

# SCIENCE GUIDELINES



## DI OCESE OF ARLINGTON

Revised 2006

## **SCIENCE GUIDELINES**

### **PHILOSOPHY**

God has planted within human nature the desire to know and understand, to learn and explore, and to seek the answers to the questions of the world around us. Science is an area of the curriculum where that desire can be fostered by allowing the children to explore and discover the wonders of their world. Science probes the mysteries of the earth and universe, seeking the Creator in all things. Using the Catholic Social Teaching Principles, we must, as educators, create a Christ-centered atmosphere in which the students can and will grow mentally, physically, and spiritually.

Our primary goal as science teachers is to facilitate the learning of science by engaging the student through enjoyable and meaningful scientific inquiry, while preparing these students to become life long learners. In this way, the students develop their full potential and grow in the love, knowledge, and appreciation of the gift of Life in our World.

## **Performance Objectives**

The following are broad performance objectives to be used when developing lesson plans throughout the year.

1. To cultivate in our students a love, curiosity, respect, and stewardship of God's infinite creation.
2. To recognize that we share the responsibility to respect the sanctity of all human life and the dignity of the human person.
3. To develop scientific inquiry skills to be used both in individual and cooperative learning environments.
4. To maximize hands-on opportunities for students to explore, discover, and experience the universe.
5. To insure the ability of students to safely use scientific materials and equipment to explore, discover, and experience the universe.
6. To incorporate mathematical tools into the organization and interpretation of the data.
7. To integrate technology to prepare students to be able to effectively succeed in today's society.
8. To achieve scientific literacy and an understanding of the role science plays in our daily lives through utilization of cross-curricular instruction.

## Kindergarten

### Scientific Investigation, Reasoning, and Logic

**S.K.1** The student will conduct investigations in which

- a) basic properties of objects are identified by direct observation
- b) observations are made from multiple positions to achieve different perspectives
- c) a set of objects is sequenced according to size
- d) a set of objects is separated into two groups based on a single physical attribute
- e) picture graphs are constructed using 10 or fewer units
- f) nonstandard units are used to measure common objects
- g) an unseen member in a sequence of objects is predicted
- h) a question is developed from one or more observations
- i) objects are described both pictorially and verbally
- j) unusual or unexpected results in an activity are recognized

### Introduction to Living Things

**S.K.2** The student will explore, experience and investigate the senses of sight, hearing, touch, taste and smell. Senses allow the analysis of information in order to learn about one's surroundings.

**Concepts** include:

- a) sight, hearing, taste, touch and smell
- b) organs associated with each sense
- c) comparative description of sensory experiences (hard, soft, hot, cold, sweet, sour, smooth, etc.)

**S.K.3** The student will explore and investigate the basic needs of living things and simple patterns that occur in his/her life.

**Concepts** include:

- a) living things need food, water and air; non-living things do not
- b) living things have a life cycle with changes that can be measured
- c) parents and offspring are similar

### Earth Science

**S.K.4** The student will describe and chart (visually display) the daily weather conditions.

**Concepts** include:

- a) common terms such as warm/cool, sunny/cloudy, etc.
- b) relate weather trends to seasonal changes

**S.K.5** The student will observe and understand that the sun, moon, stars, clouds, birds, and airplanes all have properties, locations, and movements that can be observed and described.

**S.K.6** The sun provides the light and heat necessary to maintain the temperature of the earth.

**Physical Science**

**S.K.7** The student will explore the concept of sink and float and properties of water during water play activities.

**Concepts** include:

- a) prediction (the student will predict if an item will sink or float before it is put into the water)
- b) the natural flow of water is downhill
- c) water occurs in different forms (solid, liquid, and gas)

**S.K.8** The student will explore the properties of matter.

**Concepts** include:

- a) colors
- b) textures (smooth, rough, etc.)
- c) relative size and position in space (high/low, behind/ before, thin/wide, etc.)
- d) compare solids, liquids, and gasses

## **First Grade:**

### **Scientific Investigation, Reasoning, and Logic**

- S.1.1** With teacher guidance, the student will plan and conduct investigations in which
- differences in physical properties are observed using the senses and simple instruments to enhance observations (magnifying glass, thermometer)
  - objects or events are classified and arranged according to attributes or properties
  - observations and data are communicated orally and with simple graphs, pictures, written statements, and numbers
  - length, mass, and volume are measured using standard and nonstandard units
  - inferences are made and conclusions are drawn about familiar objects and events
  - predictions are based on patterns of observation rather than random guesses
  - simple experiments are conducted to answer questions

### **Plants/Life Science:**

**S.1.2** The student will identify and describe the basic structures and essential needs of plants. The student will chart observations.

**Concepts** include:

- needs of plants: air, water, light, nutrients and a place to grow
- sequential observations of structures and processes: seeds, roots, stems, leaves, flowers, seeds (life cycle)
- characteristics of plants: flowering/non-flowering, evergreen/deciduous, edible/non-edible
- seeds develop into plants, then flowers, and then fruits which contain seeds
- seasonal changes

**S.1.3** The student will be able to compare the basic needs of animals and humans, and contrast those with the needs of plants.

**Concepts** include:

- needs: air, nutrients, water, a place to grow
- physical characteristics: shape, size, locomotion, and appendages
- classify animals according to one or more properties
- relationship of offspring to parent
- seasonal adaptations, hibernation, camouflage, and migration

### **Living and Non-Living Relationships/ Life Science**

**S.1.4** The student will describe the characteristics and needs of living things and identify things as living or non-living.

### **Human Body/Life Science**

**S. 1.5** The student will be able to identify the basic characteristics and needs of the human body.

**Concepts include:**

- a) appendages and major organs
- b) nutritional needs, food groups, basic nutritional plan, effects of appropriate nutritional plan, basic digestion
- c) hygiene needs: teeth (structure, care, correlation of diet), hand washing
- d) seasonal needs: clothing, shelter

**Position and Motion/Physical Science**

**S.1.6** The student will develop an understanding that the position of an object can be described by locating it relative to another object or to the background.

**S.1.7** The student will be able to describe an object's motion as straight, circular, and/or back and forth, by tracing and measuring its position over time.

**S.1.8** The student will discover that the position and motion of objects can be changed by pushing or pulling, and that the size of the change is related to the strength of the push or pull.

**S.1.9** The students will discover that sound is produced by vibrating objects. Changing the rate of the vibration changes the pitch of the sound.

**Earth Science:**

**S.1.10** The student will explore and investigate the relationship of the sun and the earth.

**Concepts include:**

- a) rotation of the earth causing night and day
- b) objects in the sky have patterns of movement (the sun, for example, appears to move across the sky in the same way every day, but it's path changes slowly over the seasons; the moon moves across the sky on a daily basis much like the sun; the observable shape of the moon changes from day to day in a cycle that lasts about a month)

**Personal and Social Perspective:**

**S.1.11** The student will be able to identify and discuss the ways living things affect and are affected by the environment.

**Concepts include:**

- a) climate, weather, availability of basic needs
- b) use and conservation of resources, both renewable and non-renewable
- c) pollution of land and water

## **Second Grade**

### **Scientific Investigation, Reasoning, and Logic**

**S.2.1** The student will conduct investigations in which

- a) observation is differentiated from personal interpretation, and conclusions are drawn based on observations
- b) observations are repeated to ensure accuracy
- c) two or more attributes are used to classify items
- d) conditions that influence a change are defined
- e) length, volume, mass, and temperature measurements are made in metric units (centimeters, meters, liters, degrees Celsius, grams, kilograms) and standard English units (inches, feet, yards, cups, pints, quarts, gallons, degrees Fahrenheit, ounces, pounds)
- f) pictures and bar graphs are constructed using numbered axes
- g) unexpected or unusual quantitative data are recognized
- h) simple physical models are constructed

### **Animal Cycles/Life Science**

**S.2.2** The student will investigate and understand that animals go through a series of changes in their life cycle.

**Concepts** include:

- a) living things change in an orderly way as they grow.
- b) the pattern of change from birth to death is called the life cycle.
- c) some animals go through distinct stages in their life cycles while others do not

### **States of Matter/Physical Science**

**S.2.3** The student will identify and classify the states of matter, and observe the changes from one state to another.

**Concepts** include:

- a) matter is anything that has mass and takes up space.
- b) matter has properties that can be observed and measured such as: color, shape, density, hardness, size, texture, smell
- c) state of matter is related to temperature
- d) solid, liquid, gas
- e) evaporation, condensation, melting, boiling, freezing
- f) matter may expand or contract with change of state (example: water expands when frozen)

**S.2.4** The student will investigate and understand that objects are made of materials that have physical properties.

**Concepts** include:

- a) objects are made of one or more materials
- b) materials are composed of parts that are too small to see without magnification
- c) physical properties remain the same as the material is reduced in size

**S.2.5** The student will explore, create and separate mixtures, using common materials, methods and tools.

**Concepts** include:

- a) interaction of substances with water: food coloring, oil, salt, sugar, sand, and gravel
- b) substances dissolve better in warm water than in cold water
- c) some substances change the way water acts (soap, detergent)
- d) mixtures can be separated: gravel and sand or sugar and rice (using a strainer), salt and water (by evaporation), sugar, sand and water (using a filter, then evaporation)

### **Light/Physical Science**

**S.2.6** The student will investigate the properties of light.

**Concepts** include:

- a) sight is not possible without light
- b) light travels in a straight line until it strikes an object
- c) white light can be refracted (bent) into the spectrum by a prism
- d) colors of the visible spectrum are red, orange, yellow, green, blue, indigo, and violet
- e) mirrors reflect light

### **Magnets/Physical science:**

**S.2.7** The student will explore and discover the properties of magnets.

**Concepts** include:

- a) magnets attract some metals (iron and steel) but do not attract non-metals
- b) different shape magnets (horseshoe, bar, rod, ring)
- c) some magnets are stronger than others
- d) all magnets have a north and a south pole
- e) like poles repel, unlike attract
- f) force is exerted around a magnet
- g) compasses and Earth's magnetic field

### **Personal and Social Perspectives**

**S.2.8** The student will review and reinforce the understanding of the impact of pollution and recycling on the community. Students should be encouraged to actively participate in some aspect of, or organize some project in, this area.

## **Third Grade**

### **Scientific Reasoning and Logic**

**S.3.1** The student will plan and conduct investigations in which

- a) predictions and observations are made
- b) objects with similar characteristics are classified into at least two sets and two subsets
- c) questions are developed to formulate hypotheses
- d) volume is measured to the nearest milliliter and liter
- e) length is measured to the nearest centimeter
- f) mass is measured to the nearest gram
- g) data are gathered, charted, and graphed (line plot, picture graph, and bar graph)
- h) temperature is measured to the nearest degree Celsius
- i) time is measured to the nearest minute
- j) inferences are made and conclusions are drawn
- k) natural events are sequenced chronologically

### **Motion/Physical Science**

**S.3.2** The student will investigate and understand characteristics and interactions of moving objects.

- a) Motion is described by an object's direction and speed;
- b) Forces cause changes in motion;
- c) Friction is a force that opposes motion; and
- d) Moving objects have kinetic energy.

### **Machines/Physical Science**

**S.3.3** The student will identify simple and compound machines and show they change the magnitude and direction of forces

**Concepts** include:

- a) push and pull (forces)
- b) ramps
- c) wedges
- d) levers
- e) screws
- f) wheels and axles
- g) pulleys (fixed and movable)

### **Life Science**

**S.3.4** The student will develop an understanding of food chains and food webs.

**Concepts** include:

- a) sun is the initial source of energy
- b) energy is passed from organism to organism
- c) producers, consumers and decomposers
- d) herbivores, carnivores and omnivores
- e) predator/prey

- f) aquatic and terrestrial food chains
- g) altered food chains and food webs

**S.3.5** The student will develop an understanding and appreciation of how living things remain alive and respond to changes and conditions in the environment

**Concepts** include:

- a) living and non-living components of ecosystems
- b) gathering and storing food
- c) shelter (habitat)
- d) innate behavior (reflex, instinct)
- e) learned behavior (mimicry, migration)
- f) defense
- g) hibernation, aestivation (hibernation in the summer)
- h) care of young
- i) biodiversity
- j) water ecosystems (pond, marshland, swamp, stream, river, and ocean)
- k) dry ecosystems (desert, grassland, rainforest, and forest)
- l) populations and communities

### **Earth Science**

**S.3.6** The student will investigate and understand the major components of soil, its origin, and importance to plants and animals including humans.

**Concepts** include:

- a) soil provides the support and nutrients necessary for plant growth
- b) topsoil is a natural product of subsoil and bedrock
- c) rock, clay, silt, sand, and humus are components of soils
- d) soil is a natural resource and should be conserved

**S.3.7** The student will investigate and understand the water cycle and its relationship to life on Earth.

**Concepts** include:

- a) energy from the sun drives the water cycle
- b) processes involved in the water cycle (evaporation, condensation, precipitation)
- c) water is essential for living things
- d) water supply and water conservation

### **Social and personal perspectives/Earth Science**

**S.3.8** The student will investigate and understand that natural events and human influences can affect the survival of species.

**Concepts** include:

- a) the interdependency of plants and animals
- b) the effects of human activity on the quality of air, water, and habitat
- c) the effects of fire, flood, disease, and erosion on organisms
- d) conservation and resource renewal

## **Human Body/Life Science**

**S.3.9** The student will investigate and understand the process of basic digestion and elimination

**Concepts** include:

- a) organs and function of the digestive system
- b) organs and function of the excretory system

## **Fourth Grade**

### **Scientific Investigation, Reasoning, and Logic**

**S.4.1** The student will plan and conduct investigations in which

- a) distinctions are made among observations, conclusions, inferences, and predictions
- b) hypotheses are formulated based on cause-and-effect relationships
- c) variables that must be held constant in an experimental situation are defined
- d) appropriate instruments are selected to measure linear distance, volume, mass, and temperature
- e) appropriate metric measures are used to collect, record, and report data
- f) data are displayed using bar and basic line graphs
- g) numerical data that are contradictory or unusual in experimental results are recognized
- h) predictions are made based on data from picture graphs, bar graphs, and basic line graphs

### **Life Processes/Life Science**

**S.4.2** The student will investigate and understand basic plant anatomy and life processes.

**Concepts** include:

- a) the structures of typical plants (leaves, stems, roots, and flowers)
- b) processes and structures involved with reproduction (pollination, stamen, pistil, sepal, embryo, spore, and seed)
- c) photosynthesis (sunlight, chlorophyll, water, carbon dioxide, oxygen, and sugar)
- d) dormancy

### **Human Body/Life Science**

**S.4.3** The student will investigate and understand the structure and basic functions of the circulatory system

**Concepts** include:

- a) heart, arteries, veins, and capillaries, blood
- b) transport of oxygen and carbon dioxide
- c) transport energy (food) and waste
- d) disease control (white blood cells)
- e) bone marrow and red blood cells
- f) the path of circulation

**S.4.4** The student will investigate and understand the basic structure and function of the respiratory system.

**Concepts** include:

- a) nose, pharynx, tracheae, bronchi, lungs, and alveoli
- b) exchange of oxygen and carbon dioxide
- c) effects of smoking on the lungs

**S.4.5** The student will investigate and understand the basic structure and function of the nervous system.

**Concepts** include:

- a) brain, spinal cord
- b) voluntary muscle control and reflexes
- c) senses
- d) safety issues regarding head injuries (bike helmets, etc.)
- e) effects of drugs on the brain and nervous system

### **Oceanography/Life Science**

**S.4.6** The student will explore and investigate the ecosystems of the ocean

**Concepts** include:

- a) physical characteristics (depth, salinity, major currents)
- b) geological characteristics (continental shelf, slope rise, trenches, plateau)
- c) biological characteristics (ecosystems)
- d) pollution and conservation
- e) effect of gravity and the formation of tides
- f) potential of the oceans as a major resource (food, energy)
- g) oceans in the water cycle

### **Weather/Earth Science**

The student will investigate and understand how weather conditions and events occur and can be predicted

**Concepts** include:

- a) temperature, air pressure, fronts, humidity
- b) reading and interpreting weather maps
- c) interpreting weather reports
- d) formation and types of clouds
- e) formation of storms (hurricane, tornado, cyclone)
- f) the relation of the position of the earth and sun to seasonal changes
- g) wind direction (direction from which the wind comes)
- h) barometer, thermometer, anemometer, rain gauge, hygrometer

### **Earth Patterns, Cycles, and Change/Earth Science**

**S.4.8** The student will investigate and understand the relationships among the earth, the sun, and moon.

**Concepts** include:

- a) the rotation and revolution of the earth
- b) causes for the earth's seasons and the phases of the moon
- c) historical contributions to the understanding the Sun-Earth-Moon system, including the work of Copernicus, Galileo, Brahe, Kepler, and Newton

**S.4.9** The student will describe major events of space exploration and know the indirect benefits of the space program.

**Electricity/Physical Science**

**S.4.10** The student will investigate and understand the characteristics of electricity

**Concepts** include:

- a) magnetism and magnetic fields
- b) static electricity
- c) lightning
- d) conductors and insulators
- e) parallel and series circuits
- f) safety in handling electrical circuits and material
- g) construct simple circuits using dry cell batteries
- h) historical contributions in understanding electricity

## **Fifth Grade**

### **Scientific Investigation, Reasoning, and Logic**

**S.5.1** The student will plan and conduct investigations in which

- a) rocks and organisms are identified using a classification key
- b) estimations of length, mass, and volume are made
- c) appropriate instruments are selected and used for making quantitative observations of length, mass, volume, and elapsed time
- d) accurate SI measurements are made using basic tools (thermometer, meter stick, balance, graduated cylinder)
- e) data are collected, recorded, and reported using the appropriate graphical representation (graphs, charts, diagrams)
- f) predictions are made using patterns, and simple graphical data are extrapolated
- g) independent and dependent variables are identified
- h) and an understanding of the nature of science is developed and reinforced

### **Physical Science**

**S.5.2** The student will investigate and understand that matter is anything that takes up space and has mass

**Concepts** include:

- a) matter has physical and chemical properties that can be measured
- b) atoms are the building blocks of all matter
- c) atoms make up molecules
- d) elements, compounds
- e) atoms are always in motion, adding or removing heat will cause atoms to move faster or slower
- f) effect of temperature on state of matter

### **Force, Motion, and Energy/Physical science**

**S.5.3** The student will investigate and understand how sound is transmitted and is used as a means of communication.

**Concepts** include:

- a) frequency, waves, wavelength, vibration
- b) the ability of different media (solids, liquids, and gases) to transmit sound
- c) uses and applications (voice, sonar, animal sounds, and musical instruments)
- d) structure of the ear and mechanics of hearing

**S.5.4** The student will investigate and understand basic characteristics of visible light

**Concepts** include:

- a) the visible spectrum and light waves
- b) refraction of light through water and prisms
- c) reflection of light from reflective surfaces (mirrors)
- d) opaque, transparent, and translucent
- e) historical contributions in understanding light
- f) structure of the eye and mechanics of sight

## **Earth Science**

**S.5.5** The student will investigate and research the Earth's structure and surface.

**Concepts** include:

- a) Earth's structure includes a crust, mantle, and core
- b) plate tectonic theory explains the movement of the Earth's crust
- c) earthquakes and volcanoes, as well as how they might be predicted
- d) geological history, topics include fossils, carbon dating
- e) surface layers include lithosphere, hydrosphere, atmosphere
- f) ocean floor has a topographical form as does land
- g) Earth's landscape includes mountains, valleys, caves, glaciers, floodplains, deltas, and sand dunes
- h) surface changes are caused by weathering, erosion, and deposition
- i) weathering may be physical or chemical
- j) natural agents of change are water (running water, groundwater, waves, glaciers) and wind
- k) geological changes may be sudden or gradual
- l) soil consists of weathered rocks and decayed organic materials as well as bacteria
- m) rocks are classified by how they are formed; the rock cycle
- n) human impact on the physical features of the Earth

## **Life Science**

**S.5.6** The student will identify the major characteristics of living things and will classify items as living or nonliving.

**Concepts** include:

- a) introduction to the six kingdoms
- b) cell is the smallest unit of a living thing
- c) plant and animal cells have similar and different parts
- d) cells, tissues, and organs work together as a system
- e) microscope

**S.5.7** The student will identify life processes for all living organisms.

**Concepts** include:

- a) use of energy
- b) development
- c) ability to adapt
- d) respiration
- e) reproduction
- f) ability to respond to a stimulus

**S.5.8** The student will investigate and recognize the major characteristics of animals.

**Concepts** include:

- a) Invertebrates are animals without backbones (eight major groups)
- b) Vertebrates are animals with backbones and internal skeletons (seven major groups)

**S.5.9** The student will identify plants as being vascular or non-vascular

**Concepts** include:

- a) simple plants (mosses) have no vessels
- b) vascular plants include ferns that produce spores and seed plants that are either flowering or non-flowering
- c) transpiration is the passage of water through a plant
- d) photosynthesis uses energy from light for the production of food
- e) respiration releases energy from food for use in the cell's activities
- f) compare and contrast photosynthesis and respiration in relation to energy
- g) water, oxygen, carbon dioxide and nitrogen are continually being recycled by organisms

**S.5.10** The student will investigate and understand the structures and functions of the internal skeletal system and muscular system of the human body.

**Concepts** include:

- a) bones, cartilage and ligaments
- b) voluntary, involuntary, and cardiac muscle
- c) nutrients, exercise and rest are needed to keep the skeletal and muscular systems healthy
- d) drugs are chemicals that can cause a change in almost any part of the body

## Sixth Grade

### Scientific Investigation, Reasoning, and Logic

**S.6.1** The student will plan and conduct investigations in which

- a) observations are made involving fine discrimination between similar objects and organisms
- b) a classification system is developed based on multiple attributes
- c) precise and approximate measurements are recorded
- d) scale models are used to estimate distance, volume, and quantity
- e) hypotheses are stated in ways that identify the independent (manipulated) and dependent (responding) variables
- f) a method is devised to test the validity of predictions and inferences
- g) data are collected, recorded, analyzed, and reported using appropriate metric measurements
- h) data are organized and communicated through graphical representation (graphs, charts, and diagrams)
- i) models are designed to explain a sequence
- j) an understanding of the nature of science is developed and reinforced

### Environmental Science

**S.6.2** The student will investigate and understand the role of solar energy in driving most natural processes within the atmosphere, the hydrosphere, and on the Earth's surface.

**Concepts** include:

- a) Earth's energy budget (total power entering and leaving the physical system of Earth)
- b) the role of radiation and convection in the distribution of Earth's energy
- c) the motion of the atmosphere and the oceans
- d) cloud formation
- e) the role of heat energy in weather-related phenomena including thunderstorms and hurricanes

**S.6.3** The student will investigate and understand the properties of air and the structure and dynamics of Earth's atmosphere.

**Concepts** include:

- a) air as a mixture of gaseous elements and compounds
- b) air pressure, temperature, and humidity
- c) how the atmosphere changes with altitude
- d) natural and human-caused changes to the atmosphere
- e) the relationship of atmospheric measures and weather conditions
- f) basic information from weather maps including fronts, systems, and basic measurements
- g) the importance of protecting and maintaining air quality

**S.6.4** The students will investigate and understand the unique properties and characteristics of water and its roles in the natural and human-made environment.

**Concepts** include:

- a) water as the universal solvent
- b) the properties of water in all three states
- c) the action of water in physical and chemical weathering
- d) the ability of large bodies of water to store heat and moderate climate
- e) the origin and occurrence of water on earth
- f) the importance of water for agriculture, power generation and public health, and
- g) the importance of protecting and maintaining water resources

**S.6.5** The student will investigate and understand the natural processes and human interactions that affect watershed systems.

**Concepts** include:

- a) the health of ecosystems and the abiotic factors of a watershed
- b) the location and structure of Virginia's regional watershed systems
- c) divides, tributaries, river systems, and river and stream processes
- d) wetlands
- e) estuaries
- f) major conservation, health, and safety issues associated with watersheds
- g) water monitoring and analysis using field equipment including hand-held technology

**S.6.6** The student will investigate and understand environmental issues.

**Concepts** include:

- a) management of renewable resources (water, air, soil, plant life, animal life)
- b) management of nonrenewable resources (coal, oil, natural gas, nuclear power, mineral resources)
- c) the mitigation of land-use and environmental hazards through preventive measures
- d) cost/benefit tradeoffs in conservation policies

### **Physical Science**

**S.6.7** The student will understand that all matter is made up of atoms.

**Concepts** include:

- a) atoms are made up of electrons, protons, and neutrons
- b) atoms of any element are alike but are different from atoms of other elements
- c) elements may be represented by chemical symbols
- d) two or more atoms may be chemically combined
- e) compounds may be represented by chemical formulas
- f) chemical equations can be used to model chemical changes
- g) a limited number of elements comprise the largest portion of the solid Earth, living matter, the oceans, and the atmosphere

**S.6.8** The student will understand that energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical reaction.

**Concepts** include:

- a) potential and kinetic energy

- b) the role of the sun in the formation of most energy sources on Earth
- c) energy transfer (heat/light to mechanical, chemical and electrical energy)
- d) law of conservation of energy (in ordinary circumstances, energy is not created or destroyed)
- e) nonrenewable energy sources (fossil fuels including petroleum, natural gas, and coal)
- f) renewable energy sources (wood, wind, hydro, geothermal, tidal, and solar)

### **Earth Space Systems**

**S.6.9** The student will investigate and understand the organization of the solar system and the relationships among the various bodies that comprise it.

**Concepts** include:

- a) the sun, moon, Earth, other planets and their moons, meteors, asteroids, and comets
- b) relative size of and distance between planets
- c) the role of gravity
- d) revolution and rotation
- e) the mechanics of day and night and the phases of the moon
- f) the unique properties of Earth as a planet
- g) the relationship of the Earth's tilt and the seasons
- h) the cause of tides
- i) the history and technology of space exploration

## Seventh Grade

### Scientific Reasoning, Investigation and Logic

**S.7.1** The student will plan and conduct investigations in which

- a) data are organized into tables showing repeated trials and means
- b) variables are defined
- c) metric units (SI—International System of Units) are used
- d) models are constructed to illustrate and explain phenomena
- e) sources of experimental error are identified
- f) dependent variables, independent variables, and constants are identified
- g) variables are controlled to test hypotheses, and trials are repeated
- h) continuous line graphs are constructed, interpreted, and used to make predictions
- i) interpretations from a set of data are evaluated and defended
- j) an understanding of the nature of science is developed and reinforced

**S.7.2** The student will demonstrate the ability to select design and implement an independent research project by participating in a Science Fair or national contest or in a competition requiring independent scientific research.

### Life Science

**S.7.3** The student will define and discuss the basic theories of the origin of life.

**Concepts** include:

- a) spontaneous generation and the disproof of this theory
- b) biogenesis and the proof of this theory

**S.7.4** The student will investigate and understand that organisms change over time.

**Concepts** include:

- a) the relationships of mutation, adaptation, natural selection, and extinction;
- b) evidence of evolution of different species in the fossil record; and
- c) how environmental influences, as well as genetic variation, can lead to diversity of organisms.

**S.7.5** The student will define, classify, and describe the **basic** characteristics of the Kingdoms of living organisms

**Concepts** include:

- a) viruses, eubacteria, archeobacteria, fungi, plants, protists, animals
- b) dichotomous key
- c) binomial nomenclature

**S.7.6** The student will define and explain the life processes and needs.

**Concepts** include:

- a) use of energy
- b) growth and development
- c) ability to adapt
- d) respiration

- e) reproduction
- f) response to stimuli

**S.7.7** The student will demonstrate and define a model of DNA.

**S.7.8** The student will explore the basic theory of genetics.

**Concepts** include:

- a) Gregor Mendel
- b) dominant and recessive traits
- c) multiple allele
- d) Punnet Square
- e) incomplete dominance

**S.7.9** The student will define, construct and interpret the cell model.

**Hands-on activities** should include observation of the following:

- a) cell wall
- b) nucleus
- c) cell processes
- d) respiration
- e) cell membrane
- f) organelles
- g) osmosis
- h) mitosis and meiosis

**S.7.10** The student will describe the utilization of matter and energy in the life process.

**Concepts** include:

- a) organic compounds of carbohydrates, proteins and lipids
- b) cellular respiration
- c) growth, cellular repair
- d) locomotion

**S.7.11** The student will define and explain the process of photosynthesis and the role of the

plant in the environment.

**Concepts** include:

- a) reagents
- b) products
- c) carbon dioxide –oxygen cycle
- d) role in ecosystems
- e) catalyst
- f) producer

**S.7.12** The student will investigate and understand that organisms within an ecosystem are dependent on one another and on nonliving components of the environment.

**Concepts** include:

- a) the carbon, water, and nitrogen cycles

- b) interactions resulting in a flow of energy and matter throughout the system
- c) complex relationships within terrestrial, freshwater, and marine ecosystems
- d) energy flow in food webs and energy pyramids

**S.7.13** The student will investigate and understand that interactions exist among members of a population.

**Concepts** include:

- a) competition, cooperation, social hierarchy, territorial imperative
- b) influence of behavior on a population

**S.7.14** The student will investigate and understand interactions among populations in a biological community.

**Concepts** include:

- a) the relationships among producers, consumers, and decomposers in food webs;
- b) the relationship between predators and prey;
- c) competition and cooperation;
- d) symbiotic relationships; and
- e) niches.

**S.7.15** The student will investigate and understand how organisms adapt to biotic and abiotic factors in an ecosystem.

**Concepts** include:

- a) differences between ecosystems and biomes;
- b) characteristics of land, marine, and freshwater ecosystems; and
- c) adaptations that enable organisms to survive within a specific ecosystem.

**S.7.16** The student will investigate and understand that ecosystems, communities, populations, and organisms are dynamic and change over time (daily, seasonal, and long term).

**Concepts** include:

- a) phototropism, hibernation, and dormancy
- b) factors that increase or decrease population size
- c) eutrophication, climate changes, and catastrophic disturbances

**S.7.17** The student will investigate and understand the relationships between ecosystem dynamics and human activity.

**Concepts** include:

- a) food production and harvest
- b) change in habitat size, quality, or structure
- c) change in species competition
- d) population disturbances and factors that threaten or enhance species survival
- e) environmental issues (water supply, air quality, energy production, and waste management)

**S.7.18** The student will identify the major organs and systems of the human body.

- a) respiratory
- b) nervous
- c) excretory
- d) musculoskeletal
- e) circulatory
- f) digestive
- g) endocrine

**S.7.19** The student will define and explain the process of growth and development and life span of the human.

**Concepts** include:

- a) neonate, infant, childhood, adolescence, and adult.
- b) behavioral and developmental expectations

**S.7.20** The student will understand the process of reproduction of the human. This unit could be integrated with, or taught as the Family Life Unit of Religion. Be **SURE** to check your school policy prior to instructing this objective. Refer to the Formation of Christian Chastity policy.

## **Eighth Grade:**

### **Scientific Investigation, Reasoning, and Logic**

**S.8.1** The student will plan and conduct investigations in which

- a) chemicals and equipment are used safely
- b) length, mass, volume, density, temperature, weight, and force are accurately measured and reported using metric units (SI—International System of Units)
- c) conversions are made among metric units, applying appropriate prefixes
- d) triple beam and electronic balances, thermometers, metric rulers, graduated cylinders, and spring scales are used to gather data
- e) numbers are expressed in scientific notation where appropriate
- f) research skills are utilized using a variety of resources
- g) independent and dependent variables, constants, controls, and repeated trials are identified
- h) data tables showing the independent and dependent variables, derived quantities, and the number of trials are constructed and interpreted
- i) data tables for descriptive statistics showing specific measures of central tendency, the range of the data set, and the number of repeated trials are constructed and interpreted
- j) frequency distributions, scattergrams, line plots, and histograms are constructed and interpreted
- k) valid conclusions are made after analyzing data
- l) research methods are used to investigate practical problems and questions
- m) experimental results are presented in appropriate written form
- n) an understanding of the nature of science is developed and reinforced

**S.8.2** The student will demonstrate the ability to select, design, and implement an independent research project by participating in a Science Fair or national contest or competition requiring independent scientific research

### **Chemistry**

**S.8.3** The student will investigate and explain the forms of matter and energy, and discuss the relationship of each with reference to the kinetic theory.

**Concepts** include:

- a) solid, liquid, gas, and plasma
- b) melting, freezing, boiling, evaporation, condensation, and sublimation
- c) melting point, freezing point, and boiling point
- d) latent heat of vaporization
- e) absolute zero

**S.8.4** The student will investigate and identify the characteristics of the classes of matter.

**Concepts** include:

- a) elements, compounds, and mixtures
- b) acids, bases, and salts
- c) solutions and suspensions/colloids
- d) organic and inorganic

**S.8.5** The student will investigate, classify and identify physical and chemical properties of matter.

**Concepts** include:

- a) physical properties: shape, density, color, odor, boiling point, melting point, solubility, and miscibility
- b) chemical properties: acidity, basicity, pH, combustibility, reactivity

**S.8.6** The student will investigate and explain physical changes of matter.

**Concepts** include:

- a) effect of temperature
- b) effect of particle size on solubility
- c) formation of a suspension
- d) effect of temperature on solubility (saturated, supersaturated solutions)
- e) miscibility of liquids

**S.8.7** The student will investigate and explain chemical changes of matter using the theory of conservation of matter and energy.

**Concepts** include:

- a) evidence of reaction
- b) reactants and products
- c) type of reaction
- d) balanced chemical equations

**S.8.8** The student will research and discuss nuclear changes in matter using the theory of conservation of matter and energy.

**Concepts** include:

- a) fusion and fission
- b) products of nuclear reactions
- c) effects on humans and the environment
- d) alternative energy sources

**S.8.9** The student will construct and explain models that illustrate the structures of the atom.

**Concepts** include:

- a) nucleus, proton, neutrons, electrons
- b) Bohr model and electron cloud model (modern model of the atom)
- c) ions
- d) isotopes
- e) the historical development of atomic theory (including Dalton, Thomson, Rutherford, and Bohr)

**S.8.10** The student will obtain and explain information from the Periodic Table of Elements.

**Concepts** include:

- a) symbol
- b) atomic number and atomic mass

- c) chemical families (groups) and periods
- d) metals, non-metals, inert gases
- e) oxidation number
- f) synthetic elements

**S.8.11** The student will analyze the Periodic Table of Elements and will develop correct inferences regarding elements and binary compounds.

**Concepts** should include:

- a) chemical activity
- b) formulas for compounds
- c) nature of bonding (ionic, covalent)
- d) physical properties
- e) names of compounds

**S.8.12** The student will evaluate past effects and propose future effects of science and technology as it applies to humans and the environment.

**Areas of concern** for discussion should include:

- a) nuclear energy
- b) space exploration
- c) environmental pollution
- d) energy resources, conservation and alternatives

### **Motion and Force**

**S.8.13** The student will define and explain work.

**Concepts** include:

- a) work
- b) power
- c) force
- d) horsepower
- e) simple machines and complex machines
- f) mechanical advantage

**S.8.14** The student will understand the basic principles of force and motion

**Concepts** include:

- a) force
- b) acceleration
- c) velocity and speed
- d) gravity, friction, and centripetal force
- e) projectiles
- f) Newton's Laws of Motion

**S.8.15** The student will explain and demonstrate the ratios required to establish the derived units applicable to forces, motion and work.

**Derived units** should include: kg-m, joule, and newton.

## **Energy**

**S.8.16** The student will define and explain energy states and energy forms.

**Concepts** include:

- a) energy states – kinetic and potential energy
- b) forms of energy: heat, mechanical, electrical, sound, light, nuclear, and chemical energy

**S.8.17** The student will investigate how energy is transferred, transformed, and utilized.

**Concepts** include:

- a) conduction, convection, and radiation
- b) energy transformations: kinetic to potential, potential to kinetic, chemical to electrical, heat to light
- c) law of conservation of energy (energy is not created or destroyed)

**S.8.18** The student will investigate and explain the basic characteristics of light

**Concepts** include:

- a) wave behavior of light
- b) the electromagnetic spectrum
- c) color
- d) reflection and refraction
- e) diffraction
- f) interference

**S.8.19** The student will investigate and explain the basic characteristics of mechanical waves

**Concepts** include:

- a) longitudinal (compression) waves, transverse waves
- b) reflection and refraction
- c) reverberation, resonance, and interference
- d) sound waves

**S.8.20** The student will investigate and explain the characteristics and technological applications of electricity and magnetism

**Concepts** include:

- a) attraction and repulsion
- b) alternating and direct current
- c) static electricity
- d) magnetic fields and magnetic field lines
- e) series and parallel circuits
- f) generators
- g) motors
- h) appliances
- i) electronics
- j) computers

# **RESOURCES TO DATE**

## **STEM CELL LESSON PLANS**

**Slide One** : Title Slide: Stem Cell Research Education Project

Developing in coordination with:

Dr. Timothy McNiff,  
Superintendent,  
Office of Catholic Schools,  
Diocese of Arlington  
Arlington, VA

By:

Anita Ostrander  
Denise Pope  
Nora M. Prestinari Burchett  
Laural Zelinski

### **Slide Two:** How Did We Get Here

In the upcoming session of the Virginia assembly, Stem Cell Research legislation will be a major topic for new laws.

The Virginia Conference of Catholic Bishops now has a legislative Lobby in Richmond which effectively lobbies for ethical legislation.

Since Stem Cell Research is in the news daily, The Virginia Conference of Catholic Bishops has tasked the Dioceses of Arlington and Richmond to have an education program for all members of their parishes.

This education will include students in parochial Middle Schools and High Schools. The rationale is that students will freely discuss current events when they are effectively taught the information they hear and see in the daily media. Students develop important ethical positions during the critical thinking skills. Critical thinking skills are the focus of brain development beginning in the middle school and culminating in young adulthood – presently estimated at approximately 30 yrs of age.

Since this development will significantly impact their decisions for the future of humankind, it is imperative that these young people be given the correct information and the appropriate guidance during this critical development of thought processes.

In presenting information in an interesting and safe environment of Catholic Schools, students will have the information to share and discuss with peers and relatives and will,

in time, be able to use the information to influence the future – as they will be the leaders of tomorrow.

In addition to long range influence, present influence can be seen in the results of parents influencing the legislature of today.

### **Slide Three:** Goal and Objective

Students will be provided with scientific knowledge of the process of stem cell research – both adult and embryonic at grade level content.

This information will be presented to the students through classroom instruction and integrated with the subject topics (religion, science, social studies, ethics, morality, etc.) designated by the grade level curricula from grade 5 through grade 12. The lesson plans for this instruction will be provided to the teachers in this packet. Resources will also be provided in this packet.

The Office of Catholic Schools will be available on an approximate 24 hour turnaround for questions regarding Stem Cell Research, the lesson plans, resources and any other issue that may arise during the instruction of this topic. Teachers are encouraged to use this resource, especially when discussion goes beyond the comfort level of knowledge of the teacher. (It is OK not to have all the answers.)

As a result of this instruction, students will be able to accurately discuss the topic of Stem Cell Research and the position of the Catholic Church both morally and ethically.

### **Slide Four:** Strategies

Base Teaching in the Principle of the Dignity of Life

All life is a Gift from God  
All Life is sacred  
No life may be taken at the whim of man

Instruction should be completed by Christmas break

Instruction fits the various curricula during the second quarter  
Voting on the issue of Stem Cell Research and discussion of such is scheduled for late January 2006.

If students are able to freely, intelligently and morally discuss Stem Cell Research with appropriate understanding and knowledge, the discussion should be able to influence parents, relatives, etc. to send the message to the legislature. The end result ideally will be moral and ethical laws regarding Stem Cell Research.

The information presented to the students must be curriculum and grade level appropriate. Students with Special Needs are to be included according to their IEP.

### **Slide Five: Dignity of Life**

Title topics for following slides ONLY.

### **Slide Six:**

#### **Faith Component**

Relative to Stem Cell Research:

Embryonic Stem Cell Research is immoral.

Embryos are living human beings with a soul.

In Vitro Embryo's are human beings with a soul, even if the means of conception are not morally acceptable.

Destroying an embryo is murder

Source of the embryo is immaterial to the morality.

Destruction of any In Vitro embryo is murder.

#### **Adult Stem Cell Research IS MORALLY AND ETHICALLY APPROPRIATE AND SHOULD BE ENCOURAGED.**

Adult Stem Cells are readily available.

Adult Stem Cells include umbilical cord blood stem cells.

Placentas and cord blood are routinely discarded and can be harvested with the permission of the family. No detrimental affect results from this harvest.

Adult stem cells can be harvested from living individuals easily and with no harm to the individual

### **What The Church Teaches About Stem Cell Research**

**Human life begins from the moment of conception and must be respected and protected. In Scripture, we see that every individual from the very beginning is a part of God's plan. (Psalm 139:13-14)**

**Teachings of the Magisterium (taken from Documents of the Congregation for the Doctrine of the Faith: Instruction on Respect for Human Life in Its Origin and the Dignity of Procreation: Replies to Certain Question of the Day)**

“From the moment of conception, the life of every human being is to be respected in an absolute way because man is the only creature on earth that God has ‘wished for himself’ and the spiritual soul of each man is ‘immediately created’ by God; his whole being bears the image of the Creator. Human life is sacred because from the beginning it involves ‘the creative action of God’ and it remains forever in a special relationship with the Creator, who is its sole end. God alone is the Lord of life from its beginning until its end: no one can, in any circumstances, claim for himself the right to destroy directly an innocent human being.”

***From the Catechism of the Catholic Church No. 2270***

“Human life must be respected and protected absolutely from the moment of conception. From the first moment of his existence, a human being must be recognized as having the rights of a person--among which is the inviolable right of every innocent being to life.”

*(The following statements are taken from the United States Conference of Catholic Bishops)*

***The Church is opposed to Stem Cell Research using the Embryo because harvesting these stem cells kills the living human embryo. The Church opposes the direct destruction of innocent human life for any purpose, including research.***

***The Church is not opposed to Stem Cell Research using cells obtained from adult tissue, umbilical cord blood, and other sources that pose no moral problem.***

***The Church tells us that we must choose the lives of the embryos regardless of all the arguments that are presented about the lives of suffering patients and the use of stem cells from embryos to bring about cures for those patients. We are called to understand that treatments that do not require destroying any human life are at least as promising and they are already healing some conditions, and are far closer to healing other conditions than any approach using embryonic stem cells. We must help those who are suffering but we may not use a good end to justify an evil means. The choice is not between science and ethics, but between science that is ethically responsible and science that is not.***

***The Church opposes cloning.***

***Cloning is a depersonalized way to reproduce, in which human beings are manufactured in the laboratory to pre-set specifications. It is not a worthy way to bring a new human into the world. When done for stem cell research, it involves the moral wrong of embryonic stem cell research plus an additional wrong. It creates human beings solely to kill them for their cells. This is ultimate reduction of a fellow human being to a mere means, to be used as an instrument of another’s wishes or uses.***

## **Slide Seven: Science of Stem Cells**

### Introduction:

Today many advances are being made in the area of new medicines and medical therapies for healing - some controversial, some not. One of the current controversial medical advancement is stem cell research. This highly debated topic has been in the forefront of the news. Our children have already been introduced to this topic through the news media, news documentaries, and National TV ads. They have also been introduced to the topic through major articles in the newspapers and magazines that they regularly read such as National Geographic, Discover magazines, and the Washington Post. As with any hotly debated topic, there can be a lot of misinformation given as fact.

Attention to this new medical science and the Church's views on this topic will only intensify in the future. Most importantly, this science involves the Dignity of Life of Human Beings, the Diocese of Arlington feels its students need to be made aware, in age appropriate ways, of this science and how the Catholic Church views this topic.

### Teacher Background:

What are stem cells? Stem cells are cells found in humans or animals that can develop into many different cell types found in a body. There are two types of stem cells - Embryonic and Adult. A living body uses "adult" stem cells as a repair system for replenishing damaged cells. In a developing embryo, stem cells are the basic cells from which all its organs and body tissues are created.

### Why are Stem cells important?

Stem cells have two important characteristics that distinguish them from other types of cells in the body. First, they are unspecialized cells that can renew themselves for long periods of time through cell division. The second is that under certain physiologic or experimental conditions, they can be induced to become cells with special functions such as beating heart cells or insulin producing pancreatic cells.

### What is so special about human embryonic stem cells?

After a human egg has been fertilized and begins to divide into many cells, the emerging human becomes an embryo. Within 4 to 5 days, the embryo has developed into a microscopic ball of cells called a blastocyst. The surface of this ball is covered with a layer of cells that will become the placenta surrounding the emerging baby. Inside is a hollow cavity containing a cell mass of about 30 stem cells which are the basic cells from which the developing baby is created. The stem cells will multiply and divide into groups of specialized cells making up all the tissues and organs of the unborn child. These cells are relatively easy to convert to a desired cell type.

What is the controversy surrounding the use of embryonic stem cells for medical use?

The controversy exists because of the potential for stem cells to change into any cell in our bodies. Current medical researchers want to extract human embryonic stem cells to use in certain medical therapies to help cure such diseases as heart disease and diabetes. Researchers want to use the stem cells from unused embryos left over from In-Vitro procedures. Embryonic stem cells are extracted by inserting a pipette through the wall of the blastocyst and removing the stem cell mass inside. These cells are placed in a prepared petri dish to multiply. This process destroys the blastocyst, thus also destroying a human life.

### **Additional Resources:**

Comprehensive Information:

- 1) The National Institute of Health  
[www.nih.gov/stemcellss.nih.gov/index.asp](http://www.nih.gov/stemcellss.nih.gov/index.asp)
- 2) University of Wisconsin-Madison  
[www.news.wisc.edu/packages/stemcells/illustrations.html](http://www.news.wisc.edu/packages/stemcells/illustrations.html)

*Slide shows:*

[www.dnale.org.stemcells.html](http://www.dnale.org.stemcells.html)

[www.sumanasinc.com/webcontent/anisamples/stemcells.html](http://www.sumanasinc.com/webcontent/anisamples/stemcells.html)

*Magazine articles:*

National Geographic, "The Power to Divide", July 2005 issue

Google Search will give over 800,000 sites with the search Stem Cell research and the Catholic Church.

**Slide Eight:**

## **Why Stem Cell Research is Important**

### **STEM CELL RESEARCH: SOCIETAL AND CULTURAL IMPACT**

### **VOCABULARY**

#### **ALL LEVELS:**

**Moral:** the principles of right conduct or the distinction between right and wrong

**Ethical:** 1. actions having to do with a set of moral principles. 2. the rules of conduct governing human actions

**Federal Funding:** money that the United States Government has received through taxing its citizens and is then granted for use to benefit its citizens as regulated by laws passed by Congress, the House of Representatives, and the Executive Branch of the government

**NIH:** The National Institutes of Health

**Private Research:** Research that is funded by an individual or group of individuals that invest their money for a specific purpose. Private research does not require following policies that regulate federal funding.

**Stem cell lines :** Stem cells which have been collected from an embryo and are being grown in Petri dishes in laboratories with the purpose of developing more and more. In collecting the stem cells, the embryo is no longer an embryo and can no longer become a person. Some of the first lines developed are grown in cultures of mouse embryos to encourage them to continue making new cells so that the 'line' continues.

**Moratorium:** A ban on something

**Pluripotent:** the ability of embryonic stem cells to specialize into the 200 different types of cells we have in our body

## **WHAT WILL SOCIETY GAIN FROM STEM CELL RESEARCH?**

### **ALL LEVELS:**

Scientists around the world are hopeful that the use of stem cells will help cure diseases, regenerate tissue and organs, and repair damaged cells. They are basing this hope on the ability of stem cells to become other cells and on their own ability to figure out how to make that happen.

#### **1.) Diseases that stem cell use is hoped to cure:**

- \*heart disease
- \*Type I diabetes
- \*sickle cell anemia
- \*leukemia
- \*non-Hodgkin's lymphoma
- \*pancreatic and ovarian cancer

#### **2.) It is hoped that stem cell use can regenerate healthy tissue and organs that would not be rejected when they are implanted in the patient.**

- \*helping Parkinson disease victims replace damaged brain cells
- \*creating new organs like kidneys from stem cells of the person needing the transplant so that the new organ isn't rejected
- \*creating new organs that can be stored in an organ bank and be ready to use
- \*helping stroke victims regain normal movement
- \*helping spinal cord injuries heal and paralysis victims to move
- \*repairing cartilage so that rheumatoid arthritis is not so painful
- \*repairing and replacing skin of burn victims
- \*using a patient's own stem cells to regenerate healthy cells

**3.) Scientists aren't sure how, but adding stem cells to damaged cells seems to "jump start" the repair process and help the cells respond quicker to treatment. These kinds of treatments are being done right now on people.**

- \*healing cornea damage to the eye
- \*repairing cartilage so that rheumatoid arthritis is not so painful
- \*replacing sickle cell blood with normal blood cells from the stem cells of umbilical cord blood

### **STEM CELL RESEARCH IS GLOBAL**

#### **LEVEL 1:**

Scientists from countries around the world are researching and experimenting with both animal and human stem cells to find out how they work and what we can use them for. You may even hear this described as a "race". (This can be a biased term since a race infers a winner and a loser, yet if a cure for something is found, everyone will benefit because it is assumed it would be shared...the ones who find it first are racing for the money that will be made from selling their product...and the fame they will get)

- Most of the experiments that are designed to see how stem cells work have been done on animals since experimenting on people is regulated in different ways by different countries.
- The United States, and some other countries have strict guidelines about any research and experiments on humans.
- This is a fairly new scientific discovery (late 1990's) and many of the things science is hopeful that stem cells will do have not been tried yet.
- The harvesting and use of adult stem cells has been used for therapeutic treatments for over 20 years. New sources of adult stem cells and their uses are being researched.
- The harvesting and growth of embryonic stem cells has only been possible since 1998. Most research is being done on animals and actual result of what they can do for humans is theoretical. Embryonic stem cell cures are not scientifically proven and are 20 to 30 years away from being used by the public.
- The use of human embryos for stem cells is a moral and ethical issue.
- Cloning human embryos for the purpose of using them for stem cells has been approved by some countries; it is a moral and ethical issue also.

#### **LEVEL II**

\*The United States was the first to develop human embryonic stem cell lines that continue to multiply and grow.

\*The U.S. has patents on many basic procedures necessary for stem cell research.

\*The U.S. continues to lead the world in the number of stem cell lines it has available.

\*The U.S. has more legal limitations on biological research than some other countries.

\*The U.S., Austria, and Ireland are doing stem cell research with legal limitations on embryonic stem cell research.

\*The United Kingdom, China, Korea and Singapore are all trying to be the epicenters of stem cell research by inviting international scientists to their facilities, providing money for research, and having fewer limitations on stem cell research.

\*Some of these countries allow embryonic research and cloning to try to increase their knowledge and abilities.

### **LEVEL III:**

\*In 1998, American scientist James Thomson removed stem cells from embryos to establish the first human embryonic stem cell line.

\*In 2001, The British parliament allowed the creation of human clones for the purpose of stem cell research.

\*The United Kingdom has a U.K. Stem Cell Bank where researchers can deposit and withdraw adult and embryonic stem cells for use in their research.

### **CURRENT POLICY OF THE UNITED STATES REGARDING STEM CELL RESEARCH and FEDERAL FUNDING**

Research using stem cells from umbilical cords and adult sources can be and are funded by the federal government through the National Institutes of Health. The laws regulating this in the U.S. are based on standard research-ethics conditions for any experiments or therapy on humans. These laws are to ensure the safety, well being, and ethical treatment of people.

- 1.) There must be knowledge and consent of the persons donating the stem cells and the person receiving the treatment.
- 2.) There cannot be monetary payment for the cells to be used.

The current policy regarding embryonic stem cell research was announced by President George W. Bush on August 9, 2001. It was developed to determine whether federal funding should be used for research in which stem cells are collected from frozen embryos that are donated for research. (**LEVEL III:** These come from fertility clinics and are extra embryos created during the In Vitro Fertilization process. The parents of the fertilized embryos must consent in writing to donate the embryos and they cannot receive payment for the embryos.)

The current policy states that stem cells which had already been collected and were in various stages of growth and regeneration (called stem cell lines) prior to August 9, 2001 could be eligible for federal funding. (**LEVEL II** This included 78 embryonic stem cell lines, 22 of which are considered by researchers to be uncontaminated and useable.) No frozen embryos or embryos created for the purpose of research or cloned embryos can be considered eligible for federal funding. The eligible embryos were already part of a research project that was privately funded.

The present policy strives to support research that could be beneficial to many, but it does not want to encourage or contribute to any future destruction of human embryos.

**LEVEL III:** Ever since *Roe v. Wade* in 1973, Congress has been concerned about the potential use of aborted fetuses or embryos for scientific research. In 1974 a law was passed putting a moratorium, or ban, on their use until the newly formed National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research could provide guidelines and standards for this type of research. Following their report an Ethics Advisory Board was formed. Although at one point in President Clinton's presidency, he was considering funding research that used leftover frozen embryos from In Vitro Fertilization, Congress did not agree and in 1996 attached the "Dickey Amendment" (named after its author Jay Dickey of Arkansas) to the Health and Human Services Funds from which biomedical research is funded through NIH. The Dickey Amendment *legally prohibits the use of any federal funds* for research that destroys or seriously endangers human embryos or creates embryos to be destroyed for research purposes.

While the Dickey Amendment affects the use of federal funds, it *does not legally prohibit the use of private funding* for such research. Although the Dickey Amendment was enacted prior to the discovery of stem cells and their potential use, it has been reenacted by our government every year with the intent that human life be protected against exploitation and destruction for scientific research. The current policy does not go against this law because the stem cell lines pre-existing August, 2001 were derived by private funds.

In the United States, the rights of the individual are protected by the Bill of Rights in our Constitution. These rights ensure the safety and equality of treatment for all individuals in our society. Embryonic stem cell research is an issue that is questioning when these rights begin. It is an issue that will have profound legal, moral, ethical, and social consequences in our country and worldwide.

**CURRENT PRO AND CON ARGUMENTS  
FOR THE USE OF EMBRYONIC STEM CELLS**

***MORAL AND ETHICAL ISSUES USING EMBRYOS FOR RESEARCH***

**PRO**

*using embryonic stem cells for research*

\*Embryonic stem cell research is a “medical breakthrough” that can save lives, help paralyzed people walk again and cure diseases.

**PRO**

\*A human embryo is not the same thing as a person.

**CON**

*using embryonic stem cells for research*

\*Embryonic stem cell research is still in the idea stage and has not been tested on humans to determine if these cures will actually happen. Years of different research studies, product development, manufacturing, and government approval mean any “medical breakthrough” is 20-30 years away for the general public.

**CON**

\*The question of what determines ‘a person’ can be both scientific and religious in nature. Because of our new knowledge and abilities with genetics, science and technology can now determine that each fertilized egg is capable of becoming a unique individual. Many religions, including Catholics and Christians believe that from the moment of conception, there is an individual with a body and a soul that is love by God. This individual is valuable.  
\*The human embryo is a person and is deserving of the same respect and rights as all people.

**PRO**

\*It is a morally good thing to use whatever you need for research if the findings will help many people.

**PRO**

\*It is immoral not to do research that will help people.

**PRO**

\*Embryonic stem cells are pluripotent and adult stem cells are not, so embryonic stem cells are easier to manipulate and create the type of cell you want.

**PRO**

\*The embryos that are left over from IVF procedures will be thrown away anyway so why not use them for something good.

**CON**

\*This assumes that the end justifies the means. Every embryo that is used for research will be destroyed to harvest stem cells so if human life begins at conception, researchers will be killing people.

**CON**

\*The number of embryos needed will be vast. \*It is immoral and illegal to kill people to help other people, and it is illegal and immoral to use people as commodities in which they are more valuable dead than alive – even if other people could benefit.

**CON**

\*This is a theory and not a proven fact. Scientists do know that stem cells from an embryo are pluripotent, but it is not known how to use this property. Adult stem cells have **not** been fully researched to see their full potential. Recently, skin cells have been tested as possible stem cells.

**CON**

\*Less than 3% of leftover embryos have been disposed of and only a small percentage more have been donated to research. Written parental permission must be obtained for either of these alternatives to freezing and saving the embryos.

**PRO**

\*Stem cells are taken from embryos that are in the cell division stage prior to cells specializing into organs and tissues. These “cell masses” should not be entitled to the same rights as human beings that are recognizable as people.

**PRO**

\*The U.S. will not be able to keep up with other countries in the area of stem cell research if they are not funded and supported by the government.

**PRO**

\*All of the stem cell lines created prior to 8-9-01 that are eligible for federal funding are not all useable for research so more are needed.

**CON**

\*Science and technology can know and predict the development of a human person from the first cell formed in fertilization. The DNA of that cell creates an individual that is different from both of its parents. There is nothing else that a cell will become except a unique person.

\*The definition of when a human becomes a human has both scientific and religious foundations.

**CON**

\*Federal funding is based on laws that ensure the rights and safety of its citizens. The government is expected to uphold policies that coincide with the Constitution and that maintain a moral foundation. Federal funding is not the only means to obtain money needed by researchers.

**CON**

\*Under the current policy, it is not legal to use more embryos to develop stem cell lines. If more embryos were to be used to develop the lines necessary, how many is that and where would they come from? Although there are those that think this policy is limiting, it is the first time in American history that human embryos have been allowed to be used for research at all.

**PRO**

\*The federal government is limiting the amount and kinds of research that can be done in the U.S., and we are losing top scientists to other countries.

**PRO**

\*If the problem with embryonic stem cells is that there is a moral issue using embryos that are genetically unique, it is possible to clone human embryos for the purpose of research; then scientists will know what they are getting genetically and they won't be destroying an individual, it will be a clone. Other countries do it, so we should too.

**CON**

\*The federal government is being prudent in the decisions it makes concerning human life. The importance and value of the individual in our country demands that the issues of bioethics be considered carefully from the perspective of the life to be sacrificed for research and the moral perspectives of the citizens it serves.

**CON**

\*The practice of creating humans for the purpose of destroying them is a dangerous one for its moral implications. Cloning is unnatural in the natural world. There are many examples of scientific solutions creating various problems, and this is a potential scenario. Devaluing life to this degree, create it to destroy it, will set a precedent that will have far reaching effects beyond stem cell research. Cloning embryos for research goes against the value that America places on the individual.  
\*Cloning humans is not respecting life or the creation of it as God intended and is against what Catholics and many other religions believe is morally right.

**PRO**

\*It is not right to let your personal beliefs get in the way of scientific progress, which is for the good of all. This is what people are doing that are against embryonic stem cell research.

**PRO**

\*Embryonic stem cell research is a political issue between liberals and conservatives.

**CON**

\*It is our responsibility to use every resource that we have to determine the value of one thing over the value of another. Personal beliefs and religious beliefs do have a place in deciding whether something is moral and ethical. Is the potential of this scientific research more valuable than the beginnings of human life? If we as a society decide to put a value on “life forms” at various stages, could this open the door to other areas of experimentation on humans? (The Nazi’s thought so, and at times during our American history we have also valued some members of society more than others...slavery, experiments on mentally ill, or prisoners, etc.) This has been made illegal in the U.S. as our Bill of Rights strives for equal value among people.

**CON**

\*Embryonic stem cell research is an issue of morality and ethics in science that will affect all of us. Many think we are at a crossroads in which we will define the values of our country. We cannot jump in and “just do it” because we are capable of the technology.

**PRO**

\*Embryonic stem cell research is the only way we will have the possibility of curing many of the diseases that cause pain and suffering or death.

**PRO**

\*The media gives us the information we can base our decisions on for issues like embryonic stem cell research. The news, newspapers and magazines will inform us. Most newspapers, magazines, and news shows are for using embryonic stem cells.

**PRO**

\*A lot of famous people are for embryonic stem cell research and they speak before Congress to give them their message, so They must know what they are talking about.

**PRO**

\*Most of the money for stem cell research should go toward embryonic stem cell research because it has the most potential.

**CON**

\*Scientists are always looking for and finding ways that will help cure diseases and help people. They should continue to research other ways, such as using chemicals from plants, etc.  
\*The cures that it is hoped embryonic stem cells can achieve may or may not be realistic. It is not a sure thing.

**CON**

\*The media is biased with the information concerning embryonic stem cell research. Accurate information can be found in various places, but we must take the initiative to look for all the viewpoints and information.

**CON**

The media uses famous people as spokesmen for embryonic research (Michael J. Fox or Christopher Reeves) or uses situations most of us will face (like our parents having a disease) to make this personal and emotional rather than rational and ethics based.

**CON**

\*Federal money for stem cell research is currently used for research involving adult stem cells, for which there is no ethical dilemma, or it is used to train scientists how to work with stem cells.

### **PRO**

\*If the federal government won't fund embryonic stem cell research, the states should.

### **CON**

\*At least two states have approved money for long term embryonic stem cell research. It seems likely that a federal issue would also be a state issue and become a legal issue as well. It does not seem right that a state policy can contradict a federal policy. It seems that on issues regarding ethics and morality, our country and its laws need to do the right thing.

Use quote about how we deal with this issue determines who we will be.....

### **OTHER FACTS**

National Geographic reports that the U.S. has 70 stem cell lines, while the next closest number is 33 lines in Sweden, 24 in South Korea, 10 in India, 7 in Singapore, 5 in Israel, 3 in the United Kingdom, 2 in Spain, and 1 in Iran.

Slide Nine:

**LESSON PLAN**

**GRADE 5**

**STEM CELL RESEARCH**

**RELIGION**

**OBJECTIVE**

1. The student will know that life is a gift from God.
2. The student will recognize that as Catholics we believe that human life begins at the moment of conception and should be respected and valued as a human life from conception until natural death.

**SCIENCE**

**OBJECTIVE**

1. 5th grade

Life Science

a. 5.8 Introduction to the cell and cell parts

- include the word stem cell in the list of cell types of the human body, such as muscles, blood, and nerve cells.
- include a generic simple definition of a stem cell

b. 5.14 Bones and the Human skeleton

- Talk about: One location where Stem cells can be found is in bone marrow tissue.

Example of cutting edge science: Stem cells are currently being used to treat such diseases as Childhood Leukemia, cystic fibrosis

**GRADE 6**  
**LESSON PLAN**  
**STEM CELL RESEARCH**

**RELIGION**

**OBJECTIVES**

1. The student will know that life is a gift from God.
2. The student will recognize that as Catholics we believe that human life begins at the moment of conception and should be respected and valued as a human life from conception until natural death.
3. The student will understand that Church teachings are based on ....and conveyed through.....
4. The student will be introduced to the concept that as Catholics we use Church teachings to help us understand and act with moral principles as we live in with those that may have a different viewpoint.
  - Morality (definition)
5. The student will be introduced to the concept that, just as Jesus taught us, and the Church guides us, we have responsibilities to show our faith.

## SCIENCE

### OBJECTIVES

1. The student will be introduced to what a stem cell is and how it is different from other cells.
2. The student will know that stem cells are described as embryonic stem cells or adult stem cells.
3. The student will know that scientists are beginning to research these cells to find out if they can cure diseases, regenerate tissue and replace organs. Examples incl:
  - curing various types of cancer
  - curing Parkinson's disease by replacing brain cells
  - curing Type I diabetes
  - making new skin for burn victims
  - helping stroke victims recover
  - creating organs that can be used for transplants
4. The student will be introduced to the term bioethics.

#### **Bioethics:**

### **Specific Objectives**

2. 6th Grade
  - Life Science
  - a. 6.5 Cells
    - review: The cell is the smallest unit of any living thing.
  - b. 6.5
    - Life Processes
    - How can you tell when a living thing is alive or dead?

### HEALTH:

Cells of the systems of the body  
Social interactions of peers, peer pressure and decision making

**GRADE 7**  
**LESSON PLANS**  
**STEM CELL RESEARCH**  
**RELIGION**

**OBJECTIVES**

1. The student will know that life is a gift from God.
2. The student will recognize that as Catholics we believe that human life begins at the moment of conception and should be respected and valued as a human life from conception until natural death.
  - Find one thing Jesus said that tells us we should respect life.
  - Know that each stage of life is equally valuable to God.
  - Be able to name 3 examples of how people can show respect for life.
3. The student will understand that Church teachings are based on ...and conveyed through.....
  - Jesus says we should “love others as we love ourselves”
  - Jesus teaches that we should take care of those weaker than we are.
    - Embryos and the unborn are weaker than we are
4. The student will be introduced to the concept that as Catholics we use Church teachings to help us understand and act with moral principles as we live in with those that may have a different viewpoint.
  - Morality (definition)
  - Ethics
  - Bioethics
  - What are some other faiths that respect life?
5. The student will be introduced to the concept that, just as Jesus taught us, and the Church guides us, we have responsibilities to show our faith.

- Learning about issues and knowing the church's teaching
  - Know where you can look to find out more about your catholic faith
    - Internet resources
    - Catechism of the Catholic Church
    - Who could I talk to?
  - What actions can you take?
    - At this age?
    - As an adult?

## SCIENCE

### OBJECTIVES

1. The student will be able to explain what a stem cell is, how it is different from other cells, and where they are found.
2. The student will be able to use and define the words:
  - pluripotent
  - regenerate
  - fertilization
  - conception
  - embryo
3. The student will know that stem cells are classified as embryonic stem cells or adult stem cells.
  - To harvest stem cells from an embryo, the embryo is destroyed
  - Adults are not harmed by the removal of stem cells from certain body cells
  - Discarded umbilical cords contain stem cells
4. The student will know that adult stem cells are already being used in some therapies, but the U.S. and scientists in other countries want to start researching embryonic stem cells to see what they will do.

5. The student will know that scientists are beginning to research these cells to find out if they can cure diseases, regenerate tissue and replace organs. Examples incl:
- curing various types of cancer
  - curing Parkinson's disease by replacing brain cells
  - curing Type I diabetes
  - making new skin for burn victims
  - helping stroke victims recover
  - creating organs that can be used for transplants
6. The student will be introduced to the term bioethics.
- Bioethics:**
- The use of embryos for research is cause for debate at individual to government levels
    - Some people argue for and some against using embryos
      - An introduction to ethical arguments
    - The Catholic Church is totally against using embryos for research
  - What are some other future science topics that involve bioethics?
    - Cloning
      - Cloning embryos for the purpose of research
    - Genetic Engineering
      - DNA 'patch'
      - Choosing genetic traits
      - Testing for diseases
        - For treatment and knowledge
        - For purpose of aborting if disease is present
    - Reproductive technology(only with okay from admin)

### Specific Objectives

#### 3. 7th Grade

- a. 7.26 Human Organs and Body systems
  - Issues In Science

- . Organ donation and the gift of life
  - Include Church's view on topic.
- b. 7.29 Human life span and Human Growth
  - Stem Cells
    - . Definition of a stem cell and where they are found in the human body and in an embryo.
- . Difference between adult and embryonic stem cells.
  - Issues in Science
    - . Adult and embryonic stem cell research.
    - . How are embryonic stem cells and stem cell lines created?

## GRADE 8

### STEM CELL RESEARCH

#### RELIGION

#### OBJECTIVES

1. The student will know that life is a gift from God.
2. The student will recognize that as Catholics we believe that human life begins at the moment of conception and should be respected and valued as a human life from conception until natural death.
  - Be able to name the encyclical, \_\_\_\_\_, by Pope John Paul II that describes our beliefs about life, respect, and dignity
    - Know that each stage of life is equally valuable to God.
      - Using embryos for research devalues this stage of life
    - People should not be used as a commodity, that does not show dignity for the human person
      - Using embryos for research is an example of this
      -
  - Be able to name 3 examples of how people can show respect for life.
3. The student will understand that Church teachings are based on ....and conveyed through.....
4. The student will be introduced to the concept that as Catholics we use Church teachings to help us understand and act with moral principles as we live in with those that may have a different viewpoint.
  - Morality (definition)
  - Ethics
  - Bioethics
  - What are some other faiths that respect life?

5. The student will be introduced to the concept that, just as Jesus taught us, and the Church guides us, we have responsibilities to show our faith.
  - Learning about issues and knowing the church's teaching
    - Know where you can look to find out more about your catholic faith
      - Internet resources
      - Catechism of the Catholic Church
      - Who could I talk to?
    - What actions can you take?
      - At this age?
      - As an adult?

## SCIENCE/HEALTH

### OBJECTIVES

1. The student will be able to explain what a stem cell is, how it is different from other cells, and where they are found.
2. The student will be able to use and define the words:
  - pluripotent
  - regenerate
  - fertilization
  - conception
  - embryo
6. The student will know that stem cells are classified as embryonic stem cells or adult stem cells.
  - To harvest stem cells from an embryo, the embryo is destroyed
  - Adults are not harmed by the removal of stem cells from certain body cells
  - Discarded umbilical cords contain stem cells

4. The student will know that adult stem cells are already being used in some therapies, but the U.S. and scientists in other countries want to start researching embryonic stem cells to see what they will do.
5. The student will know that scientists are beginning to research these cells to find out if they can cure diseases, regenerate tissue and replace organs. Examples incl:
  - curing various types of cancer
  - curing Parkinson's disease by replacing brain cells
  - curing Type I diabetes
  - making new skin for burn victims
  - helping stroke victims recover
  - creating organs that can be used for transplants
6. The student will be introduced to the term bioethics.

**Bioethics:**

- The use of embryos for research is cause for debate at individual to government levels
  - Some people argue for and some against using embryos
    - An introduction to ethical arguments
  - The Catholic Church is totally against using embryos for research
- What are some other future science topics that involve bioethics?
  - Cloning
    - Cloning embryos for the purpose of research
  - Genetic Engineering
    - DNA 'patch'
    - Choosing genetic traits
    - Testing for diseases
      - For treatment and knowledge
      - For purpose of aborting if disease is present
  - Reproductive technology(only with okay from admin)

**.Specific Objectives**

4. 8th Grade

a. 8.29 Ethics and Issues in Science

(incorporate with religion)

. Stem cell research

. Cloning

. Inventions/technology can be used for good or evil.

\*\* Ideal for incorporating with confirmation formation.

**Slides Ten and Eleven: Summary**

## Science Resources for 6<sup>th</sup> Grade Teachers

General:

[VA SOL Scope and Sequence](#) This includes recommended links.

[A Teacher's Guide to the VA Sixth Grade Science Standards of Learning](#)

[Project Learn -Cycles of the Earth and Atmosphere](#) This is great – background and activities for energy, atmosphere, and hydrosphere. This is from the National Center for Atmospheric Research

[EPA Education Resources](#)

[PUMAS \(Practical Uses of Math and Science\)](#)

[USGS Education Page](#)

[NASA Earth Observatory](#)

Water – Water Cycle, Wetlands, Conservation:

[Virginia's Natural Resource Education Guide](#)

[Project Wet \(Virginia\)](#) This project has a whole curriculum, but they will not sell it – You have to attend a workshop to get it.

[Project Wet Homepage \(includes a store for education products\)](#)

[USGS Water Science for Schools](#)

Energy Balance

[Investigating Climate Systems - Energy](#)

[Earth-Sun Connection Forum](#)

[Earth Observatory - Energy Systems](#)

Atmosphere and Weather:

[NASA Free Online Books - Meteorology](#) These are great! I ordered copies of all the *Investigating the Climate Systems* books through OfficeMax for our 6<sup>th</sup> grade teacher..

[Virginia's Natural Resource Education Guide](#)

[NASA SCOOL \(Student Cloud Observations Online\) Project](#)

[Teacher Resources from NASA S'COOL Project \(including lesson plans\)](#)

[Teachers tips for Weather lessons- University of Colorado](#)

[Jetstream - Online School for Weather](#)

Interesting Things:

[Earth Systems Science Course - \(Online Course for Teachers\)](#) An online course on teaching middle school Earth systems (energy, water, air)

[NASA Surplus Equipment - Donations to Schools](#)

[NASA Goddard Space Flight Center –In Service Education for Teachers](#)

[NASA CORE - Low Cost Resources for Educators](#)

[NASA Online Educational Materials](#) Free online curriculum guides with lesson plans. Good for all grades.

[NASA Earth Observing System Links](#)

[Teach the Earth](#)

[Federal Resources for Educational Excellence](#)