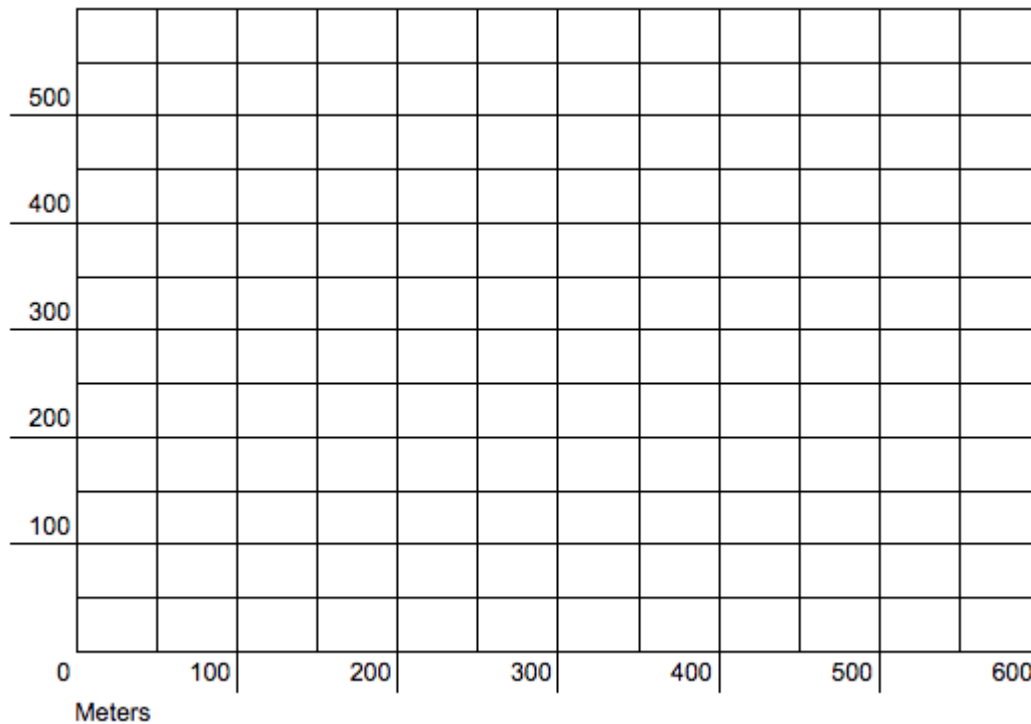


Day 4: Graphing Coordinate plane

Math

Practice graphing coordinates by tracking the Curiosity Rover during it's travels across the surface of Mars. You will use the data to plot points and then analyze that data.

Following the Curiosity Rover on Mars



The Curiosity Rover is traveling across the surface of Mars. We can follow its path by recording a series of destinations as ordered pairs using the local North-South location as the Y-axis, and East-West as the X-axis. Draw the coordinate grid, with units marked every 50 meters from 0 to 500 meters on each axis.

Graph the following destinations:

Day 39: (+210, +180) Day 45: (+315, +165) Day 52: (+470, +200)

Day 41: (+270, +210), Day 48: (+360, +175) Day 56: (+500, +205)

Day 42: (+300, +200), Day 49: (+390, +180)

Problem 1 - Along which axis was the change in position the largest?

Problem 2 - How far, in meters, did Curiosity travel between Day 42 and Day 52?

Problem 3 - What was the average speed of Curiosity between Day 42 and Day 52? (Speed = Distance/Time)

Day 4: Comparing and Contrasting Earth & Mars

Science

Using the chart provided, begin collecting data for the chart to compare the Earth & Mars. Be sure to keep this chart for Day 5, Day 6, and Day 8!

Planet	Earth	Mars
Size (Volume)		
Size (in miles or kilometers)		
What is the gravity compared to Earth?		
Period of Rotation (How long is a day?)		
Period of Revolution (How long is a year?)		
Distance from Sun (in miles or AU)		
Average temperature (use the same unit)		
Is there an atmosphere?		
What is the atmosphere made of?		
Is there life on the planet?		
Is there water on this planet?		
Can you grow plants there?		

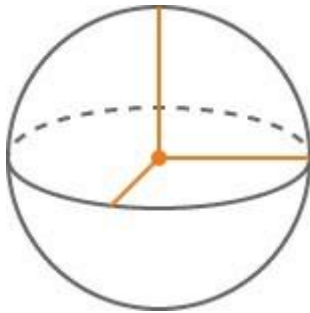
Online Resource: <https://science.nasa.gov/mars/facts/>



The Planet

Mars is no place for the faint-hearted. Arid, rocky, cold and apparently lifeless, the Red Planet offers few hospitalities. Fans of extreme sports can rejoice, however, for the Red Planet will challenge even the hardest souls among us. Home to the largest volcano in the solar system, the deepest canyon and crazy weather and temperature patterns, Mars looms as the ultimate lonely planet destination.

Size

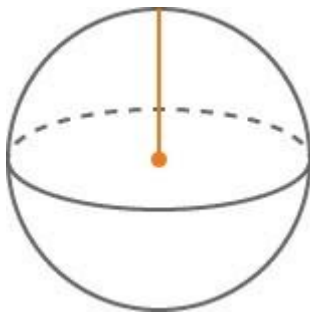


Volumetric Mean Radius

Distance from the planet's center to its surface, if the planet's volume were contained in a symmetric sphere

About half (53.2%) that of Earth

Mars: 3,389.5 kilometers <i>or</i> 2,106.1 miles	Earth: 6,371 kilometers <i>or</i> 3,958.8 miles
--	---

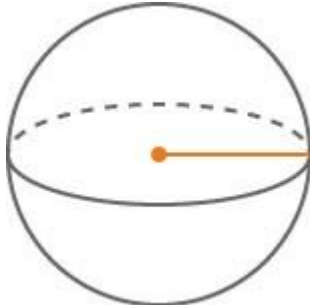


Polar Radius

Half the diameter of the planet from pole to pole

About half (53.1%) that of Earth

Mars: 3,376.2 kilometers <i>or</i> 2,098 miles	Earth: 6,356.8 kilometers <i>or</i> 3,950 miles
--	---

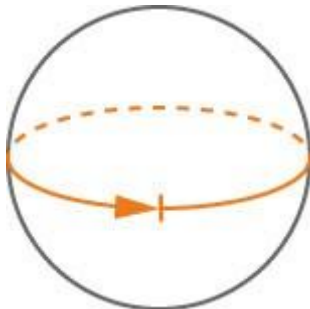


Equatorial Radius

Half the diameter of the planet at its equator

About half (53.2%) that of Earth

Mars: 3,396.2 kilometers <i>or</i> 2,110 miles	Earth: 6,378.1 kilometers <i>or</i> 3,963 miles
--	---



Equatorial Circumference

A measurement of the distance around the equator of Mars

About half (53.2%) that of Earth

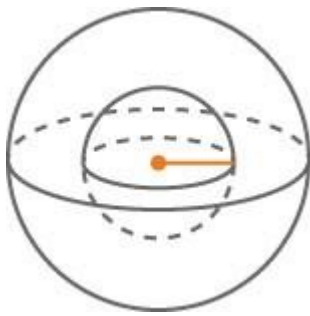
Mars: 21,339 kilometers <i>or</i> 13,259 miles	Earth: 40,075 kilometers <i>or</i> 24,901 miles
--	---

Radius of the Core

The distance from the planet's center to the outer boundary of the core

About half (50%) that of Earth

Earth: Total core: ~3,400 kilometers <i>or</i>
--



2,113 miles

Mars:
Total core:
1,700 kilometers

"Solid" inner core: ~1,220 kilometers
or
758 miles

or
1,056 miles

Liquid outer core: ~2,266 kilometers
or
1,408 miles



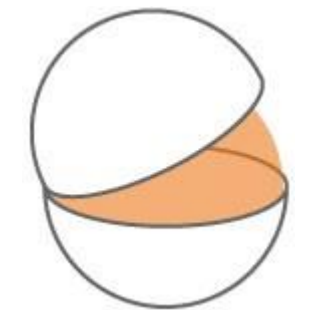
Surface Area

The sum of the areas of all shapes that cover the surface of the planet

About 28% that of Earth

Mars:
144,371,391 square kilometers
($1.4437 \times 10^8 \text{ km}^2$)
or
55,742,106 square miles

Earth:
510,064,472 square kilometers
($5.1006 \times 10^8 \text{ km}^2$)
or
196,936,994 square miles



Volume

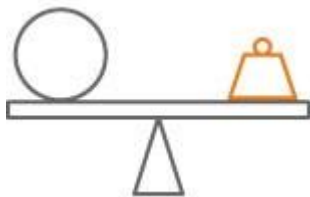
The quantity of three-dimensional space that a planet contains

About 15.1% that of Earth

Mars:
163,115,609,799 cubic kilometers

Earth:
1,083,206,916,846 cubic kilometers

($1.63116 \times 10^{11} \text{ km}^3$) ($1.0832 \times 10^{12} \text{ km}^3$)



Mass

A measurement of the amount of matter Mars contains

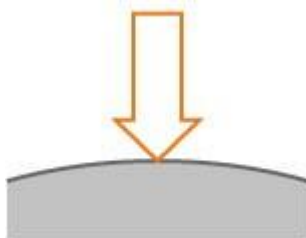
About 11% that of Earth

Mars:
641,693,000,000,000,000,000,000 kilograms
($6.4169 \times 10^{23} \text{ kg}$)

Earth:
5,972,190,000,000,000,000,000,000 kilograms
($5.9722 \times 10^{24} \text{ kg}$)

Gravity and More

Surface Gravity



The gravitational acceleration experienced at a planet's surface

About 38% that of Earth

Mars:
3.71 meters per second squared
or
12.2 feet per second squared

Earth:
9.80665 meters per second squared
or
32.174 feet per second squared

Escape Velocity



The speed an object needs to break free from the gravitational attraction of a planet, moon, or other body without further propulsion

About 45% that of Earth

Mars:
18,108 kilometers per hour
(5.03 km/second)
or
11,252 miles per hour

Earth:
40,284 kilometers per hour
(11.19 km/second)
or
25,030 miles per hour

Temperature

Temperature of the Surface (Typical)



Minimum/Maximum)

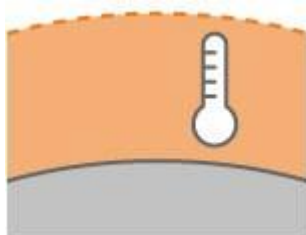
How hot or cold the surface varies between day and night and among seasons

Mars is colder than Earth because it is farther from the Sun.

Mars:
-190 to 86° Fahrenheit
-120 to 30° Celsius
150 to 303 Kelvin

Earth:
-126 to 136° Fahrenheit
-88 to 58° Celsius
185 to 331 Kelvin

Average Temperature of the Atmosphere



Measurement of how hot or cool the atmosphere is at different altitudes (heights relative to the surface)

Mars:
-81° Fahrenheit
-63° Celsius
210 Kelvin

Earth:
59° Fahrenheit
15° Celsius
288 Kelvin



Composition of the Planet

The chemical materials that make up a planet

Mars' composition is similar to Earth's

Mars:

Crust and Surface : mostly iron-rich basaltic rock similar to Earth's thin crust

Mantle: Silicate rock

Core: probably an iron, nickel, and sulfur core, but whether it is hot liquid or cooled metal is not known

Earth:

Crust and Surface: iron magnesium silicate igneous rocks, like basalt

Mantle: Silicate rock rich in magnesium and iron

Core: Iron-nickel alloy



Composition of the Atmosphere

The chemical materials that make up the layers of gases surrounding a planet or moon, which are held in place by the object's gravity

Mars' atmosphere is 100 times less dense than Earth's

Mars:

Main Gases:

96% Carbon Dioxide (CO₂)*

1.93% Argon (Ar)**

1.89% Nitrogen (N₂)

0.145% Oxygen (O₂)

<0.01% Carbon

Monoxide (CO)

Earth:

Main Gases:

78.09% Nitrogen (N₂)

20.95% Oxygen (O₂)

0.93% Argon (Ar)

0.039% Carbon

Dioxide (CO₂)

Both planets also have other gases in very small amounts (trace gases).

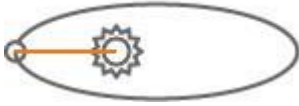
Did you know...?

**Carbon dioxide is used for carbonation in beverages. Frozen carbon dioxide is "dry ice."*

***Argon is used to make blue "neon lights."*

Perihelion

The closest distance



between the Sun and Mars as the Red Planet travels in its orbit around the Sun

1.405 times that of Earth

Mars:

206,655,215

kilometers

2.06655×10^8 km

or

128,409,598 miles

or

1.381 AU

Earth:

23 hours, 56 minutes
(23.934 hours)

kilometers

1.47098×10^8 km

or

91,402,640 miles

or

0.9833 AU*

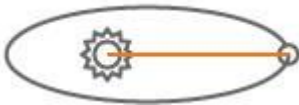
An AU is an astronomical unit. In simple terms, 1 AU is the average distance between the Sun and Earth.

Did you know...?

**The reason that the perihelion of Earth is less than 1 AU is that this is a measure of its closest distance from the Sun (its minimum distance). 1 AU is the average between the minimum and maximum distances.*

Aphelion

The farthest distance between the Sun and Mars as the Red Planet travels in its orbit around the Sun



1.639 times that of Earth

Mars:

249,232,432

kilometers

2.49232×10^8 km

or

154,865,853 miles

or

1.666 AU

Earth:

152,098,233

kilometers

1.52098×10^8 km

or

94,509,460 miles

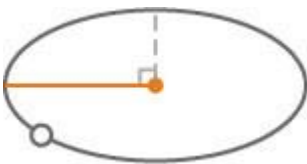
or

1.017 AU

An AU is an astronomical unit. In simple terms, 1 AU is the average distance between the Sun and Earth.

Orbit

Orbit Size Around Sun (semi-major axis)



One half of the longest diameter of an orbital ellipse (radius of the orbit at the orbit's two most distant points)

About 1.5 times that of Earth

Mars:

227,943,824

kilometers

2.2794382×10^8 km

or

141,637,725 miles

or

1.523662 AU

Earth:

149,598,262

kilometers

1.4959826×10^8 km

or

92,956,050 miles

or

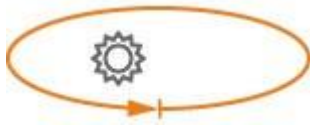
1.000 AU

An AU is an astronomical unit. In simple terms, 1 AU is the average distance between the Sun and Earth.

Circumference of Orbit

About 1.5 times that of Earth

Mars: 1,429,085,052 kilometers (1.429×10^9) km <i>or</i> 887,992,283 miles	Earth: 939,887,974 kilometers (9.399×10^8) km <i>or</i> 584,019,311 miles
---	--



The distance Mars travels in its orbit around the Sun.

Orbital Eccentricity

Mars' orbit is about 5.6 times more elliptical than that of Earth, which is nearly a perfect circle

Mars: 0.0933941	Earth: 0.01671123
---------------------------	-----------------------------



A measurement of how much Mars' orbit around the Sun differs from a perfect circle; 0 = a perfect circle, and values between 0 and 1 represent an elliptical (oval) orbit

Orbit Inclination

Earth's orbital plane is almost flat, but Mars' has a slight tilt

Mars: 1.85 degrees	Earth: 0.00005 degrees
------------------------------	----------------------------------



The angle an orbit is "tilted" relative to a reference plane

0 degrees (reference plane for describing the position of bodies in the solar system)

The ecliptic is the plane of Earth's orbit around the Sun

Average Length of Day (Sidereal Rotation Period)

Day

About 37 minutes longer than an Earth day

Mars: 24 hours, 37 minutes (24.623 hours) 1.029 Earth days	Earth: 23 hours, 56 minutes (23.934 hours)
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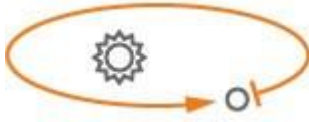
The time it takes for a planet or other body to make one rotation (one spin on its axis)

Year

Length of Year (Sidereal Period or Revolution)

About twice as long as an Earth year

Mars: about 687 Earth days
Earth: 365.25 Days



The time it takes for a planet or other body to make a full orbit of the Sun (or outside of our solar system, its primary star)

Tilt / Seasons

Axial Tilt (Obliquity)

Very similar to Earth's - only a 2-degree difference

Mars: 25.2°
Earth: 23.5°



The angle between Mars' orbital plane and its spin axis

Change in Axial Tilt

The tilt of Mars changes more dramatically over time

Variations in the angle of tilt

Unlike Earth, substantial changes in the obliquity (or tilt) of Mars occur on timescales of hundreds of thousands to millions of years and result in long-term climate change



Seasons

Mars' year is almost twice as long as Earth's so its seasons are longer too

Changes in the amount of sunlight reaching different latitudes due to the varying orientation of the axial tilt as the planet orbits the Sun

4 seasons, roughly twice as long as those on Earth, but with more variation given Mars' eccentric orbit and the fact its orbital speed varies more as result (fastest when at perihelion; slowest at aphelion)



Season (Northern Hemisphere)	Length of Season on Earth	Length of Season on Mars
Spring	93	194
Summer	93	178
Autumn	90	142
Winter	89	154

Day 4: Primary Source Analysis

Social Studies

Name _____

Date _____

Lewis & Clark Written Primary Source Activity

One of the major objectives of the Corps of Discovery expedition was to take a census of the fauna and flora in the Louisiana Territory. Other major objectives were to map the territory and to befriend the American Indians who lived there.

President Jefferson encouraged Lewis and Clark to keep detailed journals of what they saw and experienced on their journey. In addition, they were encouraged to return home with animal, plant, and mineral specimens.

Here are several journal entries for you to read and discuss.

Capt. Lewis, March 5, 1806 The Crow raven and Large Blackbird are the same as those of our country only that the crow is here much smaller yet it's note is the same. I observe no difference either between the hawks of this coast and those of the Atlantic. I have observed the large brown hawk, the small or sparrow hawk, and the hawk of an intermediate size with a long tail and blewish coloured wings remarkably swift in flight and very fierce. sometimes called in the U'States the hen hawk. these birds seem to be common to every part of this country and the hawks crows & ravens build their nests in great numbers along the high and inaccessible cliffs of the Columbia river and it's S.E. branch where we passed along them.

Capt. Lewis, May 28, 1806 since my arrival here I have killed several birds of the corvus genus of a kind found only in the rocky mountains and their neighbourhood. I first met with this bird above the three forks of the Missouri and saw them on the heights of the rocky Mountains but never before had an opportunity of examining them closely. the small corvus described at Fort Clatsop is a different species, tho' untill now I had taken it to be the same, this is much larger and has a loud squawling not something like the mewling of a cat. the beak of this bird is 1d 1/2 inches long, is proportionably large, black and of the form which characterizes this genus. the upper exceeds the under chap a little. the head and neck are also proportionably large. the eye full and rather prominent, the iris dark brown and purple black. it is about the size and somewhat the form of the Jaybird tho rather rounder or more full in the body. the tail is four and a half inches in length, composed of 12 feathers nearly of the same length. the head neck and body of this bird are of a dove colour. the wings are black except the extremities of six large feathers occupying the middle joint of the wing which are white. the under disk of the wing is not the shining or glossy black which marks its upper surface. the two feathers for half their width the balance are of pure white. the feet and legs are black and imbricated with wide scales. the nails are black and remarkably long and sharp, also much curved. it has four toes on each foot of which one is

Day 4: Primary Source Analysis

Social Studies

Name _____

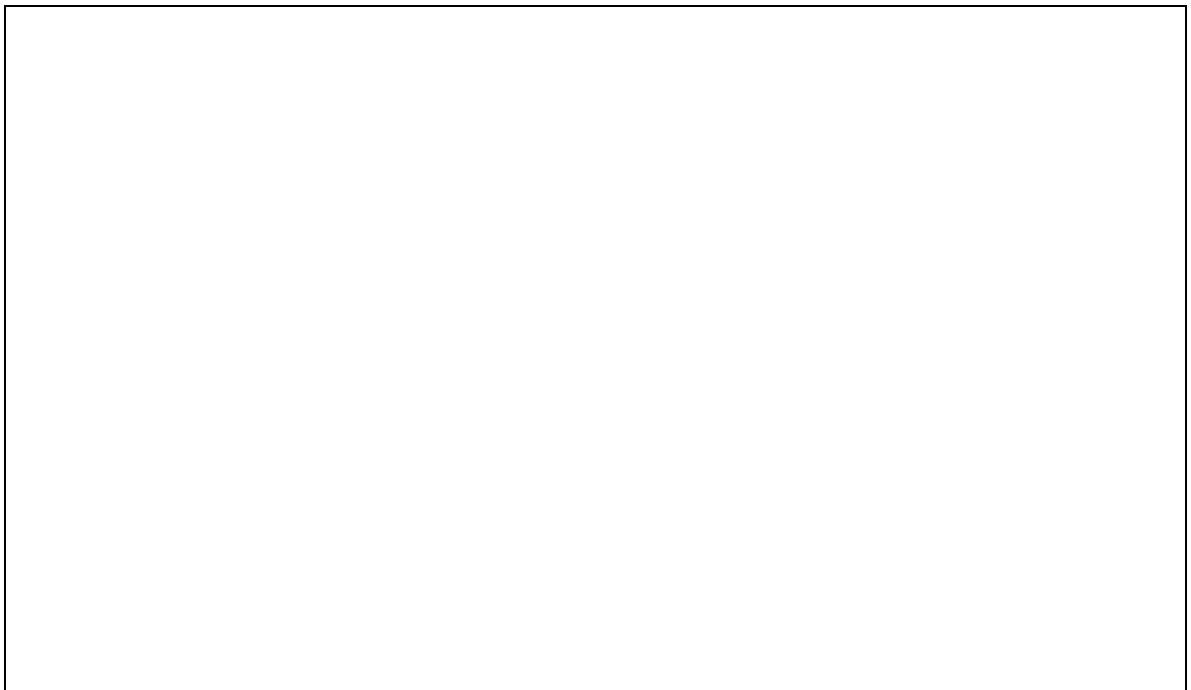
Date _____

in the rear and three in front. the toes are long particularly that in the rear. This bird feeds on the seed of the pine and also on insects. it resides in the rocky mountains at all seasons of the year, and in many parts is the only bird to be found.

Question and Activity:

1. What do these two preceding passages reveal about the observational skills of Meriwether Lewis?

2. The longer passage describes a bird now known as Clark's Nutcracker. Based on Lewis's description, draw a picture of this bird.



Day 4: Primary Source Analysis

Social Studies

Name _____

Date _____

Capt. Clark, December 7, 1804 a very cold day wind from the NW. the Big White Grand Chief of the Ist Village, came and informed us that a large Drove of Buffalows was near and his people was waiting for us to join them in a chase Capt Lewis took 15 men & went out joined the Indians, who were at the time he got up, Killing the Buffalow on Horseback with arrows which they done with great dexterity, his part killed 10 Buffalow, five of which we got to the fort by the assistance of a horse in addition to what the men Packed on their backs. one cow was killed on the ice after drawing her out of a vacancey in the ice in which She had fallen, and Butchered her at the fort. those we did not get in was taken by the Indians under a Custom which is established amongst them i.e. any person seeing a buffalow lying without an arrow Sticking in him, or some purticular mark takes possession, many times (as I am told) a hunter who kills maney Buffalow in a chase only Gets a part of one . . . the river Closed opposit the fort last night 1 1/2 inches thick, The Thermometer Stood this Morning at I d. below 0. three men frost bit badly to day.

Writing Activities:

1. Using the preceding entry, expand on the description, imagining that you were a member of the Corps writing a letter home to your family.

2. Based on the preceding passage, describe the relationship between the Corps and the local American Indians. Also, describe how the American Indians felt about the buffalo.

Day 5: Tone, Mood, and Theme

English Language Arts

- Apply the concept of tone, mood, and theme to President Jefferson's address to Lewis in 1803.
- Complete the questions at the conclusion of Jefferson's letter.

Tone, Mood, and Theme

Transcript: Jefferson's Instructions for Meriwether Lewis

Thomas Jefferson and Early Western Explorers

Transcribed and Edited by Gerard W. Gawalt, Manuscript Division, Library of Congress. June 20 1803

To: Captain Meriwether Lewis esq. Capt. of the 1st. regimt, of Infantry of the United States

Full Transcript Available at <https://www.loc.gov/exhibits/lewisandclark/transcript57.html>

[ante June 20 1803]

To <Captain> Meriwether Lewis esq. Capt. of the 1st. regimt, of Infantry of the US. of A.

Your situation as Secretary of the President of the US has made you acquainted with the objects of my confidential message of Jan. 18. 1803 to the legislature; you have seen the act they passed, which they expressed in general terms, was meant to sanction these objects, and you are appointed to carry them into execution.

(5) Instruments for ascertaining by celestial observations, the geography of the country through which you will pass, have been already provided. Light articles for barter and presents among the Indians, arms for your attendants, say from 10. to 12. men, boats, tents, & other travelling apparatus with ammunition, medicine, surgical instruments and provisions you will have prepared with such aids as the Secretary at War can yield in his department; & from him also you will receive authority to (10) engage among our troops, by voluntary agreement, the number of attendants above mentioned, over whom you, as their commanding officer, are invested with all the powers the laws give in such a case.

The object of your mission is to explore the Missouri river, & such principal stream of it as by it's course and communication with the waters of the Pacific ocean whether the Columbia, Oregon, Colorado or any other river may offer the most direct & practicable water communication across this (15) continent for the purposes of commerce.

Beginning at the mouth of the Missouri, you will take careful observations of latitude & longitude at all remarkable points on the river, & especially at the mouth of rivers, at rapids, at islands, & other places & objects distinguished by such durable natural marks & characters of a durable nature kind as that they may with certainty be recognized hereafter.

(20) The course of the river between these points of observation may be supplied by the compass, the log-line & by time, corrected by the observations themselves. The variations of the compass too, in different places should be noticed.

The interesting points of the portage between the heads of the Missouri, & of the water offering the best communication with the Pacific ocean, should also be fixed by observation, & the course of that (25) water to the ocean, in the same manner as that of the Missouri.

Your observations are to be taken with great pains & accuracy, to be entered distinctly & **intelligibly** for others...fix the latitude and longitude of the places at which they were taken, and are to be rendered to the war office for the purpose of having the calculations made concurrently by proper persons within the US. several copies of these as well as of your other notes should be made at (30) leisure times, & put into the care of the most trust-worthy of your attendants, to guard by multiplying them against the accidental losses to which they will be exposed. A further guard would be that one these copies be on the paper of the birch, as less liable to injury from damp than common paper.

The commerce which may be carried on with the people inhabiting the line you will pursue, renders a (35) knowledge of those people important. You will therefore **endeavor** to make yourself acquainted with as far as a **diligent** pursuit of your journey shall admit, with the names of the nations & their numbers; the extent & limits of their possessions; their relations with other tribes of nations; their language, traditions, monuments; their ordinary occupations in agriculture, fishing, hunting, war, arts & the implements for these; their food, clothing, & domestic accommodations; the diseases prevalent (40) among them, & the remedies they use; moral & physical circumstances which distinguish them from the tribes we know; peculiarities in their laws, customs & dispositions; and articles of commerce they may need or furnish & to what extent.

Other objects worthy of notice will be the soil & face of the country, it's growth & vegetable productions, especially those not of the US. the animals of the country generally, & especially those (45) not known in the US. the remains & accounts of any which may be deemed rare or extinct; the mineral productions of every kind; but more particularly metals; limestone, pit-coal, & salt-petre; salines & mineral waters, noting the temperature of the last & such circumstances as may indicate their character; volcanic appearances; climate, as characterized by the thermometer, by the proportion of rainy, cloudy, & clear days, by lightening, hail, snow, ice, by the access & recess of (50) frost, by the winds prevailing at different seasons, the dates at which particular plants put forth or lose their flower, or leaf, times of appearance of particular birds, reptiles or insects.

Although' your route will be along the channel of the Missouri, yet you will endeavor to inform yourself, by enquiry, of the character & extent of the country watered by it's branches & especially on it's Southern side, the North river or Rio Bravo which runs into the gulph of Mexico, and the North (55) river, or Rio Colorado which runs into the gulph of California, are understood to be the principal streams heading opposite to the waters of the Missouri, and running Southwardly. Whether the dividing grounds between the Missouri & them are mountains or flat lands, what are their distance from the Missouri, the character of the intermediate country, & the people inhabiting it, are worthy of particular enquiry.

(60) The Northern waters of the Missouri are less to be enquired after, because they have been ascertained to a considerable degree, & are still in a course of ascertainment by English traders, and travellers. But if you can learn anything certain of the most Northern source of the Mississippi, & of it's position relatively to the lake of the woods, it will be interesting to us.

Two copies of your notes at least & as many more as leisure will admit, should be made & confided to (65) the care of the most trusty individuals of your attendants.

In all your intercourse with the natives, treat them in the most friendly & **conciliatory** manner which their own conduct will admit; allay all jealousies as to the object of your journey, satisfy them of it's innocence, make them acquainted with the position, extent character, peaceable & commercial dispositions of the US. of our wish to be neighborly, friendly, & useful to them.

(70) If a few of their influential chiefs within practicable distance, wish to visit us, arrange such a visit with them, and furnish them with authority to call on our officers, on their entering the US. to have them conveyed to this place at the public expense.

If any of them should wish to have some of their young people brought up with us, & taught such arts as may be useful to them, we will receive, instruct & take care of them. Such a mission whether of (75) influential chiefs or of young people would give some security to your own party.

Carry with you some matter of the kinexox; inform those of them with whom you may be, of it's efficacy as a preservative from the smallpox; & instruct & encourage them in the use of it. This may be especially done wherever you winter.

As it is impossible for us to foresee in what manner you will be received by those people, whether (80) with hospitality or hostility, so is it impossible to prescribe the exact degree of perseverance with which you are to pursue your journey. We value too much the lives of citizens to offer them to probable destruction. Your numbers will be sufficient to secure you against the unauthorized opposition of individuals or of small parties: but if a superior force authorized, or not authorized by a nation, should be arrayed against your further passage, and inflexibly determined to arrest it, you (85) must decline it's farther pursuit, and return.

In the loss of yourselves, we should lose also the information you will have acquired. By returning safely with that, you may enable us to renew the essay with better calculated means. To your own discretion therefore must be left the degree of danger you risk, and the point at which you should decline, only saying we wish you to err on the side of your safety, and to bring back your party safe (90) even if it be with less information.

Should you reach the Pacific Ocean inform yourself of the circumstances which may decide whether the furs of those parts may not be collected as advantageously at the head of the Missouri ... On your arrival on that coast endeavor to learn if there by any port within your reach frequented by the sea-vessels of any nation, & to send two of your trusty people back by sea, in such way as they (95) shall judge shall appear practicable, with a copy of your notes: and should you be of opinion that the return of your party by the way they went will be eminently dangerous, then ship the whole, & return by sea, by the way either of cape Horn, or the cape of good Hope, as you shall be able. As you will be without money, clothes or provisions, you must endeavor to use the credit of the U.S. to obtain them, for which purpose open letters of credit shall be furnished you, authorizing you to draw upon (100) the Executive of the U.S. or any of it's officers...

Should you find it safe to return by the way you go, after sending two of your party round by sea, or with your whole party, if no conveyance by sea can be found, do so; making such observations on your return, as may serve to supply, correct or confirm those made on your outward journey.

On re-entering the U.S. and reaching a place of safety, discharge any of your attendants who may (105) desire & deserve it, procuring for them immediate payment of all arrears of pay & clothing which may have incurred since their departure, and assure them that they shall be recommended to the liberality of the legislature for the grant of a soldier's portion of land each, as proposed in my message to Congress; & repair yourself with your papers to the seat of government

To provide, on the accident of your death, against anarchy, dispersion, & the consequent danger to (110) your party, and total failure of the enterprise, you are hereby authorized, by any instrument signed & written in your own hand, to name the person among them who shall succeed to the

command on your decease, and by like instruments to change the nomination from time to time as further experience of the characters accompanying you shall point out superior fitness...

Given under my hand at the city of Washington this 20th day of June 1803.

Th. J. Pr. U.S. of A.

Directions: Read Jefferson's Letter and complete the following questions.

1. What **tone** does Jefferson set throughout the letter?
2. Consider your answer to the first question. Provide one line of evidence as to why you made this selection.
3. What is the potential **theme** of Jefferson's letter to the Corps of Discovery?
4. Provide two pieces of evidence from the text (sentences/quotes) that support your choice of a theme:
 - A.
 - B.