E D M O N T O N P U B L I C S C H O O L S

May 24, 2005

TO: Board of Trustees

FROM: A. McBeath, Superintendent of Schools

SUBJECT: Science Alternative Program

ORIGINATOR: B. Holt, Executive Director, Instructional and Curricular Support Services

RESOURCE STAFF: Karen Bardy, Laurie Beggs, Gloria Chalmers, Margaretha Ebbers, David Kun, Jim Lovgren, Scott Millar, Sid Shugarman, Judy Welch

RECOMMENDATION

1. That the *Science Alberta Foundation* alternative program be discontinued in September 2006.
2. That the *Science Alternative Program* be approved as an alternative program beginning in the 2006-07 school year.

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In the spring of 2000, the board approved the Science Alberta Foundation alternative. This alternative involved a partnership with the Science Alberta Foundation and a relationship with the Calgary Science Alberta Foundation charter school. Since that time, the foundation has redefined its work, no longer works directly on specific alternative programs and suggested that a change to the names of the alternatives would be appropriate. The Calgary charter has already changed its name and, due to a change in leadership and direction, no longer has a relationship with our district. Consequently, the district undertook a review of the district's Science Alberta Foundation alternative program.

As a result of the review, it is recommended that the Science Alberta Foundation alternative program be discontinued and that a refocused program called the Science Alternative Program designed for typical district school grade configurations and based on current best practice in science education be approved in its stead. The Science Alberta Foundation alternative was developed to serve grades 4 to 9 but this grade configuration proved not to work well within our system in which alternatives typically begin at kindergarten and grade 1. The refocused program is designed as a kindergarten to grade 6 alternative with the possibility of extension to junior high.

Another reason for maintaining a science alternative program is to continue to support the district's mission of offering a breadth of choice in the district. This provision of choice is now evident in other school districts in the province. Calgary Public introduced a science alternative in September 2004 and Edmonton Catholic offers a science alternative at two locations.

There are also compelling pedagogical reasons for offering a science alternative program. While there was a renewed focus on science education across the country after the 1984 Science Council of Canada study, recent research indicates that after grade 4, interest in science declines. A renewed science alternative program in the district would serve to enhance interest in science for students. In addition, science learning has the potential to motivate all students and to enable them to take ownership of their own learning. A 2004 article in *Educational Leadership* makes a strong case for this and for authentic science learning. This is further supported by a quote from *Beyond 2000: Science Education for the Future* (Millar & Osborne, 1998) stating that primary science provides "a framework for developing children's curiosity about their natural environment and their skills of careful observation and 'precise language for descriptive purposes'. Furthermore, a science alternative program provides an effective means of linking the core subjects to scientific ideas, of meaningfully using technology for research and experimentation and for early consideration of ethical issues. It could also serve as a professional development site for strategies related to elementary science education.

The proposed science alternative was developed in collaboration with a district committee composed of staff with education, teaching experience and an interest in science. As well, it reflects input from a broad range of community members from the medical and education faculties at the University of Alberta, the Space and Science Foundation/Odyssium, the provincial museum, APEGGA, Alberta Research Council, and the Community Services department of the City of Edmonton (e.g., John Janzen Nature Centre). Community support for the proposed program is strong and, should the alternative be approved, the district would proceed to confirm some formal community alliances to support the program.

Program Description

A description of the proposed Science Alternative Program is provided in Appendix I. This description includes information regarding the curriculum and program focus, target students, staffing, district support, location, and program monitoring and review. If the proposed alternative program is approved, work will be undertaken in the next year to develop plans for implementation so that the program can be offered as of September, 2006.

GC/KB:ee

APPENDIX I: Science Alternative Program: Program Description

APPENDIX I

SCIENCE ALTERNATIVE PROGRAM: PROGRAM DESCRIPTION

Name: Science Alternative Program (Kindergarten to Grade 6, with potential to expand to Grade 9)

Curriculum and Program Focus: While the curriculum for the alternative program will be that prescribed by Alberta Education, the program will be enhanced by specific emphases. These include a focus on key ideas in science, the use of inquiry across the subject areas, an attention to the language of science, and environmental/social perspectives of science. In addition, there will be a focus on teacher education and research, as well as partnerships with the greater science community.

Key ideas in science: While Alberta Education lays out the units and learner expectations for the different grade levels, it does not specify key science ideas that might be used to link the topics at each grade. These ideas are fundamental to the study of science by the way they structure **what** people look for, and **how** they go about investigating. A few examples of key ideas are:

- People in science examine change and constancy.
- People in science investigate the diversity of life.
- People in science are interested in properties and characteristics.
- People in science use, study and are part of systems and interactions.
- People in science articulate relationships and organization.
- People in science develop laws and theories that are used to explain natural phenomena.

These ideas, as well as many others, are part of scientific endeavor, whether or not they are articulated. Once articulated however, these ideas can be used to link science learning across units, grades, and even schools. In addition, by using key ideas, teachers in the Science Alternative Program will be able to extend the mandated curriculum into topics for further study as student interests dictate. Appendix A describes how this might be accomplished at a specific grade level.

Role of inquiry: Inquiry will play an extremely important role, not only in science, but also across all areas of the curriculum in the science alternative program. It is a multi-faceted activity that involves the mastery of many discrete skills. Some of the skills may be somewhat global such as making observations, posing questions, and seeking out information in a variety of ways. Other inquiry skills however are more closely aligned to the practices of scientists. These would include developing reasons; working with theories; planning investigations; reviewing what is already known in the science community; using specific tools to gather, analyze and interpret data; developing predictions, hypotheses and explanations of natural phenomenon; as well as communicating the results to others. Appendix B describes a cycle of inquiry which is just one of many different perspectives regarding how inquiry might be articulated.

Genuine inquiry comes out of a context that stimulates questions. Questions that fuel inquiry with respect to school science may arise out of class discussion, discrepant events, activities that happen at home, student curiosity, or from observation of the natural world.

Once questions are stimulated, investigation begins. One stage in investigation is planning the type of investigation best suited for the question. In terms of science study, there are many different kinds of investigations, undertaken by many different kinds of scientists and occurring in a variety of environments. One of the responsibilities of the science alternative program will be to introduce students to this variety and to break down long held stereotypes such as: *all investigations are experiments; scientists always wear lab-coats;* and *scientists are white, western and male*.

A significant aspect of investigation will be the data that is collected and how it is to be managed. The purpose of inquiry is not just to collect data for describing phenomena, but also to explore the relationships that are useful for building particular explanations. Scientists use models as a way of articulating relationships that may explain how a phenomenon occurs. Relationships are constructed to account for the features of the phenomenon, while observations are made to generate the evidence needed to test an explanation. Since the aim of science is to provide reasons and explanations, albeit tentative, for natural phenomena, the science alternative program should reflect this aim. Even the youngest students can be encouraged to generate evidence out of the pool of data they collect and use this evidence as a basis for defending their own explanations and in turn, consider alternative explanations.

The process of inquiry is not a linear one. For example, during the stage of data collection, a student may well need to rethink and reframe an original question. Or, gaps in the explanation may point to the need for more evidence and therefore that further investigation is required. Students comfortable with inquiry will recognize this iteration as a valuable part of scientific practice.

The process of investigation also requires that the results of the investigation be shared with the rest of the science community. This sharing may take several different forms such as reports, posters, debates, oral presentations and through various forms of technology.

<u>Language of science:</u> In North America, emphasis during the past decade has been placed on the role of language in science. This emphasis comes from recognition that language is used for more than information sharing. Instead, communities can be identified by the specific ways in which they use language. Thus, as teachers of science, we not only introduce students to the inquiry practices of scientists, we introduce them to the specific way language is used during the different phases of inquiry.

A focus on language in science means the attention paid to the way language is used for reading, writing and speaking science. It does not simply mean the attention paid to scientific vocabulary.

Reading figures very highly in the science community. Scientists themselves read a great deal. They read the reports of peers, journal articles in their fields, background information in their areas of interest and so forth. Science writing demands from the reader the ability to follow a particular logic. Often text is structured around making inferences, drawing conclusions, indicating sequence or chronology and of course, cause and effect. This demands ways of

reading that are different from the reading of fiction. Science reading demands familiarity with the written genres of description, explanation, persuasion and argument.

Visual literacy beyond the decoding of print is also an important dimension of science practices. Students involved in data collection/analysis will need to become increasingly familiar with both the reading and construction of images, diagrams, tables, charts, models and graphs.

Finally, with respect to writing, elementary students are just beginning to become aware of the variety of textual genres that are part of our literate society. Through the Science Alternative program, they will develop continuing facility with the genres listed above, in concert with their ability to construct explanations by drawing on evidence as support for a particular point of view.

Environmental and social perspectives: The Council of Ministers of Education developed the Common Framework of Science Learning Outcomes across Canada in 1997. It is to be used for science curriculum writing in all provinces. One of the foundation statements is concerned with the relationships between science and technology within social and environmental contexts.

The Science Alternative program will include a focus on Canadian contributions to the science community. It will also emphasize historical and social perspectives. There are a number of key science challenges today (global warming, water use, etc) that are featured regularly in our media. These topics may provide foci for further investigations.

As well, there is growing concern with the development and maintenance of urban green space. The Science Alternative program will be expected to engage in some type of project work with respect to their school site.

Teacher education and research: Teachers of the Science Alternative program will be expected to form a professional learning community in order to work on continual program improvement. Opportunities will be provided for co-operative planning, interclass visitations and dialogue with other teachers in Alberta who teach in science schools. Teachers will be encouraged to engage in personal inquiry with respect to their own practice and to share their results with colleagues on a regular basis.

Partnerships and learning beyond the classroom environment: One of the cornerstones of the Science Alternative program will be its partnership with the extended scientific community at the local, provincial and national levels. Teachers will be encouraged to extend the boundaries of science education outside the classroom through outdoor projects, field studies and on-site work in other locations. In order to encourage an appreciation of the work that is done by scientists, interactions between scientists and various organizations such as APEGGA will be encouraged and maintained through field trips, visitations and perhaps mentorship. Attention will be given to having a variety of speakers come in to the school on a regular basis in order that a multi-dimensional view of science will be presented.

Resources and materials that support the program: In order to facilitate the programming that will go beyond the current elementary science curriculum, some specialized equipment will be required. Included in this list are the following:

- Viewing materials such as microscopes, telescopes
- Class sets of the following construction materials for robotics and electricity Lego™ Dacta™
- Technology such as digital camera (s), video, LCD projector, sufficient computers
- Habitat resources, for example a large aquarium, lighting, tanks
- Gardening tools and outside shed for storage, indoor full spectrum light stand
- Solar panels
- Print resources: library books that highlight practices of scientists; professional resources such as educational journals, books; class sets of field guides for trees, birds, insects, etc. at each grade

Target Students: The program will initially be established as a kindergarten to grade six program, with the potential to expand to grade nine. The program will be particularly suited to students who have demonstrated keen interest in science and inquiry. Students will be able to enroll in the program at any grade level.

Staffing: The program requires staff who are supportive and possess expertise related to the objectives and mission of the alternative program. Staff in the program would need to have the following attributes:

- A passion for science and investigation
- An awareness, or willingness to learn about the nature of science including the, practices, history, and members of the scientific community
- An understanding of key ideas in science
- Experience in teaching science outside the borders of the classroom
- Expertise in conducting inquiry
- Dedication to lifelong learning
- Willingness to engage in inquiry related to professional practice, and to work with other teachers, other professionals or with partner organizations
- An ability to make cross-curricular links and to deconstruct concepts so that they are understood by learners of varying levels.

Qualifications for the positions of leadership would include the same descriptors as that of the teachers with the additional requirements:

- A desire to spearhead partnerships with the broader science community
- An ability to facilitate professional development as an inquiry process
- A dedication to fostering collaboration and community building and the recruitment of volunteers

District Support: It is recommended that a start-up grant of $319 be provided for each student in the first year of implementation and for growth in year two. This recommendation is consistent with district practice over ten years. This enables the school location to acquire the resources and to ensure staff has the initial professional training required. There would then be an expectation that the alternative would be sustainable without additional funding.

Location: The building and the site itself are an important dimension of the Science Alternative program. As one of the emphases on the program is an environmental perspective, the school site must include at least the beginning of an outdoor classroom, with room to expand. Mature trees would be a benefit as well as the space for naturalizing part of the play area, to be then used for botany and zoology study. An effective site will provide large classrooms for ongoing science projects, windows that can be used for growing plants, and ample storage space.

If the Science Alternative program is approved, Planning will identify a site based on the physical characteristics of the site, interest and support from the school community, and demand in the sector, plus other criteria typically used in site selection.

Program Monitoring and Review: As is the case with all alternative programs, monitoring information will be collected annually in regard to achievement and student, staff, and parent satisfaction. During the implementation phase, assistance will be offered to ensure the program is offered as described. The program will be reviewed periodically to determine whether modifications are required to keep the program current and viable.

APPENDIX A

USING KEY IDEAS AS A WAY OF EXTENDING MANDATED CURRICULUM INTO TOPICS OF EXTENDED STUDY

Grade 4 Topics: Waste and our World,
Wheels and Levers,
Building Devices and Vehicles that move,
Light and Shadows,
Plant Growth and Changes.

Rather than teaching each unit discretely, the Grade 4 topics can be examined under the key idea *People in science use, study, and are part of systems and interactions.* As part of the learning process, students could study a variety of systems, both natural and made by humans. Many of these systems could be self-selected, dictated by student interest. Through their study, students would learn not only the expectations outlined in the program of studies, but also other key concepts related to the main idea. This includes concepts such as:

- Systems involve parts which interact.
- Parts can be examined to understand the whole.
- Problems can be identified by looking at the whole, or at parts.
- Plants operate as systems.
- Plants are part of larger ecosystems.
- The Earth is part of a solar system.
- Human action can affect the balance of natural systems.
- One part of an ecosystem can affect other parts of the system.

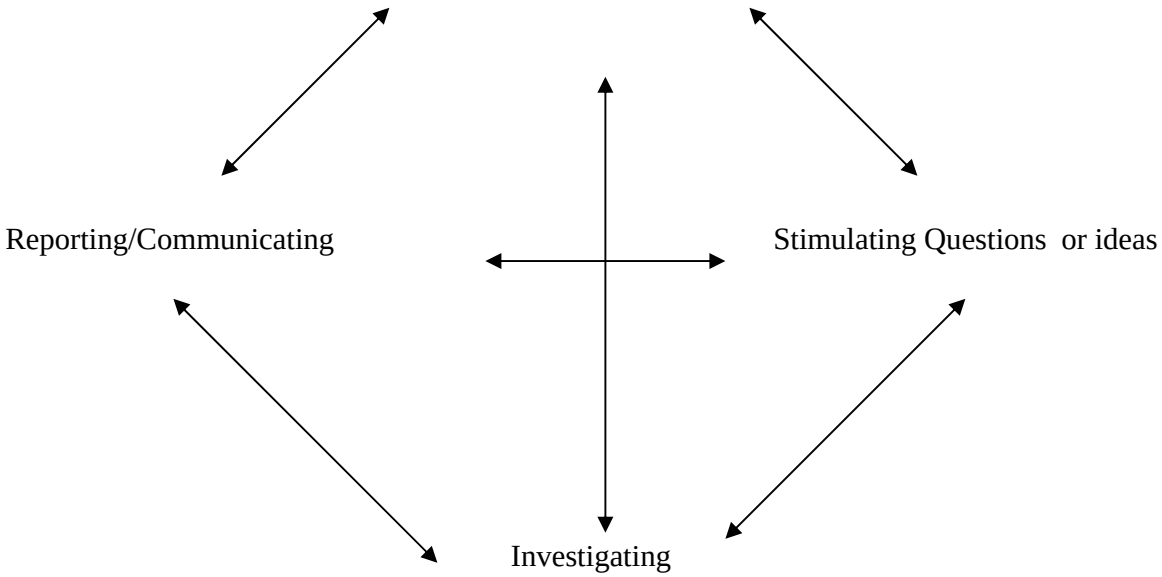
While it would be expected that students in grade 4 would continue to cover the expectations outlined in the program of studies, various learner expectations from that document could easily be subsumed under other topics of interest.

Topic 4A (Waste and our world) has as its first Specific Learner Expectation #1, *Identify plant and animal wastes and describe how they are recycled in nature. For example, plant leaves serve as a source of food for soil insects, worms and other creatures. The wastes of these animals may then be further broken down by molds, fungi and bacteria.* This expectation could be covered equally well in a study of any ecosystem, any animal, or any plant of interest. What would link the various interests would be how a system operates, and how the various components of the systems interact.

APPENDIX B

ONE POSSIBLE CYCLE OF INQUIRY

Developing a context : What are the reasons for this particular study?



Plan

Develop Reasons

Collect, manage data

Use Data as evidence for possible Explanation

APPENDIX C

REFERENCES

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