LOCALLY DEVELOPED COURSE

ESL INTRODUCTION TO SCIENCE 15 (LEVEL 1 AND 2) GRADE 10

Calgary Board of Education

2008

ACKNOWLEDGEMENTS:

Produced for the Calgary Board of Education by:

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Board Motion

The Board of Trustees approved this course for use in Calgary Board of Education by Board Motion on May 20, 2008. (Attachment)

Implementation Date

September 1, 2008 to August 31, 2011

Philosophy and Rationale

A significant number of ESL students enter high school with such limited language proficiency and/or limited understanding of scientific concepts that they are unable to participate in high school Science courses. ESL students face language-related difficulties in science due to the use of extensive subject-specific vocabulary and the complexity of the discourse, grammatical structures, language functions and study skills required. Another difficulty that ESL students from other educational backgrounds face is that they may lack prior cultural or real-world experience upon which understandings of scientific concepts are built. They may have been had instruction in science that was based on factual content rather than investigation.

This course is designed to address the conceptual and linguistic gaps that newcomer ESL students have when they enter high school and provide the necessary pre-requisite skills to assist the eventual integration into grade-level science classes, Science 16, 14 or 10. Learning Outcomes focus on high-priority knowledge, skills, and attitudes associated with the science program of studies of earlier grades. Learning Outcomes also specify receptive and expressive language skills required to communicate scientific understanding.

ESL Introduction to Science is based on the following approach:

- Participation in authentic “hands-on” scientific inquiry, experimentation and observation;
- Using themes to help students understand relationships among scientific principles and processes;
- Selecting content relevant to essential understandings of the science program of studies;
- Making scientific information accessible to language learners by modifying and adapting materials;
- Explicit instruction in vocabulary, grammar, and discourse needed to understand and create scientific text; and
- Deliberate attention to learning strategies.

Credit Allocation/ Instructional Hours

5 Credits / 125 Hours

Learner Outcomes

General Learner Outcomes

Students will:

General Outcome 1	Engage in scientific inquiry which demonstrates purposeful procedures for observation, investigation, and reporting.
General Outcome 2	Communicate basic knowledge and concepts of life science, physical science, and earth and space science.
General Outcome 3	Demonstrate skill in the use of instruments, tools and technology to conduct scientific investigations.
General Outcome 4	Demonstrate expressive and receptive language skills appropriate for Science text and media.

Specific Learner Outcomes

General Outcome 1
Students will engage in scientific inquiry which demonstrates purposeful procedures for observation, investigation and reporting.

Students will:

- Engage in observation and investigation using scientific inquiry skills (state a problem; propose a hypothesis; follow procedures; make and record observations; interpret data; draw conclusions)
- Engage in observation and investigation using a problem solving model (identify a need; propose ways of solving the problem; try out new ideas; evaluate how things work)
- Manipulate and examine data and evidence creatively and critically (e.g. manipulate variables, hypothesize, infer)
- Participate in cooperative investigative activities requiring joint effort and a sharing of different points of view

- Collect and report observations and findings in a variety of ways:
    - take notes in abbreviated verbal, graphic or numerical form
    - create analogies or mental models to connect experiences, information and ideas
    - summarize and paraphrase textual materials
- Identify causes and effects of common natural phenomenon
- Describe and classify objects based on observable characteristics
- Explain procedures and processes
- Identify human actions that have an impact on the environment and health

General Outcome 2
Students will communicate basic knowledge and concepts of life science, physical science and earth and space science.

Students will:

- Describe the characteristics of living things
- Describe the basic structure and function of systems in animal and human bodies (e.g., sensory, circulatory, respiratory, digestive)
- Describe some lifestyle factors that contribute to good health
- Classify some common plants and animals
- Identify and describe the interactions of organisms in a particular ecosystem (e.g., food web, habitat characteristics, needs and adaptations)
- Explain physical and chemical properties in everyday materials
- Explain the particle model of matter
- Explain concepts related to heat and heat transfer (e.g., conduction, radiation)
- Describe the use, production, and impact of common sources of energy (renewable and non-renewable)
- Explain common movements and forces (e.g., friction, magnetism, structural stresses)
- Recognize and describe characteristics of water (e.g., states, solutions, buoyancy)
- Identify factors related to water supply, cleanliness and consumption
- Describe common weather phenomena
- Explain seasonal change, and animal and human adaptations
- Describe the characteristics of the earth, atmosphere and solar system
- Identify the technologies and procedures which are used to gather information about the earth and solar system
- Describe the properties and uses of different rocks and minerals
- Explain phenomena which change the earth (e.g., erosion, volcanoes, earthquakes, human impacts)

General Outcome 3
Students will demonstrate skill in the use of instruments, tools and technology to conduct scientific investigations.

Students will:

- Select and use appropriate materials for construction and modeling tasks
- Know the safety rules for school laboratories
- Use and maintain tools and apparatus safely
- Select and integrate information from various print and electronic sources
- Use and/or construct graphic organizers for the compilation, organization and display of data, e.g. line drawings, diagrams, retrieval charts, flow charts, tables, bar graphs, line graphs, classification key
- Use a database or spreadsheet for recording data
- Use and read measurement devices accurately (e.g., thermometer, graduated cylinder, balance, protractor, pH indicators,
- Estimate measurements
- Conduct simple procedures for investigating materials (e.g., separating, dissolving, testing components in foods, measuring forces, etc.)
- Operate optical devices (e.g., microscope, camera, hand lens
- Report on common methods and technologies used by scientists to observe natural phenomena

General Outcome 4
Students will demonstrate expressive and receptive language skills appropriate for Science text and media.

Students will:

- Demonstrate comprehension of the vocabulary and phrases common to science text
- Demonstrate comprehension of main ideas from short presentations on science concepts with contextual and visual support
- Engage in structured spoken interactions on science topics
- Elicit, clarify and respond appropriately to questions and ideas presented orally
- Use correctly the grammatical structures appropriate for this level (see Appendix D)
- Read, understand and identify the features of a number of different types of simple written text on science topics
- Use a number of reading comprehension strategies
- Write short texts to convey information about science topics
- Organize information in sequential, spatial or causal patterns
- Use communication technologies to gather or present information

Facilities or Equipment Necessary

- access to a science lab and basic scientific apparatus
- classroom kits with appropriate materials for simple experiments
- access to a computer lab with internet connection
- reading books on the chosen themes at Level 1 and 2 Reading Levels
- video/DVD player

It is recommended that field trips to appropriate sites be incorporated. These might include the Calgary Zoo, the Science Center, the Planetarium, The Bird Sanctuary, The Fish Hatchery, the Police Museum, the water treatment plant, public health clinics or food processing facilities.

All Off-site activities are organized according to Calgary Board of Education Administrative Regulation 3027 – *Off-Site Activities*.

External resources such as guest speakers must be approved by school administration and may be subject to independent contract agreement as per Calgary Board of Education guidelines and Administrative Regulation 1014 – *School Participation in Programs – Outside Services*

Teacher Qualifications

This course should be taught by a certified ESL teacher who can modify curriculum to integrate content and language learning outcomes.

Identification of Controversial or Sensitive Course Components

The investigative approach to science may be unfamiliar to students from other cultures and should be introduced with sensitivity.

Learning Resources

Bassano, Sharron and Christison, Mary Ann, Life Science: Content and Learning Strategies, Addison Wesley, 1992

Bassano, Sharron and Christison, Mary Ann, Earth and Physical Science: Content and Learning Strategies, Addison Wesley, 1992

Gomez, Stephen, McKay Heather, Tom, Abigail and White, Kathleen, Eureka ! Science Demonstrations for ESL Classes, Addison Wesley, 1995

Henderson, Corinne, Smith, Alastair, Rogers, Kirsteen, et.al, The Usborne Internet Linked Library of Science Series, 2001

- Human Body
- Mixtures and Compounds
- Energy, Forces and Motion
- World of Plants

Mr. Science: Basic Science Concepts
http://library.thinkquest.org/05aug/00014/

The Why Files: Educators' Index of Curriculum Topics
http://whyfiles.org/teach/

Rader's Biology4Kids
http://www.biology4kids.com/

Rader's Chem4Kids
http://www.chem4kids.com

Rader's Physics4Kids
http://www.physics4kits.com

Rader's Cosmos 4Kids
http://www.cosmos4kids.com

Projected Enrolment

400 students

Significant Overlap with Provincial Curriculum

There is no significant overlap.

Assessment Standards

Learning Log.....20%
Assignments.....25%
Activities/Labs.....20%
Tests and Quizzes.....20%
Final Exam.....15%

Tasks and exams would be commensurate with Language Proficiency Level 2 as identified in the High School ESL Program of Studies and the ESL High School Guide to Implementation.

Course Evaluation and Monitoring

The school's principal will ensure the outcomes of the course are being met. The teachers ensure that they are meeting the guidelines under which the course was intended. Curriculum Support will regularly review the course.

Appendices

Appendix A - Cognitive Academic Language Proficiency
Appendix B - Learning Strategies for Science
Appendix C - Additional Resources
Appendix D - Language Reference Chart
Appendix E - Key Concepts of the K-9 Program of Studies

Appendix A

Cognitive Academic Language Proficiency

Vocabulary	Linguistic Functions
• subject specific • word families • context defined vocabulary • suffixes and prefixes • synonyms and antonyms • adjectives and adverbs	• predict (modals) • enquire(questions) • explain • recount • persuade • discuss • report • describe • classify
Discourse	**Linguistic Structures**
• sequence • comparison/contrast • cause and effect • enumeration (listing) • description/definition	• word order • present and past tenses • interrogative • prepositions • phonics • subject verb agreement • connectors • relative pronouns

Following are examples of activities that develop academic language for Science:

Listening: listening and taking notes (either graphic or verbal) while observing a science demonstration; listening and taking notes from video or multimedia sources; listening to and following directions for carrying out an experiment; listening for specific information

Speaking: using key vocabulary to answer how/what/why questions; observing and describing observations orally; posing questions and formulating answers; discussing the steps while conducting an experiment; working cooperatively to build a model; presenting a report

Reading: classifying words into special categories; reading graphs and charts; finding information in textual material; reading and following directions; sharing lab reports and other class writing about science topics; finding information in reference material

Writing: drawing and labeling diagrams; writing answers to questions posed by the teacher or classmates; completing summaries; keeping a learning log; writing lab reports; writing a report about a science topic; writing about personal or imaginative experiences related to science

Technology: locating information from online resources; working collaboratively on multimedia presentations; using common word processing and presentation software; engaging in "virtual" interactive online experiences

Appendix B

Learning Strategies for Science

The students will use Meta-cognitive Strategies for planning, monitoring and evaluating their learning of concepts and skills.

- Preview
- Skim and scan
- Plan how to accomplish a task
- Plan the parts and sequence of ideas
- Listen or read for specific information
- Attend to text features
- Manage time and environment for learning
- Monitor one' s own comprehension and production
- Reflect on what has been learned

The students will use Cognitive Strategies for interacting with the information to be learned, changing or organizing it either mentally or physically.

- Use reference materials
- Classify information
- Use graphic organizers and visuals to organize information
- Take notes in abbreviated verbal, graphic or numerical form
- Relate new information to previous knowledge and experience
- Make analogies
- Summarize
- Use manipulatives to visualize ideas
- Use mental or real pictures to learn new information or solve problems
- Review and rehearse new vocabulary
- Use context clues

Students will use Social/Affective Strategies for interacting with others to assist learning.

- Use personal attitudes and feelings to help learning
- Ask questions for clarification
- Work cooperatively with others to complete a task or solve a problem
- Reduce anxiety through self-talk

Appendix C

Additional Resources

Professional Readings

Rosebery, Ann and Warren, Beth, 2007. Teaching Science to English Language Learners: Building on Students' Strengths, NSTA Press Book

Northwest Regional Educational Laboratory, 1999. "Teaching Mathematics and Science to English Language Learners."
http://www.nwrel.org/msec/images/resources/justgood/11.99.pdf

Spanos, George, 2001. "ESL Math and Science for High School Students: Two Case Studies."
http://www.ncela.gwu.edu/pubs/symposia/third/spanos.htm

Additional Print Resources

Berger, Melvin, Scholastic Science Dictionary, Scholastic Reference, 2003

Kalman, Bobbie, The Life Cycle Series, Crabtree Publishing, 2003

Kalman, Bobbie, The Science of Living Things, Crabtree Publishing, 2002

Miles, Lisa and Smith, Alastair, The Usborne Internet Linked Book of Astronomy and Space, Usborne Publishing, 2001

National Geographic Literacy Titles

- Insects
- Exploring Space
- A Tree for All Seasons

National Geographic Life Science Series

- Amazing Animals
- Looking at Cells
- Plant Power
- Protecting the Planet
- You and your Genes
- Animal Adaptations
- Classification Clues
- Ecosystems
- Life Cycles

National Geographic Human Body Series

- Fighting Disease
- The Human Machine
- Keeping Fit
- Making Healthy Choices
- Understanding the Brain
- Bones and Muscles
- Respiration and Circulation

National Geographic Earth Science Series

- Exploring Space
- The Oceans around Us
- Uncovering Earth's History
- Volcanoes and Earthquakes
- Weather and Climate
- Earth, Sun, Moon
- Extreme Weather
- Rocks an Minerals
- Stars and Galaxies
- Wonders of Water

National Geographic Physical Science Series

- Machines Make It Move
- The Magic of Light and Sound
- Matter, Matter Everywhere
- Understanding Electricity
- Using Force and Motion
- Acids and Bases
- Chemical Changes
- Introduction to Energy
- The Mystery of Magnets
- Newton's Laws

Vogt, Gregory, The Galaxy Series, Bridgestone Books, 2000

- Earth
- Jupiter
- Mars
- Mercury
- Venus
- Uranus
- Sun
- Saturn
- Neptune

Additional Online Resources

Kids Place: Science Library Adventures
http://www.eduplace.com/kids/sla/index.html

Exploratorium: Hands-on Activities
http://www.exploratorium.edu/explore/handson.html

Exploratorium: Science Snacks
http://www.exploratorium.edu/snacks/index.html

The Why Files, Science Behind the News
http://whyfiles.org/

BBC Bitesize Science
http://www.bbc.co.uk/schools/ks2bitesize/science/

The Why Files: Interactive Simulations
http://whyfiles.org/interactives/

The Why Files: Educators' Index of Curriculum Topics
http://whyfiles.org/teach/

Exploring Earth: Visualizations
http://www.classzone.com/books/earth_science/terc/navigation/visualization.cfm

Polar Science Station
http://literacynet.org/polar/

Water Science for Schools
http://ga.water.usgs.gov/edu/

Natural Disasters
http://library.thinkquest.org/CR0212082/

Appendix D

Language Reference Chart

This chart outlines some of the grammatical structures that are likely to be suitable for students at this level. Instruction of grammatical structures should be reinforced with opportunities for students to apply their growing understanding of the English language through participation in Science activities.

I. Grammatical Structures

Nouns	• Count: singular and plural of regular and irregular forms • Non-count (e.g., *knowledge, progress, chemistry, rain, humidity*) • Possessive forms of singular and plural nouns (e.g., *The wetland's biological diversity; The researchers' findings*) • Articles: *a, an, the or no article* • Gerunds for activities and pastimes (e.g., *investigating, exploring*)
Pronouns	• Subject: *I, you, he, she, it , we, they* • Object: *me, you, him, her, it, us, them* • Possessive: *mine, yours, his, hers, its, ours, theirs* • Reflexive: *myself, yourself, himself, herself, ourselves, yourselves, themselves* • Impersonal expressions: It + be *(e.g., **It is** cold in space.)*
Verbs	• Be (e.g., *Oxygen **is** necessary for human survival*.) • There is/are • Modals which express degrees of certainty: may, might, could, must (e.g., *Global warming **may** harm the habitat of the polar bear.)* • Simple present: (e.g., *Ecosystems **change** over time*.) • Simple past of regular and irregular verbs: (e.g., *When birds ate the poisoned insects, the poisons built up in their tissues.*) • Simple future: (e.g., *Exploration of space **will continue** in the future*.) • Present Progressive: (e.g., *Plant scientists are creating new species.)* • Past Progressive: (e.g., *Early astronomers were looking at the night sky when they found Mars*.) • Infinitive forms after verbs such as *want, start, would like, tell* (e.g., *The government **would like** to reduce pollution.*)
Adjectives	• Comparative/ Superlative (e.g., *safer/ safest; more efficient/ most efficient; better/ (the) best*) • Noun + two adjectives (e.g., *the cold, lifeless moon*) • *Some, any, every, all, a little, a lot of, much, many*

Adverbs	• Used to modify adjectives (e.g., *very harmful*) • Adverbs of frequency, time and manner (e.g., *today, always, never, sometimes, then, quickly, quietly*) • *Too*
Transition Words and Phrases	• *When, because, if, although* (e.g., *Tornadoes are dangerous because high winds destroy buildings.*) • *Like/ unlike*; *similar to/ different from* • *First, second(ly), in the beginning, as well, next, finally*
Question Forms	• Yes/ no questions: (e.g., *Do you recycle*?) • "Wh" questions
Negation	• Be in simple present and past (e.g., *There wasn't enough rainfall.*) • Do and will: (e.g., *The magnet won't attract aluminum.*)
Prepositions	• Of location (*beside*), direction(*from*) and time (*before*) • With phrasal verbs (e.g., *talk over, wait for*)
Sentences	• Simple sentences: subject + verb + object or prepositional phrase (e.g., *Astronauts travel in space*. *All living things need nutrients*.) • Compound sentences with *and, but, or, so* • Simple forms of direct and indirect speech (e.g., *The teacher told us to get a microscope and a slide*.)

II. Conventions of Print

Punctuation	• Final punctuation: period, question mark, exclamation mark • Comma: for items in a list • Quotation marks • Apostrophe: contractions and possessive forms • Period with abbreviations (e.g., *Dr., cm., ml., hr., min.*)
Capitalization	• First word in a sentence • Proper nouns (e.g., names of people and places)

Appendix E
Key Concepts of the K-9 Science Program of Studies

LIFE SCIENCE	PHYSICAL SCIENCE	EARTH AND SPACE SCIENCE
Biological Diversity • Biological diversity • Species • Diversity within species • Habitat diversity • Niches • Populations **Cells And Systems** • Organisms • Organs • Tissues • Structure and function • Systems • Response to stimuli **Interactions And Ecosystems** • Interactions and interdependencies • Environment – monitoring, impacts • Producers, consumers, decomposers • Nutrient cycles and energy flow • Species distribution • Succession • Endangered species • Extinction • Environmental management	**Season and Weather** • Seasonal changes • Plant and animal changes on a seasonal basis (form, appearance, location, activity, production of young) • Human preparations and adaptations for weather • Patterns of air movement • Methods for measuring wind speed and direction • Forms of precipitation • Weather over a period of time • Weather systems • Climate • Climate variation **Matter And Chemical Change** • Substances and properties • Endothermic and exothermic reactions • Reactants and products • Conservation of mass • Factors affecting reaction rates **Mix And Flow Of Matter** • Pure substances, mixtures and solutions • Concentration • Particle model of matter • Properties of fluids • Viscosity and flow rate • Mass, volume, density • Pressure • Buoyancy	**Sky And Space** • Light emission, radiation, reflection • Movement of objects in the night sky • Effects of the angle of the Sun above the horizon • The moon's phases • Seven known planets • Moons of other planets • Astronomical technology and procedures • Solar system • The known universe **Planet Earth** • Strata • Rocks and minerals • Rock cycle: formation of igneous rock, metamorphism and sedimentary processes • Mountain formation: folding and faulting • Crustal movement/plate tectonics • Geological time scale • Fossil formation • Weathering and erosion • Sudden and gradual/incremental change • Development of models based on observation and evidence

Plants For Food And Fiber • Needs and uses of plants • Plant propagation and reproduction • Life processes and structure of plants • Fertilizers and soil nutrients • Chemical and biological controls • Plant varieties • Selective breeding • Monocultures • Resource management • Sustainability • Environmental factors	**Freshwater And Saltwater Systems** • Water cycle • Water quality • Waterborne materials • Erosion and deposition • Stream characteristics • Continental drainage systems • Ocean basins • Climate • Glaciers and icecaps • Adaptations to aquatic ecosystems • Human impact **Heat and Temperature** • Heat energy needs • Heat energy technologies • Thermal energy • Particle model of matter • Temperature • Thermal expansion • Change of state • Heat transfer • Insulation and thermal conductivity • Thermal energy sources • Energy conservation **Mechanical Systems** • Design and function • Systems and subsystems • Transmission of force and motion • Simple machines • Mechanical advantage, speed ratios and force ratios	**Rocks and Minerals** • Various kinds of rock, similarities and differences • Properties of rocks and minerals • Classification of rocks • Composition of rocks • Components of soils • Uses of rocks and minerals