used to observe the Sun's chromosphere safely.

Neutral Density White Light Filter used to observe the Sun's photosphere safely.

Mounting: Software Bisque ME Paramount. Telescopes and cameras are remote operated from videocon studio)

Computer: Apple Mac-mini running Software Bisque SkyX for telescope control and Astro IIDC for camera control.

Important: NEVER observe the sun, with or without a telescope, without proper equipment and adult supervision. Observing the sun for any length of time, without these provisions, can cause permanent eye damage.

Observing the Sun with Telescopes

K-12 TEKS alignments

Kindergarten

- 112.11. Grade K(b) – 1(A) identify and demonstrate safe practices as described in The Texas Safety Standards during classroom and outdoor investigations, including wearing safety goggles, washing hands, and using materials appropriately.
- 112.11. Grade K(b) – 2(A) ask questions about organisms, objects, and events observed in the natural world.
- 112.11. Grade K(b) – 2(B) plan and conduct simple descriptive investigations such as ways objects move.
- 112.11. Grade K(b) – 2(C) collect data and make observations using simple equipment such as hand lenses, primary balances, and non-standard measurement tools.
- 112.11. Grade K(b) – 2(D) record and organize data and observations using pictures, numbers, and words.
- 112.11. Grade K(b) – 2(E) communicate observations with others about simple descriptive investigations.
- 112.11. Grade K(b) – 3(C) explore that scientists investigate different things in the natural world and use tools to help in their investigations.
- 112.11. Grade K(b) – 4(A) collect information using tools, including computers, hand lenses, primary balances, cups, bowls, magnets, collecting nets, and notebooks; timing devices, including clocks and timers; non-standard measuring items such as paper clips and clothespins; weather instruments such as demonstration thermometers and wind socks; and materials to support observations of habitats of organisms such as terrariums and aquariums.
- 112.11. Grade K(b) – 8(C) observe, describe, and illustrate objects in the sky such as the clouds, Moon, and stars, including the Sun.

Grade 1

- 112.12. Grade 1(b) – 1(A) identify and demonstrate safe practices as described in the Texas Safety Standards during classroom and outdoor investigations, including wearing safety goggles, washing hands, and using materials appropriately.
- 112.12. Grade 1(b) – 2(A) ask questions about organisms, objects, and events observed in the natural world.
- 112.12. Grade 1(b) – 2(A) ask questions about organisms, objects, and events observed in the natural world.
- 112.12. Grade 1(b) – 2(B) plan and conduct simple descriptive investigations such as ways objects move.

- 112.12. Grade 1(b) – 2(C) collect data and make observations using simple equipment such as hand lenses, primary balances, and non-standard measurement tools.
- 112.12. Grade 1(b) – 2(D) record and organize data and observations using pictures, numbers, and words.
- 112.12. Grade 1(b) – 2(E) communicate observations with others about simple descriptive investigations.
- 112.12. Grade 1(b) – 3(C) describe what scientists do.
- 112.12. Grade 1(b) – 4(A) collect information using tools, including computers, hand lenses, primary balances, cups, bowls, magnets, collecting nets, and notebooks; timing devices, including clocks and timers; non-standard measuring items such as paper clips and clothespins; weather instruments such as demonstration thermometers and wind socks; and materials to support observations of habitats of organisms such as terrariums and aquariums.
- 112.12. Grade 1(b) – 8(B) observe and record changes in the appearance of objects in the sky such as clouds, the Moon, and stars, including the Sun.

Grade 2

- 112.13. Grade 2(b) – 1(A) identify and demonstrate safe practices as described in the Texas Safety Standards during classroom and outdoor investigations, including wearing safety goggles, washing hands, and using materials appropriately.
- 112.13. Grade 2(b) – 2(A) ask questions about organisms, objects, and events during observations and investigations.
- 112.13. Grade 2(b) – 2(C) collect data from observations using simple equipment such as hand lenses, primary balances, thermometers, and non-standard measurement tools.
- 112.13. Grade 2(b) – 2(D) record and organize data using pictures, numbers, and words.
- 112.13. Grade 2(b) – 2(F) compare results of investigations with what students and scientists know about the world.
- 112.13. Grade 2(b) – 3(C) identify what a scientist is and explore what different scientists do.
- 112.13. Grade 2(b) – 4(A) collect, record, and compare information using tools, including computers, hand lenses, rulers, primary balances, plastic beakers, magnets, collecting nets, notebooks, and safety goggles; timing devices, including clocks and stopwatches; weather instruments such as thermometers, wind vanes, and rain gauges; and materials to support observations of habitats of organisms such as terrariums and aquariums.
- 112.13. Grade 2(b) – 8(D) observe, describe, and record patterns of objects in the sky, including the appearance of the Moon.

Grade 3

- 112.14. Grade 3(b) - 2 (A) plan and implement descriptive investigations, including asking and answering questions, making inferences, and selecting and using equipment or technology needed, to solve a specific problem in the natural world.
- 112.14. Grade 3(b) - 2 (D) analyze and interpret patterns in data to construct reasonable explanations based on evidence from investigations. • 112.14. Grade 3(b) - 2 (F) communicate valid conclusions supported by data in writing, by drawing pictures, and through verbal discussion.
- 112.14. Grade 3(b) - 3 (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student.
- 112.14. Grade 3(b) - 3 (C) represent the natural world using models such as volcanoes or Sun, Earth, and Moon system and identify their limitations, including size, properties, and materials.
- 112.14. Grade 3(b) - 3 (D) connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists. • 112.14. Grade 3(b) – 4 (A) collect, record, and analyze information using tools, including microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, wind vanes, rain gauges, pan balances, graduated cylinders, beakers, spring scales, hot plates, meter sticks, compasses, magnets, collecting nets, notebooks, sound recorders, and Sun, Earth, and Moon system models; timing devices, including clocks and stopwatches; and materials to support observation of habitats of organisms such as terrariums and aquariums.
- 112.14. Grade 3(b) - 5 (A) measure, test, and record physical properties of matter, including temperature, mass, magnetism, and the ability to sink or float.
- 112.14. Grade 3(b) - 5 (B) describe and classify samples of matter as solids, liquids, and gases and demonstrate that solids have a definite shape and that liquids and gases take the shape of their container.
- 112.14. Grade 3(b) - 6 (A) explore different forms of energy, including mechanical, light, sound, and heat/thermal in everyday life.
- 112.14. Grade 3(b) - 6 (C) observe forces such as magnetism and gravity acting on objects.
- 112.14. Grade 3 (b) – 8 (B) describe and illustrate the Sun as a star composed of gases that provides light and heat energy for the water cycle
- 112.14. Grade 3 (b) – 8 (C) construct models that demonstrate the relationship of the Sun, Earth, and Moon, including orbits and positions.

Grade 4

- 112.15. Grade 4 (b) - 2 (F) communicate valid, oral, and written results supported by data.
- 112.15. Grade 4(b) - 3 (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student.

- 112.15. Grade 4(b) - 3 (C) represent the natural world using models such as rivers, stream tables, or fossils and identify their limitations, including accuracy and size.
- 112.15. Grade 4(b) - 3 (D) connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.
- 112.15. Grade 4 (b) – 4 (A) collect, record, and analyze information using tools, including microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, wind vanes, rain gauges, pan balances, graduated cylinders, beakers, spring scales, hot plates, meter sticks, compasses, magnets, collecting nets, notebooks, sound recorders, and Sun, Earth, and Moon system models; timing devices, including clocks and stopwatches; and materials to support observation of habitats of organisms such as terrariums and aquariums.
- 112.15. Grade 4(b) - 6 (A) differentiate among forms of energy, including mechanical, sound, electrical, light, and heat/thermal.

Grade 5

- 112.16. Grade 5 (b) - 2 (B) ask well-defined questions, formulate testable hypotheses, and select and use appropriate equipment and technology; • 112.16. Grade 5 (b) - 2 (D) analyze and interpret information to construct reasonable explanations from direct (observable) and indirect (inferred) evidence;
- 112.16. Grade 5 (b) - 2 (F) communicate valid conclusions in both written and verbal forms.
- 112.16. Grade 5 (b) - 3 (D) connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists. • 112.16. Grade 5 (b) - 4 (A) collect, record, and analyze information using tools, including calculators, microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, prisms, mirrors, pan balances, triple beam balances, spring scales, graduated cylinders, beakers, hot plates, meter sticks, magnets, collecting nets, and notebooks; timing devices, including clocks and stopwatches; and materials to support observations of habitats or organisms such as terrariums and aquariums; and;
- 112.16. Grade 5 (b) - 5 (A) classify matter based on physical properties, including mass, magnetism, physical state (solid, liquid, and gas), relative density (sinking and floating), solubility in water, and the ability to conduct or insulate thermal energy or electric energy;
- 112.16. Grade 5 (b) - 6 (C) demonstrate that light travels in a straight line until it strikes an object or travels through one medium to another and demonstrate that light can be reflected such as the use of mirrors or other shiny surfaces and refracted such as the appearance of an object when observed through water;
- 112.16. Grade 5 (b) - 8 (D) identify and compare the physical characteristics of the Sun, Earth, and Moon.;

Grade 6

- 112.18. Grade 6(b) - 2 (A) plan and implement comparative and descriptive investigations by making observations, asking well-defined questions, and using appropriate equipment and technology.

- 112.18. Grade 6(b) - 2 (C) collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers.
- 112.18. Grade 6(b) - 2 (E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends. • 112.18. Grade 6(b) - 3 (B) use models to represent aspects of the natural world such as a model of Earth's layers
- 112.18. Grade 6(b) - 3 (D) relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content.
- 112.18. Grade 6(b) - 4 (A) use appropriate tools to collect, record, and analyze information, including journals/notebooks, beakers, Petri dishes, meter sticks, graduated cylinders, hot plates, test tubes, triple beam balances, microscopes, thermometers, calculators, computers, timing devices, and other equipment as needed to teach the curriculum
- 112.18. Grade 6(b) - 9 (A) investigate methods of thermal energy transfer, including conduction, convection, and radiation
- 112.18. Grade 6(b) - 9 (C) demonstrate energy transformations such as energy in a flashlight battery changes from chemical energy to electrical energy to light energy
- 112.18. Grade 6(b) - 11 (A) describe the physical properties, locations, and movements of the Sun, planets, Galilean moons, meteors, asteroids, and comets
- 112.18. Grade 6(b) - 11 (B) understand that gravity is the force that governs the motion of our solar system

Grade 7

- 112.19. Grade 7(b) - 2 (A) plan and implement comparative and descriptive investigations by making observations, asking well-defined questions, and using appropriate equipment and technology
- 112.19. Grade 7(b) - 2 (E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends • 112.19. Grade 7(b) - 3 (B) use models to represent aspects of the natural world such as human body systems and plant and animal cells
- 112.19. Grade 7(b) - 3 (D) relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content.
- 112.19. Grade 7(b) - 4 (A) use appropriate tools to collect, record, and analyze information, including life science models, hand lens, stereoscopes, microscopes, beakers, Petri dishes, microscope slides, graduated cylinders, test tubes, meter sticks, metric rulers, metric tape measures, timing devices, hot plates, balances, thermometers, calculators, water test kits, computers, temperature and pH probes, collecting nets, insect traps, globes, digital cameras, journals/notebooks, and other equipment as needed to teach the curriculum

Grade 8

- 112.20. Grade 8(b) - 2 (A) plan and implement comparative and descriptive investigations by making observations, asking well-defined questions, and using appropriate equipment and technology

- 112.20. Grade 8(b) - 2 (E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends • 112.20. Grade 8(b) - 3 (B) use models to represent aspects of the natural world such as an atom, a molecule, space, or a geologic feature
- 112.20. Grade 8(b) - 3 (D) relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content
- 112.20. Grade 8(b) - 4 (A) use appropriate tools to collect, record, and analyze information, including lab journals/notebooks, beakers, meter sticks, graduated cylinders, anemometers, psychrometers, hot plates, test tubes, spring scales, balances, microscopes, thermometers, calculators, computers, spectrometers, timing devices, and other equipment as needed to teach the curriculum
- 112.20. Grade 8(b) - 5 (A) describe the structure of atoms, including the masses, electrical charges, and locations, of protons and neutrons in the nucleus and electrons in the electron cloud
- 112.20. Grade 8(b) - 8 (B) recognize that the Sun is a medium-sized star near the edge of a disc-shaped galaxy of stars and that the Sun is many thousands of times closer to Earth than any other star.

Grades 9-12:

- 112.33. Astronomy(c) - 2 (E) plan and implement investigative procedures, including making observations, asking questions, formulating testable hypotheses, and selecting equipment and technology.
- 112.33. Astronomy(c) - 2 (G) organize, analyze, evaluate, make inferences, and predict trends from data, including making new revised hypotheses when appropriate
- 112.33. Astronomy(c) - 2 (I) use astronomical technology such as telescopes, binoculars, sextants, computers, and software.
- 112.33. Astronomy(c) – 3 (D) evaluate the impact of research on scientific thought, society, and the environment
- 112.33. Astronomy(c) - 3 (E) describe the connection between astronomy and future careers.
- 112.33. Astronomy(c) - 6(A) compare and contrast the scale, size, and distance of the Sun, Earth, and Moon system through the use of data and modeling • 112.33. Astronomy(c) - 10 (A) identify the approximate mass, size, motion, temperature, structure, and composition of the Sun
- 112.33. Astronomy(c) - 10 (B) distinguish between nuclear fusion and nuclear fission, and identify the source of energy within the Sun as nuclear fusion of hydrogen to helium
- 112.33. Astronomy(c) - 10 (C) describe the eleven-year solar cycle and the significance of sunspots
- 112.33. Astronomy(c) - 10 (D) analyze solar magnetic storm activity, including coronal mass ejections, prominences, flares, and sunspots.