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PARTENAIRES FAVORISANT L'APPRENTISSAGE

Proceedings of the 14th Annual Conference of the
Canadian Association for Distance Education

Le 14 Congrès
de l'Association canadienne de l'éducation à distance

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Published by the host of the CADE/ACÉD '98 conference
Athabasca University
1 University Drive
Athabasca AB T9S 3A3
Canada

May 1998
Volume II

CADE/ACÉD

TEACHING BIOLOGY AT A DISTANCE: dealing with the living

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The session will discuss the delivery of university-level biology to distance education students. Because of the wide diversity of organisms, ethical considerations, and potential hazards, biology offers significant challenges to learning at-a-distance. As biology is a 'life science', course objectives have to consider the availabilities of living organisms, seasonal variations, and geographic considerations. This presentation will emphasize techniques that have been used successfully at a distance, especially laboratory components. It will review the colleges and universities in Canada that teach biology at a distance. Specific recommendations will be made about overcoming obstacles and how to include laboratory components in all levels of biology study.

Biology is often defined as 'the study of life'. This definition implies that biologists work directly with living organisms, including their internal and external environments. From the perspective of distance educators, this presents a major challenge to the successful delivery of biology courses.

Of the Canadian universities and colleges that engage in distance education in a substantial way, about 50% offer one or more biology courses, and only about 20% offer five or more. An even smaller proportion includes some type of laboratory component in any of their courses. Why do these small numbers occur? The problems arise when educators try to answer questions such as:

- How can laboratories be integrated into distance education biology?
- Can students study living organisms at home?
- What about the risks of diseases and parasites as well as potential chemical hazards?
- How do we deliver labs when students may enroll from across the country and progress through courses at different rates and at different times of the year?
- The objective of this paper is to demonstrate that biology, as a lab science, can be taught successfully at-a-distance.

Successful teaching of university-level biology at-a-distance often means taking a much different approach to course design compared to traditional courses. Designing successful biology courses for distance education means putting highest priority on accommodating the distance student in terms of time and space, without sacrificing course content. In other words, one must allow students to successfully complete university level courses independent of their locations and on

flexible time schedules. There are two options for laboratory components: either have students attend labs on-site, or take the labs to the students.

- **Geography:** From the outset of designing a course, one must be aware of where the students are likely to live. Normally, the bulk of students will come from the home province of the distance education institution. However, with open admission policies, students may come from anywhere in the country or even abroad. This means that, as much as possible, lab activities should be designed for home-use. It also means that if a course requires an in-person lab component (because of content, educational, safety or economic concerns), it must be made available in at least one concentrated session (e.g. summer). It must also be advertised well in advance (i.e. at least a year) for students who have to travel long distances. If possible, in-person lab activities for various courses should be scheduled so that students can make one trip and attend the labs for more than one course.

- **Seasonal variation:** This is related to the geographic location of students. If courses run twelve months per year, and students can start in any month, this means that labs must be designed so that any organisms and materials used at home are accessible year-round. This may mean foregoing on traditionally used items and finding readily available components that are available locally in all seasons.

- **Home Lab Kits:** Lab kits may be provided as part of the course package or borrowed from the institution. The latter is usually done for expensive items, the former for cheap or expendable items. Kits can usually be augmented by materials from students' homes or purchased locally. The cost of inventory and packing of items even for a small kit can be substantial. There is also the problem of checking items that are returned for re-use. Proper disposal of used items (e.g. razor blades or broken pieces of glassware) needs to be considered.

- **Living Organisms At Home:** The idea of sending live organisms through the postal system is not new - a whole industry revolves around mailing seeds to millions of gardeners. However, because of postal regulations (e.g. restrictions on potentially hazardous materials and organisms), any laboratory materials being mailed must be harmless and non-liquid. Such materials should also have a long shelf life. Usually, organisms have a very limited or no shelf life. Thus either special shipping must be arranged (expensive) or alternatives must be designed. In some cases, students may be required to obtain plants or flowers from a florist, vegetables or meat products from a grocer, and crickets or fish from a pet store. In rare cases students may be able to locally obtain fish (legally caught but not gutted) or insects (restricted to the summer unless one is looking for head lice).

- **Safety:** Course developers must decide what level of risk is acceptable for students (and the institution). For chemicals, this is usually decided by regulations on what chemicals are accessible to the public. Nevertheless, even simple labs can harbour potential hazards. These include acids and bases and explosive or flammable chemicals. For example, an at-home laboratory may involve students testing for starch in plant leaves. Part of such a lab would involve the extraction of pigment by boiling leaves in alcohol (poisonous and flammable) on a kitchen stove and then using an iodine solution (poisonous). Clear instructions on what to do, an explanation of what could happen, and procedures for dealing with an accident need to be emphasized. There are also biohazards. For example, in microbiology, if students culture bacterial and fungal colonies which they find around their home, the concentrated cultures may become pathogenic to the students or members of their families.

- **Ethical Considerations:** At-home laboratories may also have ethical considerations. For example, in animal behaviour students may carry out a project on the feeding behaviour of

slugs, territoriality of fish, or the mating behaviour of mice. Students must be very conscious of how they treat the animals they are studying and the ramifications of their project.

CONCLUSION

Biology at-a-distance can be a successful and rewarding venture, both for students and instructors. Inclusion of at-home laboratories is certainly possible, however there are many restrictions on what can be done. Although we do not deliver all of our labs at-home, we are moving closer to this goal every year. We hope others will do the same.