OVERVIEW OF THE ENTIRE UNIT

The unit focuses on the ways that men have physically explored their own environment (the earth) and the environment beyond (outer space):

Part 1 – “Exploring Your Surroundings” begins with the question of why students would personally be interested in physically exploring their local environment. Students identify the types of explorations that they have done and the reasons that they have done them. They assess the risks of exploration and how exploration tools such as maps could help them reduce the risks. They learn how to use maps to determine distance, direction and elevation to reduce the risks of an exploration.

Part II – “Exploring Our Solar System” begins with the question of benefits vs. risks of space exploration. Students explore the perspectives of different groups of people who are for and against space exploration. Students learn that the first explorations were earth-based with tools such as telescopes. In the 1950’s, humans entered the modern space age with spaced-based explorations. Students explore the various types of space-based exploration vehicles and machines that are in use today.

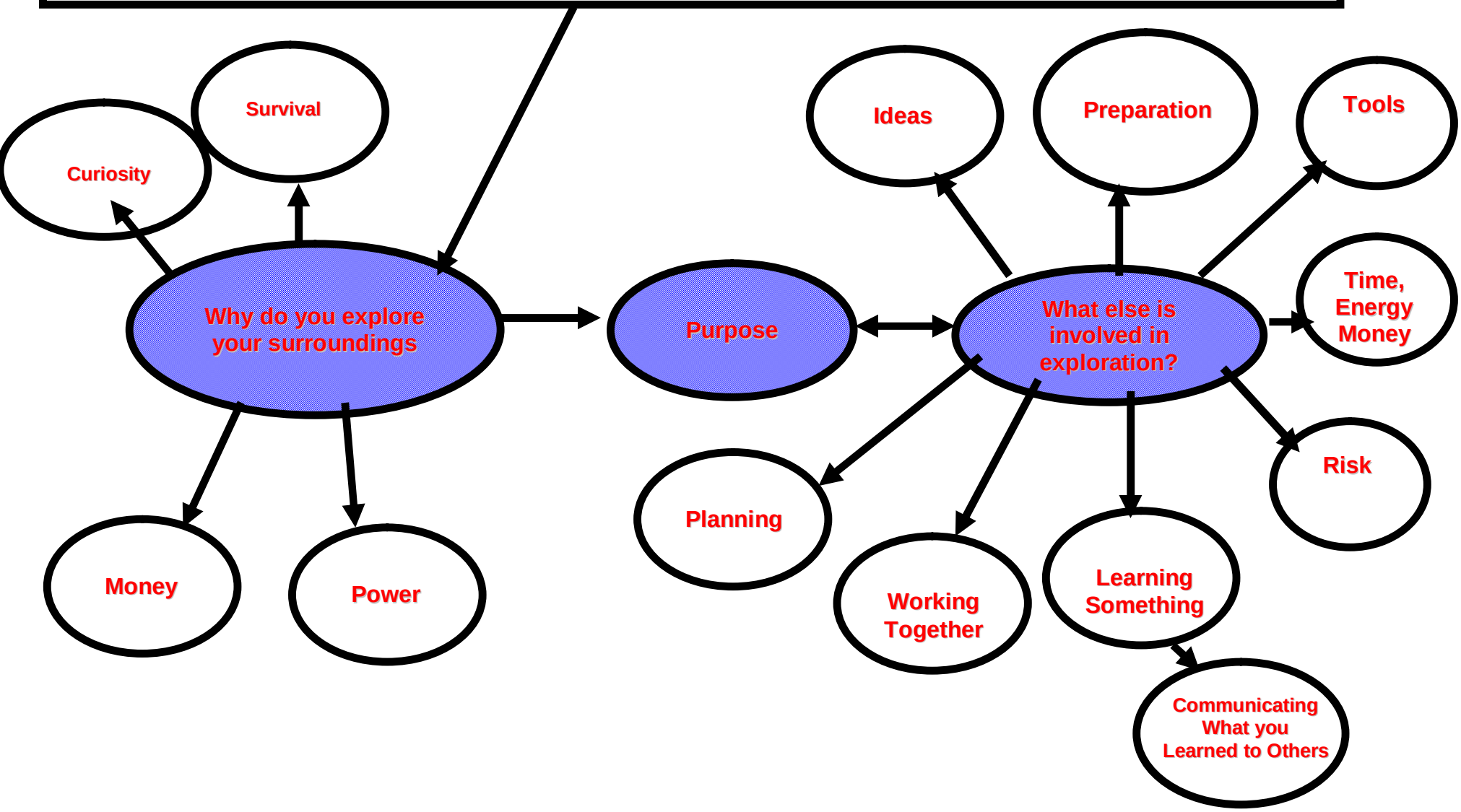
SCIENCE UNIT Part I

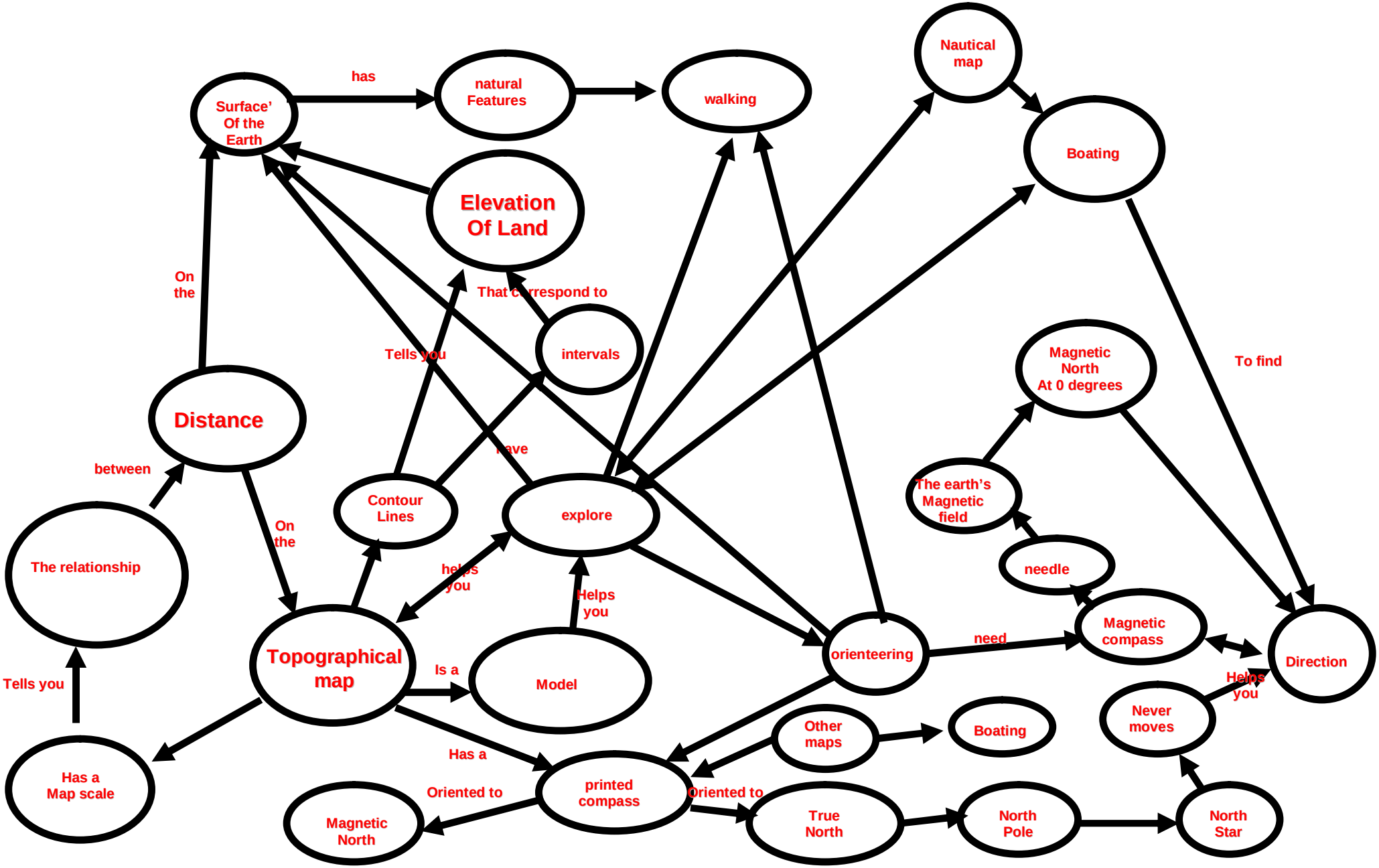
Exploring Your Surroundings

Massachusetts Science and Technology standards addressed in this section of the unit:

Mapping the Earth
Recognize, interpret, and be able to create models of the earth's common physical features in various mapping representations, including contour maps.

Exploring Your Surroundings




Surface' Of the Earth
has
natural Features
walking
Nautical map
Boating
Elevation Of Land
On the
That correspond to
Tells you
intervals
Distance
have
Magnetic North At 0 degrees
To find
between
Contour Lines
explore
The earth's Magnetic field
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Helps you
Magnetic compass
Direction
Topographical map
Is a
Model
orienteering
need
Tells you
Helps you
Never moves
Other maps
Boating
Has a Map scale
Has a
printed compass
Oriented to
Oriented to
Magnetic North
True North
North Pole
North Star

SCIENCE UNIT – DAY 2
MAPS HELP US EXPLORE OUR ENVIRONMENT

Behavioral Objectives:

- Students will think of activities they do that involve physical exploration of the local environment
- Students will think of the risks and benefits of their explorations
- Students will create the concept that certain types of maps can help with a particular exploration and reduce its risk.

New Content Objectives

- A map is a model (representation) of a physical environment
- Maps help us prepare for and reduce the risks of exploration by providing information about distance, direction, and surface features.
- Road maps help us explore by car.
- Road maps and topographical maps help us explore on foot
- Nautical maps help us explore by boat.

Pre-existing concepts:

- What does exploration involve?
- Reasons for exploring

Materials:

- Poster board
- Road maps
- Nautical maps
- Topographical maps

Description of Activity or Procedure:

- **Group interview** for access to prior knowledge on exploring the local environment, risks and benefits.
- Explore road maps, topographical maps and nautical maps.
- **Think-Pair-Share** on associating maps that would be useful for a particular type of exploration.

Assessment: Homework assignment on matching different maps to various explorations.

SCIENCE UNIT – DAY 3
COMPUTING ACTUAL DISTANCES WITH MAP SCALES

New Content Objectives

- A map scale tells the relationship between a distance on the map and the actual distance on earth..
- There are two types of map scales:
    - Proportional map scale i.e. 1 inch = 10 miles or 1 cm = 1 kilometer
    - Scale ratios – 1:24000
- A road map usually has a proportional map scale in English and metric measurements. Compute distances by multiplying map units by earth units
- Nautical and topographical maps usually have map scale ratios in metric measurements. Multiply the distance on the map by the scale factor to find the actual distance on the earth's surface.
- A map with a large-scale ratio shows greater detail than a map with a smaller scale ratio.

Materials:

- Road maps
- Nautical maps
- Topographical maps
- Yarn
- Metric and English rulers

Total Time for Lesson Plan: Two class periods

Behavioral objectives/ Description of Activity or Procedure:

- Students will identify the proportional map scale on road map.
- Students will layout a piece of yarn along for a road trip. Four different roads must be involved and the minimum distance is 15 km. They will mark the yarn where the trip begins and ends. They will measure the total map distance with English and metric rulers and compute the actual distance for both types of units.
- Students will identify the map scale ratio on both a topographical map and a nautical map.
- Students will layout a piece of yarn along a certain hiking trail or boat route, The minimum distance for the hiking trail is 5 km and the minimum distance on the boat trip is 15 km. The yarns will be marked at the beginning and end. The yarns will be measured in English and metric units and actual distances will be computed.

Assessment:

- Group worksheet with map distances and actual work distances
- Teacher observation of participation.

Days 5 and 6
NAVIGATING BY ORIENTING MAPS TO THE NORTH STAR

New Content Objectives

- The Earth axis of rotation "runs" from the North to South Pole.
- A zenith is the point in the sky directly above a point on the earth.
- The North Star is always at the zenith of the North Pole. Maps can be made using the North Pole/North Star as a common reference point.
- Latitude can be determined by the "height" of the North Star off the horizon.
- Other stars appear to rotate in the sky during the night, but it is actually the earth that is rotating on its axis. The stars are stationary.
- It is possible to determine directions from a known location by orienting the top center of the map to the North Star.
- A map alone cannot determine direction in a featureless environment unless the stars are visible.

Materials:

- A large blow-up globe
- A star planetarium projector
- Pieces of yarn.
- Maps of various points on the planet with printed compasses.

Total Time for Lesson: Two class periods

Behavioral Objectives/Description of Activity or Procedure:

- Turn on the star projector at our latitude and longitude. Students will see that the stars change position throughout the night. They will identify the North Star as a stationary star at the zenith of the North Pole.
- Students will learn that it ancient times, people made and used maps by orienting their location to the "North Star". The Phoenicians were the first people KNOWN to have identified "True North" by using the "North Star" for navigation.
- Students will understand that latitude can be determined by the height of the North Star off the horizon. A piece of yarn will be taped from a specific point on the earth to the North star, and the star projector view will be adjusted for latitude so that students will understand why the star appears higher or lower on the horizon at different latitudes.
- Students will orient maps of various known points on earth to the North Star using maps. They will also locate the other directions:
    - 0° as North
    - 90° as East
    - 180° as South
    - 270° as West

SCIENCE UNIT – DAY 7
NAVIGATING USING THE EARTH'S MAGNETIC FIELD

Behavioral Objectives:

- Students will use a compass to determine directions oriented to the Earth's magnetic field.
- Students will use a compass for to determine magnetic North and then correctly orient a map to "True North" in daytime conditions.

New Content Objectives

- The earth's magnetic field originates deep inside the earth's core; the needle on a compass aligns itself with the earth's magnetic field.
- The earth's magnetic field is misaligned with the Earth's rotational axis by about 15°; the needle on a compass points to "magnetic North" and does not point to "True North".
- If there are no stars and no identifiable features in the environment, a map alone cannot be used". You must use a map and a compass. The map should have "magnetic north and "true north" pointers. Align the compass to magnetic north and then orient yourself to "true North" by looking at the other pointer.

Materials:
- Topographical maps with "magnetic north" and 'True North" pointers.
- Compasses

Behavioral Objectives/Description of Activity or Procedure:
- Students will use a compass to determine directions oriented to the Earth's magnetic field.
- Students will use a compass to determine magnetic North and then correctly orient a map to "True North" in daytime conditions.
- Students will walk ten paces in each direction (North, West, South and East. If this is done correctly, they will be back where they started.

Assessment: Teacher observation

SCIENCE UNIT – DAY 8
TOPOGRAPHICAL MAPS

Behavioral Objectives:

- Students will review orienteering by using a compass to determine magnetic North and then correctly orienting a topographical map to “True North” in daytime conditions.
- Student will create “contour” mountains out of Styrofoam layers that match a mountain depicted on a contour map.
- Students will explore the relationship between the steepness of the mountain and the width of the contour intervals depicted on the map.
- Students will determine the actual elevation of the mountain on the earth’s surface.

New Content Objectives

- Topographical maps are models of the earth’s surface features (mountains, rivers, valleys, etc.)
- A topographical map is useful for hiking, orienteering, camping, and building a house because it allows you to predict the steepness of the terrain.
- Contour lines show an increase in elevation in metric units.
- Contour intervals show the steepness of terrain; short intervals depict steeper slopes, wide intervals depict flatter slopes.

Materials:
- Topographical maps.
- Potatoes

Behavioral Objectives/ Description of Activity or Procedure

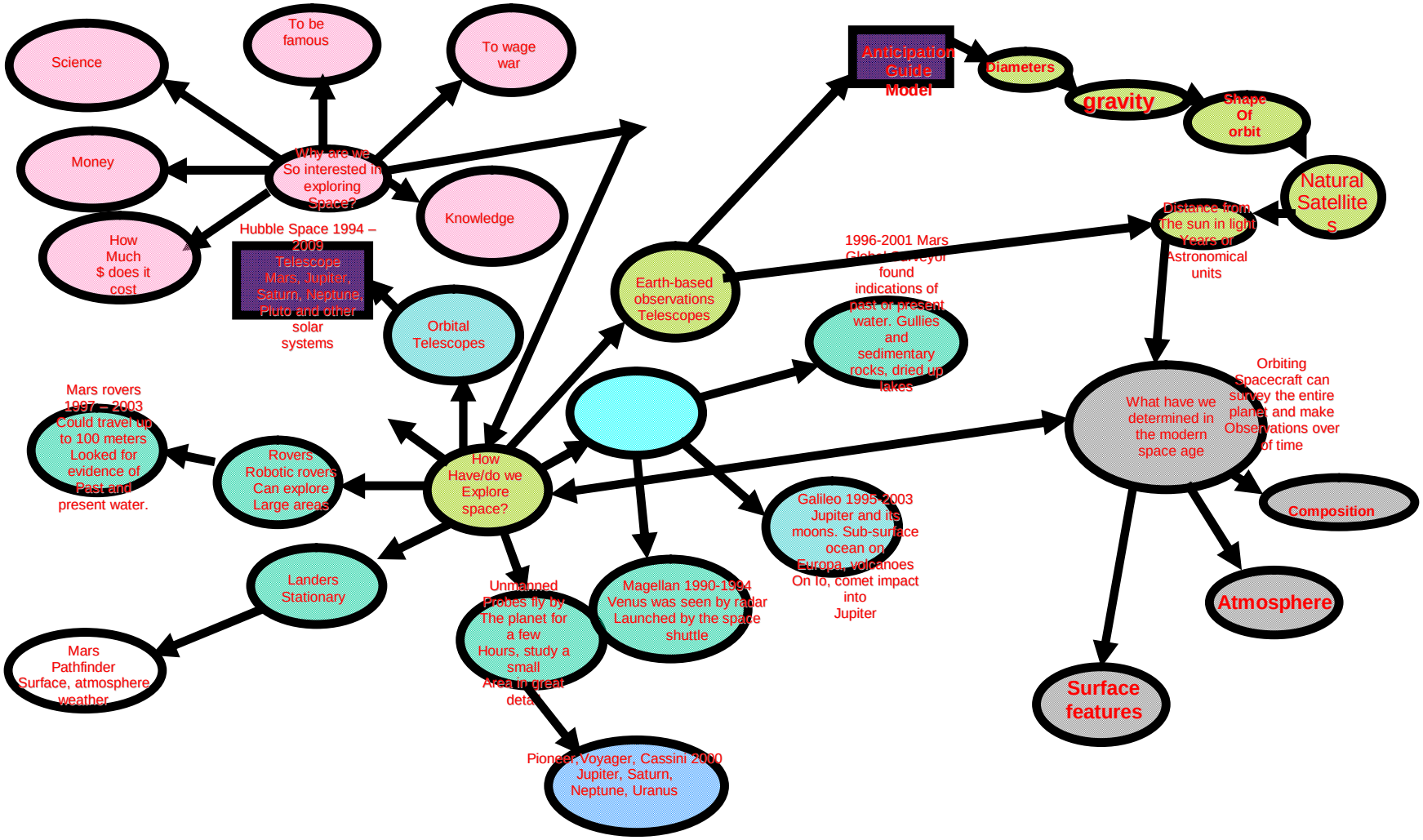
- Individual students will create “contour” mountains out of potatoes. Students will trace the contour lines from their “potato” mountains onto a piece of paper.
- Students will explore the relationship between the steepness of the mountain and the width of the contour intervals depicted on the map.
- Students will determine the actual elevation of the mountain on the earth’s surface.

Assessment:
- Individual students will trace the contour lines from their “potato” mountains onto a piece of paper.
- Groups of students will describe the relationship between contour intervals and steepness of slope on a worksheet.

Exploring Our Solar System

Massachusetts Science and Technology standards addressed in this section of the unit:

- The Earth in the Solar System
  Compare and contrast properties and conditions of objects in the solar system (sun, planets, moon) to those on earth (gravitational force, distance from the sun, speed, movement, temperature, and atmospheric conditions).


Science
To be famous
To wage war
Money
Why are we So interested in exploring Space?
Knowledge
How Much $ does it cost
Hubble Space 1994 – 2009
Telescope Mars, Jupiter, Saturn, Neptune, Pluto and other solar systems
Orbital Telescopes
Anticipation Guide
Model
Diameters
gravity
Shape Of orbit
Natural Satellites
Distance from The sun in light Years or Astronomical units
Earth-based observations Telescopes
1996-2001 Mars Global Surveyor found indications of past or present water. Gullies and sedimentary rocks, dried up lakes
Mars rovers 1997 – 2003 Could travel up to 100 meters Looked for evidence of Past and present water.
Rovers Robotic rovers Can explore Large areas
How Have/do we Explore space?
What have we determined in the modern space age
Orbiting Spacecraft can survey the entire planet and make Observations over of time
Composition
Galileo 1995-2003 Jupiter and its moons. Sub-surface ocean on Europa, volcanoes On Io, comet impact into Jupiter
Landers Stationary
Unmanned Probes fly by The planet for a few Hours, study a small Area in great deta
Magellan 1990-1994 Venus was seen by radar Launched by the space shuttle
Atmosphere
Mars Pathfinder Surface, atmosphere, weather
Surface features
Pioneer, Voyager, Cassini 2000 Jupiter, Saturn, Neptune, Uranus

DAY 9 – Should we explore outer space?

Content Objectives

- Reasons for exploring space
  - Money
  - Fame
  - Survival
  - To wage war
  - Knowledge
  - Etc.
- Who is interested in exploring space?

Materials:

- A.V unit
- Large index cards

Behavioral Objectives and Lesson Plans:

- Students will watch clips from a variety of TV shows, movies and newsreels that depict exploration of space (Sputnik, JFK speech, Star Trek 1960's, movies, moon landings, 1990's, Deep Space 9, etc) (5 m)
- Student groups will brainstorm about why we are so interested in exploring space (5 m). Students will view more clips depicting organisms describing why they want to explore space (2m). A class list of reasons for exploring space will be developed (5m).
- Student groups will brainstorm about why we should not exploring space (5 m). Students will view more clips depicting organisms describing why space should not be explored (2m). A class list of reasons for not exploring space will be developed (5m).
- Student groups will receive a large index card that has a category of people who are interested in exploring space on one side and a category of people who are not interested in exploring space on the other side. They will do **Academic Controversy**. Each person in the group will take a position and contribute a poker chip **(Talking Tokens)** as they speak. A summary of the pro-con points of view on the will be written on the appropriate side of the index card. Each member of the group will sign the card and write down what part they took in the Academic Controversy.

Assessment/rubric:

Excellent Participation	Good participation	Borderline participation	Not equal participation
At least one pro-and con point of view filled in	At least one pro and con point of view filled in	At least one pro and con point of view filled in	Either or both pro and con point of view is missing
All group members signed the card with their personal contribution	One signature/contribution Missing.	More than one person did not contribute	

DAYS 10 and 11
Earth-based space exploration

New Content Objectives

- Humans discovered predictable patterns in the stars and the “wanderers” more than five thousand years ago.
- The telescope was invented by Dutch optometrists and first used by Galileo to observe the features of the moon and became a major tool of earth-based space exploration.
- A moon is a natural satellite of a planet.
- One revolution around the sun corresponds to the length of the planet’s year.
- An astronomical unit is the distance from the earth to the sun (150 km or 93 m miles). The distance from the rest of the planets to the sun can be expressed in astronomical units.

Pre-existing concepts:

- The rotation of the earth makes the stars appear to move, however, the stars are stationary.

Materials:

- Star theater projector
- Small spheres of different sizes (plastic pinheads, beads, popcorn kernels, blueberries, marbles, super-balls, tennis balls etc). Clay balls can be substituted for the spheres.
- Yarn
- Slides of historical pictures taken by telescope.

Total time for lesson plan: Two days

Behavioral Objectives/Description of Activity or Procedure:

- Students will see how man first explored space, by observing the constellations (star projector) and their predictable patterns of movement throughout the night. Students will again observe that the North Star does not move (10m).
- Students will see slides of what early astronomers, such as Galileo, saw with their telescopes (10 m)
- Student groups will start making a model of the solar system (with different sized spheres and yarn orbits) based on their pre-existing knowledge (30m)
- After models are created, student groups consult many sources to find characteristics of planets, fill out a “planet table” and correct their model.
    - Composition (gas, rock, ice etc)
    - Diameter in relation to the size of the earth or in kilometers.
    - Length of planetary year (revolution around the sun)
    - Shape of orbit (introduce students to the NASA Solar System Simulator at http://space.jpl.nasa.gov).

    - Number of moons
    - Surface features
        - Presence of water, volcanoes, etc
    - Atmosphere
    - Gravity in newtons or in relation to the gravity of the earth (i.e. 3 times the gravity of earth)
    - Distance from the sun in astronomical units
    - Students will print a photo of each planet from the Internet.

Assessment:

- The teacher will assess prior knowledge of the solar system by taking a photo of each model prior to the students' research.
- The teacher will assess new knowledge by comparing the photo of the "prior knowledge" model with the completed planet table and inspection of the corrected model.

SCIENCE UNIT – DAY 12 –13-14
How do we explore the planets in the modern space age?

New Content Objectives

- Since the 1950's men have used space-based exploration to explore the planets and their moons.
- Orbiting spacecraft (unmanned satellites and manned space stations) can survey the entire planet/moon and make observations over a long period of time.
- Orbital telescopes can take pictures of the entire planet/moon over a long period of time.
- The orbit of all manmade satellites deteriorates over time; eventually the manmade satellite will fall into the planet.
- Unmanned probes fly by the planet for a few hours and study a small area in great detail.
- Manned and unmanned landers are stationary on a planet's surface and can take data from a relatively small area.
- Robotic rovers can explore and take data from large areas of a planet's surface.

Pre-existing skills:

- Students need to be familiar with Powerpoint and/or Word

Materials for the class

- Internet workstations for pairs of students.
- Color printers if available.
- Paper tick-marks
- Glue
- Internet workstations
- Color printers
- Worksheets for students to record data
- Scissors

Teacher Preparation:

- The "Space-based" Exploration Time-line should be posted in the hallway or classroom.
- The teacher needs to prepare a "Powerpoint skeleton" presentation that the students will add to.

Total time for the entire lesson: 3 class periods

Behavioral Objectives/Description of Activity or Procedure:

- Students will observe the empty "Space-based" exploration time line that has been constructed by the teacher on the wall of the classroom or hallway(5m).

- Students will go to Internet workstations and explore the Nasa NASA Solar System Simulator at http://space.jpl.nasa.gov). They can select space-based exploration vehicles and an object to look at; the simulator will show the photo of the selected object taken from the vehicle. There are many exploration vehicles and perspectives to choose from; students will be very engaged in looking at different views of the planets (25m).
- The teacher will explain the research project. They will be finding photos and information on the different categories of space exploration vehicles. The categories of space exploration machines are:
    - Orbital spacecraft\
        - Manned
        - Unmanned
    - Orbital telescopes
    - Unmanned probes
    - Landers
        - Manned
        - Unmanned
    - Robotic rovers
- Student groups will produce a Powerpoint presentation, a research report or a poster that summarizes their findings. They may choose another type of project after consulting with the teacher. This project is a summative assessment. The project will include the names and the categories of exploration vehicles, and a number of research items for a particular vehicle that is part of that category i.e. Apollo 11 is an example of a manned lander. They must "collect" a picture of the machine, at least one major discovery or contribution that it made (photo or data), year of launch and years in space. They will have the time in class (2 ½ days) plus additional time after school or at home to complete the project.
- Students will add information on specific space exploration machines to the "Space-based Exploration" time line.

Assessment:

- Group project checklist.

	Category name included	**Name of machine**	**Picture of machine**	**Major discoveries**	**Year of Launch**	**Years in space**
Manned Orbital spacecraft						
Unmanned orbital spacecraft						
Orbital telescopes						
Unmanned probes						
Manned						

Landers						
Unmanned landers						
Robotic Rovers						

- Group project grade rubric

	A	B	C	D
Categories of Space exploration Machine	All categories present	One category Missing	2 categories missing	More than two categories missing
Category of machine	All definitions present, accurate and unclear	One definition missing, inaccurate or unclear	2 definitions Missing, inaccurate or unclear.	More than two definitions missing, inaccurate or unclear.
Photos and name of specific exploration machine	All photos present	One photo missing	2 photos missing	More than two photos missing
Major discovery or contribution of the exploration	A major discovery or contribution for every specific exploration vehicle	One contribution Or discovery Missing.	Two contributions Or discovery Missing	More than two contribution Or discovery Missing
Year launched	All launch years included	One missing launch year	Two missing launch years	More than two missing launch years
Years in space	All lifespans included	One lifespan missing	Two missing lifespans	More than two missing lifespans

My contribution to the Space-based Exploration project

DATE:

NAME:

NAME OF GROUP:

CLASS SECTION:

1) My roles and my participation in the group project consisted of the following:

Research categories:

Slides created:

Other

2) I am proudest of these contributions.

3) Considering the feedback that I have received from members of my group and/or the class, I feel that I have earned a/an ____ for my participation.