

Student Name: _____

Course Name: Earth Systems 3209

R – retain, D – delete, C – changed, A-added

Outcomes	R	D	C	A	Changed Outcomes
UNIT 1					
Introduction to Earth Science					
Earth Systems as a Science					
<ul style="list-style-type: none"> Describe at least two aspects of Earth science that make it different from other sciences. (114-6) <ul style="list-style-type: none"> define Earth Science (Geoscience) identify the major branches of Earth science Include: <ul style="list-style-type: none"> (i) astronomy (ii) geology (iii) oceanography (iv) meteorology relate Earth science to other scientific fields 					
Origins of Planet Earth					
<ul style="list-style-type: none"> Describe the formation of the universe using the big bang theory. (333-1) <ul style="list-style-type: none"> describe the four stages of the nebular hypothesis that led to the formation of our solar system 					
<ul style="list-style-type: none"> Explain the roles of evidence, theories and paradigms in the development of scientific knowledge. (114-2) 					
<ul style="list-style-type: none"> Analyze why and how a particular technology was developed and improved over time. (115-5) 					

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<ul style="list-style-type: none"> Describe and evaluate the design of technological solutions and the way they function, using scientific principles. (116-6) 					
<ul style="list-style-type: none"> Analyze why scientific and technological activities take place in a variety of individual and group settings. (117-6) 					
<ul style="list-style-type: none"> Analyze examples of Canadian contributions to science and technology. (117-11) 					
<ul style="list-style-type: none"> Describe the formation of the universe using the big bang theory. (333-1) <ul style="list-style-type: none"> describe the segregation/formation of Earth layers identify the various Earth layers Include: <ul style="list-style-type: none"> (i) inner core (ii) outer core (iii) mantle (asthenosphere) (iv) lithosphere (crust) 					
Earth as a Complex System					
<ul style="list-style-type: none"> Describe major interactions among the hydrosphere, lithosphere, and atmosphere. (332-3) <ul style="list-style-type: none"> identify that Earth is a dynamic planet recognize that Earth processes operate within spheres Include: <ul style="list-style-type: none"> (i) atmosphere (ii) geosphere (iii) hydrosphere (iv) biosphere 					

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UNIT 2					
Historical Geology					
Historical Developments and Geologic Time					
<ul style="list-style-type: none"> Recognize that uniformitarianism is a fundamental principle of geology and contrast this principle with catastrophism. (332-5) <ul style="list-style-type: none"> define uniformitarianism 					
<ul style="list-style-type: none"> Explain the appropriate applications of absolute and relative dating. (332-6) <ul style="list-style-type: none"> distinguish between absolute and relative time demonstrate an understanding of the principles and laws used to establish relative time Include: <ul style="list-style-type: none"> (i) superposition (ii) cross-cutting relations (iii) horizontality (iv) inclusions (v) fossil succession (index fossils) (vi) unconformities 					

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<ul style="list-style-type: none"> Explain the appropriate applications of absolute and relative dating. (332-6) <i>con'd</i> <ul style="list-style-type: none"> construct and interpret cross-sectional diagrams of Earth using geological concepts Include: <ul style="list-style-type: none"> (i) horizontality (ii) superposition (iii) correlation (iv) cross-cutting relationships (v) unconformities (vi) inclusions (vii) folding and faulting (viii) metamorphism 					
<ul style="list-style-type: none"> Explain how scientific knowledge evolves as new evidence comes to light and as laws and theories are tested and subsequently restricted, revised, or replaced. (115-7) 					
<ul style="list-style-type: none"> Analyze natural and technological systems to interpret and explain their structure and dynamics. (116-7) 					
<ul style="list-style-type: none"> Compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data. (213-5) 					
<ul style="list-style-type: none"> Communicate questions, ideas, and intentions, and receive, interpret, understand, support, and respond to the ideas of others. (215-1) 					
<ul style="list-style-type: none"> Select and use appropriate numeric, symbolic, graphical, and linguistic modes of representation to communicate ideas, plans, and results. (215-2) 					

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<ul style="list-style-type: none"> Work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise. (215-6) 					
<ul style="list-style-type: none"> Describe theories and evaluate the limits of our understanding of Earth's internal structure. (330-1) 					
<ul style="list-style-type: none"> Explain the appropriate applications of absolute and relative dating. (332-6) <ul style="list-style-type: none"> demonstrate an understanding of the processes and features used to establish absolute time Include: <ul style="list-style-type: none"> (i) varves (ii) growth rings (iii) radioactive dating 					
<ul style="list-style-type: none"> Explain how the half-lives of radioactive elements are used in estimating ages of materials. (332-4) <ul style="list-style-type: none"> define half-life define isotope identify parent and daughter elements determine the age of a sample using radiometric data 					
<ul style="list-style-type: none"> Evaluate the sources of error and limitations in estimating radiometric age. (214-10) 					
<ul style="list-style-type: none"> Explain the importance of communicating the results of a scientific or technological endeavour, using appropriate language and conventions. (114-9) 					

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<ul style="list-style-type: none"> Distinguish between scientific questions and technological problems. (115-1) 					
<ul style="list-style-type: none"> Analyze and describe examples where scientific understanding was enhanced or revised as a result of the invention of a technology (116-2) 					
<ul style="list-style-type: none"> Analyze and describe examples where technologies were developed based on scientific understanding. (116-4) 					
<ul style="list-style-type: none"> Analyze the knowledge and skills acquired in their study of science to identify areas of further study related to science and technology (117-9) 					
<ul style="list-style-type: none"> Identify limitations of a given classification system and identify alternative ways to classify to accommodate anomalies. (214-2) 					
Fossils and Geologic Time					
<ul style="list-style-type: none"> Describe how fossils are used to distinguish geologic time (332-7) <ul style="list-style-type: none"> - define fossil - describe three conditions necessary for fossilization - describe the formation of various types of fossils Include: <ul style="list-style-type: none"> (i) petrification by replacement (ii) carbonization (iii) mould and cast (iv) preserved intact (frozen, amber) 					

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<ul style="list-style-type: none"> - describe the formation of various types of fossils Include: <i>cont'd</i> <ul style="list-style-type: none"> (v) imprints (soft tissue) (vi) trace fossils (e.g., dinosaur eggs, coprolite) 					
<ul style="list-style-type: none"> • Explain how scientific knowledge evolves as new evidence comes to light and as laws and theories are tested and subsequently restricted, revised, or replaced (115-7) 					
<ul style="list-style-type: none"> • Identify and describe the work of paleontologists (117-7) 					
<ul style="list-style-type: none"> • Use instruments effectively and accurately for collecting data (213-3) 					
<ul style="list-style-type: none"> • Identify limitations of a given classification systems and identify alternative ways of classifying to accommodate anomalies (214-2) 					
<ul style="list-style-type: none"> • Identify and explain sources of error and uncertainty in measurement and express results in a form that acknowledges the degree of uncertainty (214-10) 					
<ul style="list-style-type: none"> • Describe geological evidence that suggests life forms, climate, continental positions, and Earth's crust have changed over time (332-7) 					

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The Geologic Time Scale					
<ul style="list-style-type: none"> • Illustrate the geologic time scale and compare to human time scales (332-4) <ul style="list-style-type: none"> - identify that the geologic time scale is divided into eons, eras, periods, and epochs - recognize that Precambrian time represents the greatest part of Earth history - recognize that the Phanerozoic eon represents the emergence of complex life forms - distinguish between Precambrian time and the Paleozoic, Mesozoic, and Cenozoic eras - list the dominant life forms present at each era. Include: <ul style="list-style-type: none"> (i) single-celled and other simple life forms (Precambrian) (ii) invertebrates (early Paleozoic) (iii) fishes (middle Paleozoic) (iv) first land plants (between early and middle Paleozoic) (v) amphibians (late Paleozoic) (vi) reptiles (Mesozoic) (vii) birds (Mesozoic) (viii) flowering plants (Mesozoic) (ix) mammals (Cenozoic) 					

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<ul style="list-style-type: none"> Illustrate the geologic time scale and compare to human time scales (332-4) <i>con'd</i> <ul style="list-style-type: none"> list the time frame that correlates with the dominant life form on Earth. Include: <ul style="list-style-type: none"> (i) Cenozoic – Age of Mammals (ii) Mesozoic – Age of Reptiles (iii) Paleozoic – Age of Amphibians (iv) Paleozoic (middle) – Age of Fishes (v) Paleozoic (early) – Age of Invertebrates 					
<ul style="list-style-type: none"> Recognize that life forms, climate, continental positions, and Earth's crust have changed over time (332-7) <ul style="list-style-type: none"> identify two mass extinction events in Earth's history. Include: <ul style="list-style-type: none"> (i) Permian-Triassic boundary (ii) Cretaceous-Tertiary boundary 					

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UNIT 3					
Earth Materials					
The Building Blocks – Mineral Chemistry					
<ul style="list-style-type: none"> Classify common minerals according to their physical and chemical characteristics (330-3) <ul style="list-style-type: none"> define mineral chemistry terms. Include: <ul style="list-style-type: none"> (i) atom (ii) ion (iii) element (iv) compound (v) molecule describe how atoms combine to form compounds. Include: <ul style="list-style-type: none"> (i) ionic compounds (ii) molecular compounds (iii) metallic compounds outline the abundance of the elements that comprise Earth's crust. Include: <ul style="list-style-type: none"> (i) oxygen (ii) silicon (iii) aluminum (iv) iron 					

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<ul style="list-style-type: none"> - outline the abundance of the elements that comprise Earth's crust. Include: <i>cont'd</i> <ul style="list-style-type: none"> (v) calcium (vi) sodium (vii) potassium (viii) magnesium - define a mineral - recognize the relationship between the abundance of the elements that comprise Earth's crust and the mineral groups. Include: <ul style="list-style-type: none"> (i) silicates (ii) carbonates (iii) halides (iv) sulfides (v) sulfates (vi) oxides (vii) native elements - name and differentiate between the major mineral groups. Include: <ul style="list-style-type: none"> (i) silicates (ii) carbonates (iii) halides (iv) sulfides (v) sulfates (vi) oxides (vii) native elements 					

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<ul style="list-style-type: none"> - identify mineral groups based on mineral formulas - describe the arrangement of silicon and oxygen within a tetrahedron 					
<ul style="list-style-type: none"> • Use instruments effectively and accurately for collecting data. (213-3) 					
<ul style="list-style-type: none"> • Identify and explain sources of error and uncertainty in measurement and express results in a form that acknowledges the degree of uncertainty. (214-10) 					
<ul style="list-style-type: none"> • Classify common Minerals according to their physical and chemical characteristics. (330-3) <ul style="list-style-type: none"> - describe the mineral properties that are used for identifying minerals. Include: <ul style="list-style-type: none"> (i) crystal shape (form) (ii) cleavage (iii) fracture (iv) hardness (v) specific gravity (vi) colour (vii) streak (viii) luster (ix) acid test (x) taste (xi) magnetism (xii) double refraction (xiii) fluorescence 					

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<ul style="list-style-type: none"> Classify common Minerals according to their physical and chemical characteristics. (330-3) <ul style="list-style-type: none"> explain why minerals exhibit different mineral properties. Include: <ul style="list-style-type: none"> (i) type of bonding involved (ii) elemental composition (iii) internal atomic structure identify minerals based on their mineral properties 					
<ul style="list-style-type: none"> Identify careers that relate to mineral chemistry. Include: (117-7) <ul style="list-style-type: none"> (i) mineralogist (ii) crystallographer (iii) geochemist (iv) gemologist 					
Introduction to Rocks and the Rock Cycle					
<ul style="list-style-type: none"> Classify rocks according to their structure, chemical composition, and method of formation. (330-2) <ul style="list-style-type: none"> define rock distinguish between rocks and minerals recognize that minerals are the building blocks of rocks 					
<ul style="list-style-type: none"> Analyze the rock cycle as a natural system and explain its structure and dynamics. (116-7) <ul style="list-style-type: none"> describe the pathways comprising the rock cycle 					

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Igneous Rocks					
<ul style="list-style-type: none"> Classify rocks according to their structure, chemical composition, and method of formation. (330-2) <ul style="list-style-type: none"> recognize that igneous rocks are classified according to their mineral composition and texture describe how mafic igneous rocks differ from felsic igneous rocks based on chemical composition identify igneous rocks that have similar chemical compositions. Include: <ul style="list-style-type: none"> (i) rhyolite and granite (ii) andesite and diorite (iii) basalt and gabbro identify igneous rocks based on texture. Include: <ul style="list-style-type: none"> (iv) rhyolite and granite (v) andesite and diorite (vi) basalt and gabbro describe igneous rock textures. Include: <ul style="list-style-type: none"> (i) coarse-grained (phaneritic) (ii) fine-grained (aphanitic) (iii) glassy (compact and frothy) (iv) vesicular (v) porphyritic describe how cooling rate and mineral composition determine rock types based on Bowen's reaction series 					

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Outcomes	R	D	C	A	Changed Outcomes
<ul style="list-style-type: none"> Classify rocks according to their structure, chemical composition, and method of formation. (330-2) <i>con'd</i> -identify igneous rocks based on mineral composition and texture 					
<ul style="list-style-type: none"> Identify limitations of a given classification system and indentify alternative ways of classifying to accommodate anomalies (214-2) 					
<ul style="list-style-type: none"> Identify and apply criteria, including the presence of bias, for evaluating evidence and sources of information. (214-9) 					
<ul style="list-style-type: none"> Communicate questions, ideas, and intentions, and receive, interpret, understand, support, and respond to the ideas of others (215-1) 					
<ul style="list-style-type: none"> Evaluate individual and group processes used in planning, problem solving and decision making, and completing a task (215-7) 					
<ul style="list-style-type: none"> Relate personal activities and various scientific and technological endeavours to specific science disciplines and interdisciplinary studies (114-60) 					
<ul style="list-style-type: none"> Analyze and describe examples where scientific understanding was enhanced or revised as a result of the invention of a technology (116-2) 					
<ul style="list-style-type: none"> Describe the functioning of domestic and industrial technologies, using scientific principles (116-5) 					
<ul style="list-style-type: none"> Analyze society's influence on scientific and technological endeavours (117-2) 					

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<ul style="list-style-type: none"> • Debate the merits of funding specific scientific or technological endeavours and not others (117-4) 					
<ul style="list-style-type: none"> • Classify rocks according to their structure, chemical composition and method of formation (330-2) <ul style="list-style-type: none"> - describe the formation of kimberlite and its relationship with diamond deposits 					
Sedimentary Rocks					
<ul style="list-style-type: none"> • Classify rocks according to their structure, chemical composition and method of formation (330-2) <ul style="list-style-type: none"> - describe the origin and process of formation of sedimentary rocks - describe the classes of sedimentary rocks. Include: <ul style="list-style-type: none"> (i) clastic (derital) (ii) chemical (iii) biochemical - identify clastic sedimentary rocks. Include: <ul style="list-style-type: none"> (i) shale (ii) siltstone (iii) sandstone (iv) conglomerate (v) breccia - relate sediment sorting to clastic sedimentary rocks - relate particle size to current velocity 					

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<ul style="list-style-type: none"> Classify rocks according to their structure, chemical composition and method of formation (330-2) <i>con'd</i> <ul style="list-style-type: none"> describe the environments and rock types that relate to clastic sedimentary rocks. <ul style="list-style-type: none"> (i) fluvial (rivers, streams) (ii) lagoonal (iii) beaches (iv) deep marine/ocean (v) shallow marine identify chemical sedimentary rocks. Include: <ul style="list-style-type: none"> evaporites <ul style="list-style-type: none"> (i) halite (ii) gypsum (iii) sylvite precipitates <ul style="list-style-type: none"> (i) limestone (ii) dolomite (iii) travertine describe the environments and rock types that relate to chemical sedimentary rocks. Include: <ul style="list-style-type: none"> (i) shallow marine (ii) deep marine/ocean (iii) cave identify biochemical sedimentary rocks. Include: <ul style="list-style-type: none"> (i) coquina (iv) limestone (coral) (ii) chert (v) coal (iii) chert 					
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<ul style="list-style-type: none"> Classify rocks according to their structure, chemical composition, and method of formation (330-2) <i>cont'd</i> <ul style="list-style-type: none"> describe the sequence of formation of coal. Include: <ul style="list-style-type: none"> (i) peat (ii) lignite (iii) bituminous (iv) anthracite describe the environments and rock types that relate to biochemical sedimentary rocks. Include: <ul style="list-style-type: none"> (i) swamp (ii) shallow marine (iii) beach (iv) deep marine identify sedimentary rocks 					
<ul style="list-style-type: none"> Identify limitations of a given classification system and identify alternative ways of classifying to accommodate anomalies (214-2) 					
<ul style="list-style-type: none"> Identify and apply criteria, including the presence of bias, for evaluating evidence and sources of information (214-9) 					
<ul style="list-style-type: none"> Communicate questions, ideas, and intentions, and receive, interpret, understand, support, and respond to the ideas of others (215-1) 					

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<ul style="list-style-type: none"> Evaluate individual and group processes used in planning, problem solving and decision making, and completing a task (215-7) 					
Metamorphic Rocks					
<ul style="list-style-type: none"> Classify rocks according to their structure, chemical composition, and method of formation (330-2) <ul style="list-style-type: none"> describe the process of metamorphism describe possible changes that result from metamorphism. Include: <ul style="list-style-type: none"> (i) texture (ii) volume change (iii) chemical change describe the result of selected rocks being metamorphosed. Include: <ul style="list-style-type: none"> (i) limestone to marble (ii) sandstone to quartzite (iii) shale to slate (to phyllite to schist to gneiss) (iv) granite to gneiss contrast the two types of metamorphism. Include: <ul style="list-style-type: none"> (i) contact (ii) regional 					

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Outcomes	R	D	C	A	Changed Outcomes
<ul style="list-style-type: none"> Classify rocks according to their structure, chemical composition, and method of formation (330-2) <i>cont'd</i> <ul style="list-style-type: none"> describe the locations where contact metamorphism occurs. Include: <ul style="list-style-type: none"> (i) beneath lava flows (ii) adjacent to magma intrusions (iii) dykes and silts describe how contact metamorphism can be used to distinguish between a buried lava flow and an intrusion of magma describe the locations where regional metamorphism occurs. Include: <ul style="list-style-type: none"> (i) areas of mountain building (ii) subduction zones identify metamorphic rocks 					
<ul style="list-style-type: none"> Identify limitations of a given classification system and identify alternative ways of classifying to accommodate anomalies (214-2) 					
<ul style="list-style-type: none"> Identify and apply criteria, including the presence of bias, for evaluating evidence and sources of information. (214-9) 					
<ul style="list-style-type: none"> communicate questions, ideas, and intentions, and receive, interpret, understand, support, and respond to the ideas of others. (215-1) 					
<ul style="list-style-type: none"> evaluate individual and group processes used in planning, problem solving and decision making, and completing a task. (215-7) 					

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<ul style="list-style-type: none"> Identify careers that relate to the study of rocks. (117-7) Include: <ul style="list-style-type: none"> (i) petrology (ii) volcanology (iii) geochemistry (iv) sedimentologist (v) hydrology 					
UNIT 4 The Forces within Earth					
Continental Drift: Birth of an Idea					
<ul style="list-style-type: none"> Explain the roles of evidence, theories, and paradigms in the development of scientific knowledge. (114-2) <ul style="list-style-type: none"> - describe the theory of continental drift - describe the evidence to support the theory of continental drift. Include: <ul style="list-style-type: none"> (i) fit of continents (ii) fossil evidence (fossil correlation) (iii) rock types (shields) (iv) structural similarities (e.g., folded mountains) (v) paleoclimatic (e.g., striations, coal deposits, glacial deposits) 					
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Plate tectonics: A Scientific Revolution					

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<ul style="list-style-type: none"> • Explain how a major scientific milestone revolutionized thinking in the scientific communities. (115-3) <ul style="list-style-type: none"> - describe the evolution of plate tectonic theory through the contributions of various scientists. Include: <ul style="list-style-type: none"> (i) Frank Taylor (ii) Alfred Wegener (iii) Alexander Du Toit (iv) Arthur Holmes (v) Harry Hess and Robert Deitz (vi) Fredrick Vine and Drummond Matthews (vii) J. Tuzo Wilson (viii) Xavier Le Pichon and Dan McKenzie 					
<ul style="list-style-type: none"> • Explain how scientific knowledge evolves as new evidence comes to light and as laws and theories are tested and subsequently restricted, revised, or replaced. (115-7) <ul style="list-style-type: none"> - contrast the explanations provided by Wegener and Holmes for the mechanism of continental movement - describe the theory of plate tectonics 					

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Outcomes	R	D	C	A	Changed Outcomes
<ul style="list-style-type: none"> Explain how scientific knowledge evolves as new evidence comes to light and as laws and theories are tested and subsequently restricted, revised, or replaced. (115-7) <i>cont'd</i> <ul style="list-style-type: none"> describe and give examples of convergent, divergent and transform plate boundaries. describe and give examples of the different types of convergent plate boundaries. Include: <ul style="list-style-type: none"> (i) oceanic-oceanic collisions (ii) oceanic-continental collisions (iii) continental-continental collisions describe a rift valley and how it evolves into a divergent plate boundary 					
<ul style="list-style-type: none"> Analyze evidence for plate tectonics theory. (332-8) <ul style="list-style-type: none"> describe the evidence which supports plate tectonic theory. Include: <ul style="list-style-type: none"> (i) paleomagnetism (ii) polar wandering (iii) magnetic reversals (iv) earthquakes (Wadati-Benioff zone) (v) deep-ocean drilling (vi) hot spots 					
<ul style="list-style-type: none"> Describe examples of Canadian contributions to science and technology. (117-10) 					
<ul style="list-style-type: none"> Analyze examples of Canadian contributions to science. (117-11) 					

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<ul style="list-style-type: none"> Use appropriate evidence to describe the geologic history of an area. (330-12) <ul style="list-style-type: none"> describe the geology of the island of Newfoundland 					
<ul style="list-style-type: none"> Provide examples of how science and technology are an integral part of their lives and their community. (117-5) 					
<ul style="list-style-type: none"> Identify new questions or problems that arise from what was learned. (214-17) 					
Crustal Deformation: Folding and Faulting					
<ul style="list-style-type: none"> Describe the geological evidence that suggests life forms, climate, continental positions, and Earth's crust have changed over time. (332-7) <ul style="list-style-type: none"> define crustal deformation define force define stress describe the types of forces/stresses that produce crustal deformation. Include: <ul style="list-style-type: none"> (i) compressional (ii) tensional (iii) shear describe the types of deformation. Include: <ul style="list-style-type: none"> (i) elastic (ii) brittle (iii) ductile 					

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Outcomes	R	D	C	A	Changed Outcomes
<ul style="list-style-type: none"> • Describe the geological evidence that suggests life forms, climate, continental positions, and Earth's crust have changed over time. (332-7) <i>cont'd</i> <ul style="list-style-type: none"> - describe the factors that affect deformation. Include: <ul style="list-style-type: none"> (i) temperature (ii) confining pressure (iii) rock type (iv) time - define faulting as the breaking of rock layers and their subsequent motion - relate faulting to the factors that affect deformation - describe the two major types of faults and associated forces/stresses. Include: <ul style="list-style-type: none"> (i) dip-slip <ul style="list-style-type: none"> ▪ normal (tensional) ▪ horst and graven (tensional) ▪ reverse (compressional) ▪ thrust (compressional) (ii) strike-slip (transform) <ul style="list-style-type: none"> ▪ left-lateral (shear) ▪ right-lateral (shear) - define folding - relate folding to the factors that affect deformation - describe the two common types of folds. Include: <ul style="list-style-type: none"> (i) anticline (ii) syncline 					

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Outcomes	R	D	C	A	Changed Outcomes
Earthquakes and Seismic Waves					
<ul style="list-style-type: none"> Describe methods of analyzing, monitoring and predicting earthquakes, volcanic eruptions, and plate interactions. (331-9) <ul style="list-style-type: none"> define earthquake describe the causes of an earthquake. Include: <ul style="list-style-type: none"> (i) moving magma (ii) elastic rebound (iii) faulting define earthquake terminology. Include: <ul style="list-style-type: none"> (i) seismic wave (ii) focus (iii) epicenter (iv) foreshock (v) aftershock identify the location of earthquakes and relate them to their plate boundary. Include: <ul style="list-style-type: none"> (i) divergent (shallow) (ii) transform (shallow) (iii) convergent (shallow, intermediate, and deep) 					

R – retain, D – delete, C – changed, A-added

Outcomes	R	D	C	A	Changed Outcomes
<ul style="list-style-type: none"> Describe methods of analyzing, monitoring and predicting earthquakes, volcanic eruptions, and plate interactions. (331-9) <i>cont'd</i> <ul style="list-style-type: none"> describe properties of the different seismic waves. Include: <ul style="list-style-type: none"> (i) surface waves (L waves) (ii) primary waves (P waves) (iii) secondary waves (S waves) distinguish between earthquake scales. Include: <ul style="list-style-type: none"> (i) Richter (ii) Modified Mercalli identify that the Richter scale increases in amplitude by a factor of ten for every increment of one identify in relation to the Richter scale, energy released increases by a factor of 30 (rounded down) for every increment of one describe how seismographs and resulting seismograms are used to measure seismic waves. 					
<ul style="list-style-type: none"> Compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots (214-3) 					
<ul style="list-style-type: none"> Identify and explain sources of error and uncertainty in measurement and express results in a form that acknowledges the degree of uncertainty (214-10) 					
<ul style="list-style-type: none"> Identify multiple perspectives that influence a science-related decision or issue. (215-4) 					

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Course Name: Earth Systems 3209

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Outcomes	R	D	C	A	Changed Outcomes
<ul style="list-style-type: none"> • Work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise. (215-6) 					
The Nature and Products of Volcanic Eruptions					
<ul style="list-style-type: none"> • Describe methods of analyzing, monitoring and predicting earthquakes, volcanic eruptions, and plate interactions. (331-9) <ul style="list-style-type: none"> - describe factors affecting the nature of volcanic eruptions. Include: <ul style="list-style-type: none"> (i) magma temperature (ii) magma viscosity (iii) magma composition - define volcano - describe the three types of volcanoes: <ul style="list-style-type: none"> (i) shield (ii) ash and cinder (iii) composite cone 					

R – retain, D – delete, C – changed, A-added

Outcomes	R	D	C	A	Changed Outcomes
<ul style="list-style-type: none"> Describe methods of analyzing, monitoring and predicting earthquakes, volcanic eruptions, and plate interactions. (331-9) <i>cont'd</i> <ul style="list-style-type: none"> describe the type of eruption for each volcano type in relation to the different plate boundaries identify the rocks that form in relation to each type of volcano. Include: <ul style="list-style-type: none"> (i) shield – basalt (ii) ash and cinder – basalt and scoria (iii) composite – andesite, basalt, rhyolite distinguish between the types of lava. Include: <ul style="list-style-type: none"> (i) pahoehoe (ropy) (ii) aa (jagged, angular) describe intraplate volcanism as it relates to hotspots describe the formation of a lava plateau 					
<ul style="list-style-type: none"> Describe major interactions among the hydrosphere, lithosphere, and atmosphere. (332-3) <ul style="list-style-type: none"> explain the global effects of volcanic activity 					
Careers in Earth Science					
<ul style="list-style-type: none"> Identify and describe science and technology-based careers related to the science they are studying. (117-7) <ul style="list-style-type: none"> identify careers related to plate tectonics, earthquakes, and volcanoes. Include: <ul style="list-style-type: none"> (i) structural geologist (ii) volcanologist 					

Student Name: _____

Course Name: Earth Systems 3209

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Outcomes	R	D	C	A	Changed Outcomes
<ul style="list-style-type: none"> - identify careers related to plate tectonics, earthquakes, and volcanoes. Include: <i>cont'd</i> <ul style="list-style-type: none"> (iii) seismologist (iv) geomorphologist (v) geochemist (vi) geophysicist (vii) petrologist (viii) sedimentologist 					
UNIT 5 Earth Resources: Real-Life Applications					
Economic Minerals					
<ul style="list-style-type: none"> • Describe the importance of minerals and mineral exploration at the local, provincial, national and global levels. (330-8) <ul style="list-style-type: none"> - define economic minerals - define ore - describe the different types of economic mineral deposits. Include: <ul style="list-style-type: none"> (i) magmatic (layered and disseminated) (ii) hydrothermal (vein deposits) (iii) placer (iv) secondary enrichment (sedimentation) (v) metamorphism 					

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Outcomes	R	D	C	A	Changed Outcomes
<ul style="list-style-type: none"> Describe the evolution of extraction and the use of several resources obtained from the lithosphere. (330-9) <ul style="list-style-type: none"> identify the types of mines. Include: <ul style="list-style-type: none"> (i) open pit (ii) underground identify exploration techniques. Include: <ul style="list-style-type: none"> (i) seismic records (ii) remote sensing (iii) prospecting (iv) observing drill cores (v) cross-sections (vi) geological mapping (vii) magnetic survey (viii) gravity survey (ix) geochemistry 					
<ul style="list-style-type: none"> Analyze and describe examples where technologies were developed based on scientific understanding. (116-3) 					
<ul style="list-style-type: none"> Compile and organize data using appropriate formats and data treatments to facilitate interpretation of the data. (213-5) 					
<ul style="list-style-type: none"> Compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, graphs and scatter plots. (214-3) 					
<ul style="list-style-type: none"> Interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables. (214-5) 					

Student Name: _____

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Outcomes	R	D	C	A	Changed Outcomes
<ul style="list-style-type: none"> Identify and explain sources of error and uncertainty in measurement and express results in a form that acknowledges the degree of uncertainty. (214-10) 					
<ul style="list-style-type: none"> Provide a statement that addresses the problem or answers the question investigated in light of the link between data and the conclusion. (214-11) 					
<ul style="list-style-type: none"> Explain how data support or refute the hypotheses or prediction.(214-12) 					
<ul style="list-style-type: none"> Identify and evaluate potential applications of findings. (214-18) 					
<ul style="list-style-type: none"> Describe the processes and techniques involved in processing ore materials. (330-10) <ul style="list-style-type: none"> - describe techniques for processing ore deposits. Include: <ul style="list-style-type: none"> (i) flotation (ii) gravity separation (iii) heap leaching (iv) pyromet (v) hydromet 					

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Outcomes	R	D	C	A	Changed Outcomes
Energy Resources – Petroleum Formation					
<ul style="list-style-type: none"> Describe the processes and techniques involved in extracting and refining hydrocarbons (330-10) <ul style="list-style-type: none"> define petroleum define crude oil define hydrocarbons describe the origin and the process of formation of petroleum. Include: <ul style="list-style-type: none"> (i) organic matter (ii) preservation potential 					
<ul style="list-style-type: none"> Describe interactions among Earth's spheres. (332-3) 					
<ul style="list-style-type: none"> Describe the processes and techniques involved in extracting and refining hydrocarbons. (330-10) <ul style="list-style-type: none"> define kerogen identify the three phases in the evolution of organic matter to petroleum. Include: <ul style="list-style-type: none"> (i) diagenesis (ii) catagenesis (iii) metagenesis describe the components involved in the formation of petroleum traps. Include: <ul style="list-style-type: none"> (i) source rock (ii) reservoir rock (iii) cap rock 					

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Outcomes	R	D	C	A	Changed Outcomes
<ul style="list-style-type: none"> Analyze and describe examples where scientific understanding was enhanced or revised as a result of the invention of technology. (116-2) 					
<ul style="list-style-type: none"> Interpret patterns and trends in data, and infer or calculate linear and non-linear relationships among variables. (214-5) 					
<ul style="list-style-type: none"> Explain how data support or refute the hypothesis or prediction. (214-12) 					
<ul style="list-style-type: none"> Synthesize information from multiple sources or from complex and lengthy texts and make inferences based on this information. (215-3) 					
<ul style="list-style-type: none"> Describe the processes and techniques involved in extracting and refining hydrocarbons. (330-10) <ul style="list-style-type: none"> describe the types of petroleum traps. Include: <ul style="list-style-type: none"> (i) anticline trap (ii) fault trap (iii) salt dome trap (iv) stratigraphic trap describe the distribution of petroleum in a reservoir describe the two main means of extracting petroleum from Earth. Include: <ul style="list-style-type: none"> (i) drilling (ii) surface extraction (open pit mining) describe the methods of refining petroleum. Include: <ul style="list-style-type: none"> (i) distillation (ii) cracking (iii) reforming 					

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Outcomes	R	D	C	A	Changed Outcomes
Energy Resources – Moving Towards a Sustainable Future					
<ul style="list-style-type: none"> Analyze from a variety of perspectives, the risks and benefits to society and the environment of applying scientific knowledge, or introducing a particular technology (118-2) 					
<ul style="list-style-type: none"> Identify factors involved in developing Earth's resources in a sustainable manner (330-11) 					
<ul style="list-style-type: none"> Propose courses of action on social issues related to science and technology, taking into account an array of perspectives, including that of sustainability. (118-10) <ul style="list-style-type: none"> - describe sustainable development in relation to the use of Earth resources - identify and describe core components involved in the sustainable development of Earth resources 					