

Educator Name	Jackie Cooke	Title of Learning Plan	The Hubble Test Telescope
Grade Levels	K-5	Subject Areas	Mathematics
Museum Sites	National Air and Space Museum	Time Frame	

Summary	Students will learn about the history of the Hubble Telescope and its contributions to further our understanding of the universe, find measurement data and create a scale model.
Digital & Mobile Media Tools	Computers with Internet Connection
Common Core State Standards	<p>Common Core Standards for Math:</p> <p>2nd: Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem.</p> <p>3rd: Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems.</p> <p>4th: Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two- column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36).</p> <p>4th: Apply the area and perimeter formulas for rectangles in real world and mathematical problems. For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.</p> <p>5th: Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.</p>
Learning Objectives and Skills Involved	<p>Learning Objectives:</p> <ul style="list-style-type: none"> Describe the scale and structure of HST and make comparisons to other large objects Understand that we create scale test models to help create the correct-sized tools to work on and simulate activities that take place on machines of such great size as the HST Learn about Hubble's contributions to space science Compute using the four operations to solve space related math problems Measure to scale
Assessments	Use grade level appropriate scoring guides to evaluate their math problem solving skills.
Museum Exhibitions and Objects	Hubble Test Telescope Exhibit at NASM

Materials	<p>Stiff paper such as cardstock for students to use to construct HST scale model</p> <p>Plain paper for sketching and labeling important features of HST</p> <p>Calculators</p> <p>Measuring tapes and rulers</p>
Resources	<p>MLI Hubble Test Telescope Video:</p> <p>Access to the NASM online exhibit: www.nasm.si.edu/exhibitions/gal114/SpaceRace/sec500/sec510.htm</p> <p>Hubble background and facts sheet at: http://hubblesite.org/the_telescope/hubble_essentials/quick_facts.php</p> <p>To learn more about the color and shape of Hubble images, watch the video at: http://hubblesite.org/gallery/behind_the_pictures/</p> <p>Downloadable pattern and directions for how to make a simple Hubble paper model or a more difficult PVC model of Hubble can be found at: http://hubblesite.org/the_telescope/hand-held_hubble/</p> <p>Hubble Diagram http://www.pbs.org/deepspace/hubble/diagram.html</p> <p>Animated Hubble: http://www.imax.com/hubble/</p> <p>How Hubble Works http://hubblesite.org/the_telescope/</p> <p>WGBH, Teachers' Domain, "Hubble's Expanding Universe" video clip (3:50 min) Astronomer Edwin Hubble determined two things that shook the foundations of astronomy: billions of galaxies exist outside of our own, each of which contains billions of stars, and the universe is actually expanding. This adapted video segment uses footage from <i>NOVA</i> and NASA to show how Hubble's findings laid the foundation for the Big Bang theory. http://www.teachersdomain.org/resource/phy03.sci.phys.fund.hubble2/</p> <p>WGBH, Teachers' Domain, "Telescope Girl" video clip (3:24 min) Features a young telescope enthusiast and her reflecting telescope. She explains how this type of telescope works and shows you what you can see through it. She also demonstrates how you can make a reflecting telescope like hers using relatively common and inexpensive materials at: http://www.teachersdomain.org/resource/phy03.sci.phys.mfe.ztelegirl/</p> <p>An interactive site to learn about the last SST mission to service HST: http://www.nasa.gov/externalflash/hubble_servicing/</p> <p>An online video called <i>20 Years with Hubble</i> and the <i>Star Witness</i>, a downloadable student magazine about the HST 20th Anniversary can be found at: http://amazing-space.stsci.edu/hubble_20/</p> <p>Interactive sites for students to gain understanding of scale and perspective: http://www.teachersdomain.org/ext/ess05_int_oneplace/index.html and http://www.windows2universe.org/the_universe/images/nsf_matter_of_scale/nsf_matter_of_scale.html</p>

Lesson Activities Descriptions

1. Make a Sketch of HST and label the important components. A diagram of HST can be found at:

<http://quest.nasa.gov/hst/images/HSTdigram.gif>

An interactive 3-D animated model can be dragged and rotated to see different views of HST at: <http://www.imax.com/hubble/>

2. Ask students to write about what they think the HST does. Then they can read about, do internet research, view videos and the teacher can share some of the facts about Hubble listed in the Background section of this lesson to help students see how close they were in their written explanations to the reality of HST's mission.

3. Show students the Animal Size Comparison Chart (see below).

Have them make comparisons between the dimensions of HST and animals of their choice. (e.g., It would take approximately 5 white rhinoceros to equal the weight of the HST)

4. Have students create a hand held scale model of Hubble using the dimensions listed in the Background Information section of this lesson plan. Depending on the grade level, the scale measurement dimension focused on could vary from length, weight, area, surface area, diameter, etc.

5. Extensions

Students could view the scale model of the space shuttle found at the NASM and do similar scale model comparisons as the ones listed above.

<http://www.nasm.si.edu/collections/artifact.cfm?id=A19860004000>

Students could research biographies of astronauts.

Background Information

The Hubble Space Telescope (HST), 1990-20??



HST is a reflecting telescope encased in a protective shell housing cameras and other instruments, solar panels for power and communications antennae. It's the size of a school-bus, 43.5 ft (13.2 m) long, 14 ft (4.27 meters) in diameter, and weighing some 24,500 lb (11,110 kg). The crew of the space shuttle Discovery (STS-31) delivered the HST into low-Earth orbit (600 kilometers) on April 25, 1990. HST travels around Earth at 5 miles per second.

STS-125 was the final shuttle mission sent to service HST. It lasted for 12 days, 21 hours, 37 minutes. It was launched at 2:01 p.m. on May 11, 2009 and landed at 11:39 a.m. on May 24, 2009. The result of this mission was six working, complementary science instruments with capabilities beyond what was available and an extended operational lifespan for HST until at least 2014.

HST Interesting Facts

Hubble does not travel to stars, planets, and galaxies. It takes pictures of them as it whirls around Earth at 17,500 miles an hour.

In its 20 years of viewing the heavens, NASA's Hubble Space Telescope has made more than 930,000 observations and snapped over 570,000 images of 30,000 celestial objects.

In its 20-year lifetime the telescope has made more than 110,000 trips around our planet. With those trips, Hubble has racked up plenty of frequent-flier miles, about 2.8 billion, which is Neptune's average distance from the Sun.

The 20 years' worth of observations has produced more than 45 terabytes of data, enough information to fill nearly 5,800 DVD movies.

Each month the orbiting observatory generates more than 360 gigabytes of data, which could fill the storage space of an average home computer.

Astronomers using Hubble data have published more than 8,700 scientific papers, making it one of the most productive scientific instruments ever built. In 2009 scientists published 648 journal articles on Hubble telescope data.

Animal Measures Comparison Chart

Animal	Average Length/Height	Average Weight
Blue Whale	110 (ft) (34 m)	238,000 (lbs) (136,000 kg)
African Elephant	21.85 (ft) (6.5 m)	18,500 (lbs) (8500 kg)
Asian Elephant	19.5 (ft) (5.9 m)	8,750 (lbs) (4200 kg)
White Rhinoceros	12.5 (ft) (3.8 m)	5,000 (lbs) (2350 kg)
Hippopotamus	11 (ft) (3.3 m)	5,250 (lbs) (2500 kg)
Giraffe	15.4 (ft) (4.6 m)	3,000 (lbs) (1400 kg)
Walrus	11 (ft) (3.3 m)	2,645 (lbs) (1200 kg)
Crocodile	20 (ft) (6 m)	1,700 (lbs) (785 kg)
Horse	6 (ft) (1.8)	1,200 (lbs) (550 kg)
Man	5'10" (1.7 m)	190 (lbs) (86 kg)