NIGHT-WALK: Science in the Dark Using Bioluminescence

We propose to develop, construct, test, and exhibit NIGHT WALK, integrated science discovery exhibits based on bioluminescence -- light generated by living systems In addition, assessment of impact and retained knowledge will be used to help direct future exhibit development and dissemination of relevant material in the form of science kits and publications.

This proposal involves a collaborative interdisciplinary project between The Children's Museum of Utah (TCMU) and the University of Utah's Center for Integrated Science Education (CISE). Together we will develop and produce a set of different interactive bioluminescent activities and prepare and provide supplementary materials and kits for science education.

This project involves the following tasks over its duration:

Exhibit Design:
Exhibit Construction:
Exhibit Maintenance & Operation:
Assessment & Evaluation: and
Dissemination.

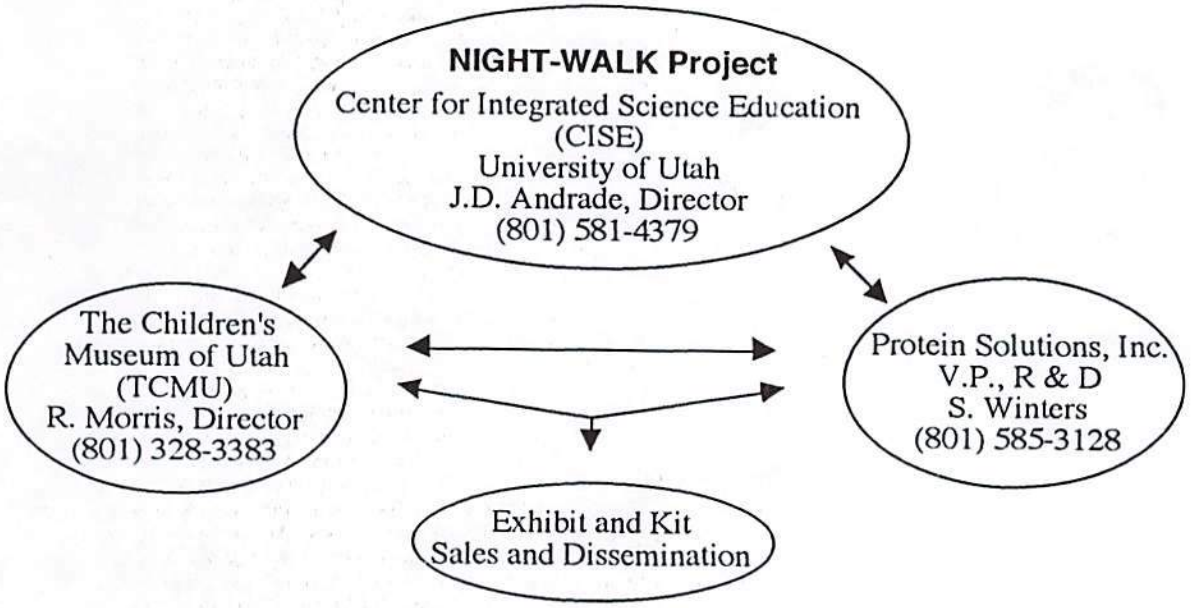


Figure 1. Participants in the NIGHT-WALK Informal Science Education Project.

NIGHT WALK

Science in the DARK!

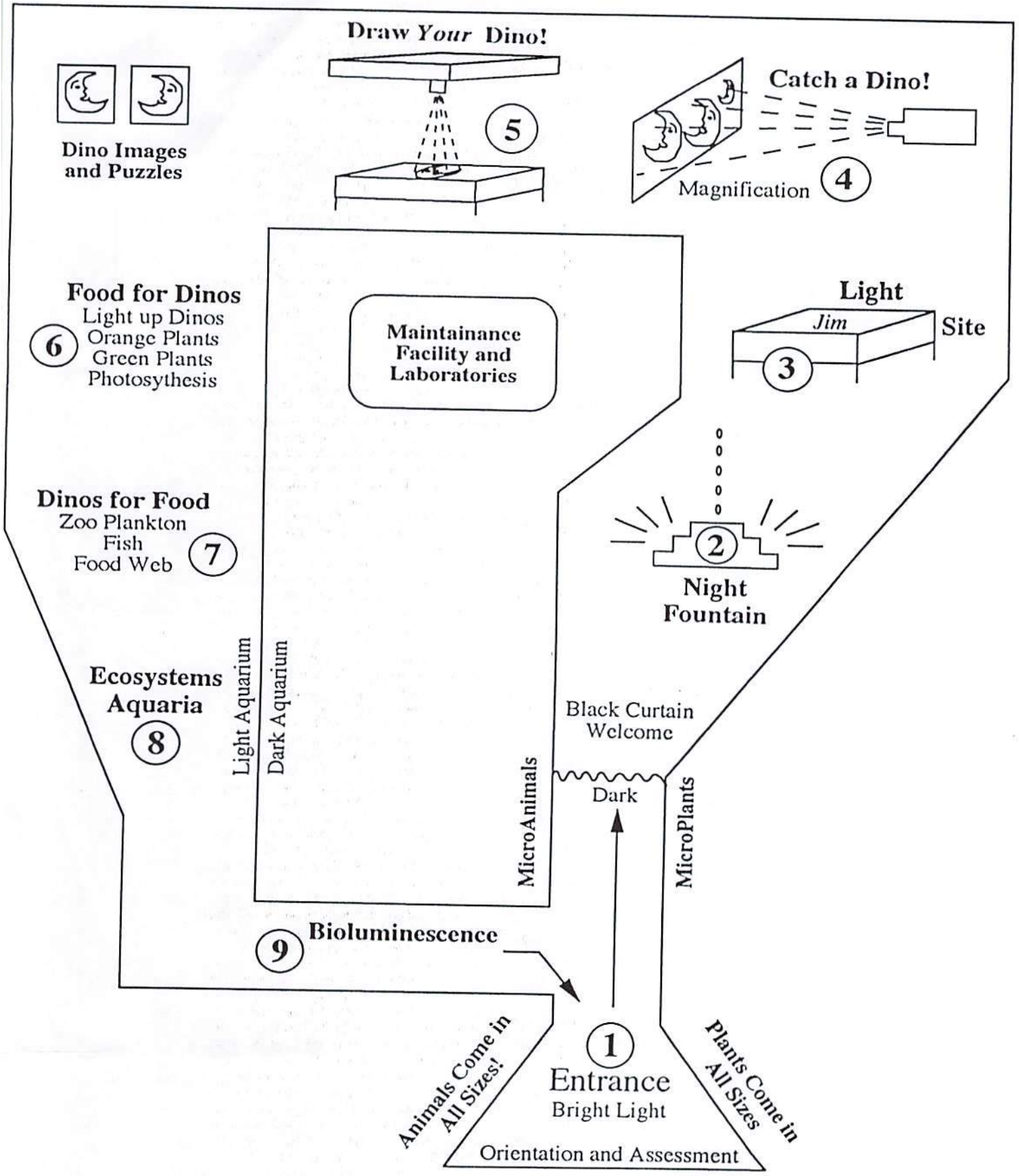


Figure 2: NIGHT WALK Exhibits and Activities

CISE-PR (2)

DEAN'S VIEW

The Graduate School of Education was an exciting place to be during the 1991-92 academic year with a wide variety of achievements and new initiatives! I invite you to take this issue outside on one of our glorious Utah days (sorry we cannot mail our weather to readers out of state) and leaf through the pages.

The blend we seek among research, teaching, and practice is evident by the activities and accomplishments of the faculty. Several research projects in each of our departments are described on the following pages, some of them making a difference today in Utah schools, some of them making a significant contribution to national education reform now and in the future, all of them, as well as others in the college, developing and refining knowledge to improve educational practice.

Colleen S. Blankenship
Dean

We have and are continuing to receive exemplary support from school districts, as we work together to establish Professional Development Schools, settings in which there is an emphasis on preparing beginning teachers and fostering the development of experienced teachers, through research and inquiry--directly influencing educational practice in the schools.

Special thanks to Ann Ellis and the Stewart School volunteers for establishing the Stewart School Scholarship. Thanks to you and the many generous donors, the spirit of the Stewart School will live on in our graduates!

CENTER TO IMPROVE SCIENCE TEACHING

The Graduate School of Education will be partner with the Colleges of Engineering and Science in the Center for Integrated Science Education (CISE) at the University of Utah. Faculty from the three colleges will work together on staff development and research programs focused on improving the teaching of science in K-12 schools and colleges.

CISE will be co-directed by Joseph Andrade, Department of Bioengineering, and Trish Stoddart, Educational Studies. The purpose of the Center, as described by Dr. Andrade, is to "serve as a focus, a catalyst, a vehicle to integrate and encourage science education activities throughout the campus and community." The Center's objectives include developing courses, curriculum materials, and laboratory experiences to prepare new and experienced teachers to teach science using a discovery-based approach. While the work of the Center will have a very direct and positive effect on science instruction in Utah, the models of instruction as well as the products developed, will be of interest to educators nationally.

Several faculty from the Graduate School of Education will participate in the CISE. Jan Dole, Gail Sinatra and Ralph Reynolds, Educational Studies, will bring to the enterprise their expertise on students' comprehension of science textbooks. Patrick Galvin, Educational Administration, will focus on the organizational aspects of the collaborative venture. Julie Gess-Newsome, Educational Studies, will contribute her expertise on the development of teachers' science content and pedagogical knowledge. Dr. Stoddart, as well as serving as Co-Director, will continue her research and development efforts in scientific conceptual change and school restructuring.

Dr. Stoddart and graduate student Dale Neiderhauser are two members of a research group from the Department of Educational Studies that has won three national awards for outstanding scholarship in the field of education. The group conducts research on the development of teachers' knowledge and skill for teaching mathematics and science. Their research has demonstrated that teachers' instructional approaches are closely related to their own experiences as learners. Teachers who learned their subject matter through ineffective, didactic lecture/memorization approaches tend to replicate this pedagogy in their classrooms--they teach as they were taught. The researchers argue that many teachers need to relearn their content through hands-on, inquiry-based approaches to instruction and propose radical shifts in the pedagogy used in university and high school mathematics and science classes.

CISE faculty have already submitted a number of grants to the National Science Foundation, NASA, and the Environmental Protection Agency which will support the development of an integrated science curricula and in-service training for teachers. For more information about CISE contact Dr. Joe Andrade, 581-4379, or Dr. Trish Stoddart, 581-7158.

Research in science teaching results in inservice education for teachers.

"There is a clear need at both the local and national level to restructure the way science is taught. There is a consensus amongst educational reformers, scientists and science educators that we need a shift in focus, a shift in approaches to instruction which rely on lecture, demonstration, and memorization towards student-centered approaches that emphasize hands-on, inquiry-oriented instruction designed to promote student's conceptual understanding by building on prior knowledge, active engagement with the subject matter content, and application to real world situations. Restructuring the teaching and learning of science will require a substantial investment of resources in teacher education and curriculum materials. The Center will bring together the expertise and resources of faculty from across the campus in collaboration with teachers from the public schools."
-Trish Stoddart

Joseph Andrade, Trish Stoddart, and Julie Gess-Newsome

INSIGHT - Newsletter, U. of Utah Graduate School of Education, 2(2) Spring, 1992

PR

VIEWPOINTS 8(10)(1992)

Hands On SCIENCE & Bioluminescence

By
J.D. Andrade, Director
Center for Integrated Science Education

Hands-on experiment based science is a growing trend in all areas of the United States and in all fields of education. It is clear that students learn best when they discover concepts for themselves. It is also clear that hands-on science does not require sophisticated or expensive materials or a strong science background on the part of the teacher. It is also clear that the most important aspect of science education is an understanding and appreciation of the scientific process -- the formulation of questions, and the design of simple experiments to obtain at least partial answers to the questions or hypothesis based on the results of the experiments and observations. That is what real scientists do.

Science education is not memory, it is not rote mastery of concepts and facts. It is learning the process, and through the process, discovering concepts and facts.

We all know from our own experiences in school, and experiences with our own children and friends, that you only learn and use concepts and facts which you have discovered for yourself, by appropriate motivation and experiment. That is the easiest and most effective learning.

Other forms of learning are more difficult and harder for most people and are generally not very effective until students become older, more disciplined, and more self motivated. It is clear that effective learning requires motivation and motivation requires interest. It is therefore essential that science teachers relate the concepts or the content that they are addressing to the student's interests and to what the student already knows.

The University of Utah's new Center for Integrated Science Education is working on new and novel materials by which to excite the interest and motivation of students. One of these sets of materials is based on bioluminescence -- light generated by living systems. Most students and teachers have never observed bioluminescence. Those who have lived in the East have seen fireflies. Joe Andrade, Director of the Center, has given a number of inservice courses titled, Light from Life: using Bioluminescence for Science Education.

The Center is cooperating with a local company, Protein Solutions, Inc., which has developed a set of materials using bioluminescence for science education. The inservices based on these topics are designed for teachers with high science anxiety levels. Andrade encourages people who think they have a fear of science to attend the inservices and develop an appreciation of the beauty and interconnections in various fields of science. He uses bioluminescence to teach various principles in biology and life science and extends that observation to include various principles of physical science, primarily light and optics, and chemical science. All participants are given a bioluminescence science education kit, which they can go back and use with their students in their classrooms.

Since most students have not observed bioluminescence and most students and teachers are not used to making observations in the dark, some of the materials and products are called NIGHT LIFE™ and the whole process is called Science in the Dark.

Joe Andrade's point is that it really doesn't matter what you use to teach science, as long as it is intrinsically interesting and motivating and permits experiments and observations by which the students can discover the concepts for themselves.

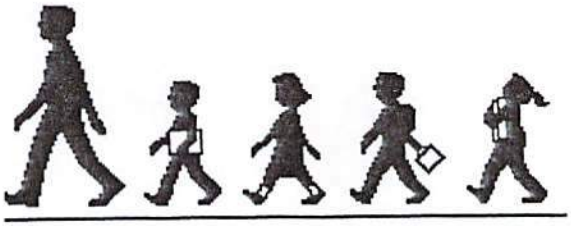
Hands- on science is a growing trend in the United States and indeed throughout the world. A recent survey says that students in the United States spend three times as much time as their counterparts abroad reading about science, but only 1/3 as much time as their overseas counterparts in actually doing science. It is clear that in the United States we have to spend much more time actually doing science rather than reading about it.

The idea is to encourage students to be observant, to question, to learn to formulate questions and then to formulate experiments from those questions. In this way they learn the scientific process. Once they learn the process, self discovery and self learning begins to become almost automatic.

There are a number of excellent recent references which deal with the process of science education and current trends. These include Science for all Americans (1), Elementary School Science for the 90's (2), The Unschooled Mind: How Children Think and How Schools Should Teach (3). The Center for Integrated Science Education at the University of Utah is another source of information.

Contact Joe Andrade, Director, at 581-4379 or Trish Stoddart, Co-Director, at 581-7158.

1. F.J. Rutherland and A. Ahlgren, Science for All Americans, Oxford University Press, 1991.
2. S. Loucks-Horsley, et al. Elementary School Science for the 90's, The Network, Andover, Mass., 1990.
3. H. Gardner, The Unschooled Mind: How Children Think and How Schools Should Teach, Basic Books, 1991.



Book Reviews

Viewpoints 8 (10) (1992)

Science for All Americans

Project 2061: Science for All Americans is the title of a report issued in 1989 by the American Association for the Advancement of Science. The result of a multi year study involving six task forces in different areas of science, mathematics, and education, Science for All Americans is having a significant impact on the way science is taught in the United States.

The National Science Foundation and the National Science Teachers Association have developed a set of demonstration projects in the state of California, Texas, Puerto Rico, and elsewhere involving concurrent science in the middle and high schools.

Rather than take a different science subject each year, as is normally the case, chemistry, physics, biology, geology, and earth sciences are taken concurrently over 5 years. In this way the various fields and technology can be more fully developed, integrated and interwoven. This is the way science curricula are organized in Europe and Japan. For historical reasons, it has been a very different situation in the United States.

A book version Science for All Americans, an Oxford University Press paperback, 1990, by F. James Rutherford and Andrew Ahlgren is now available for $9.00. It is well worth reading. The chapters in the book include the Nature of Science, the Nature of Mathematics, the Nature of Technology, the Physical Setting, the Living Environment, the Human Organism, the Human Society, the Designed World, the Mathematical World, Historical Perspectives, Common Themes, Habits of Mind, Effective Learning and Teaching, Reforming Education, the Next Steps.

This report has had a significant influence on the development of the theme and concept approach to science education. The major themes or concepts developed in the Science for All Americans project include systems, models, constancy, patterns of change, evolution, and scale.

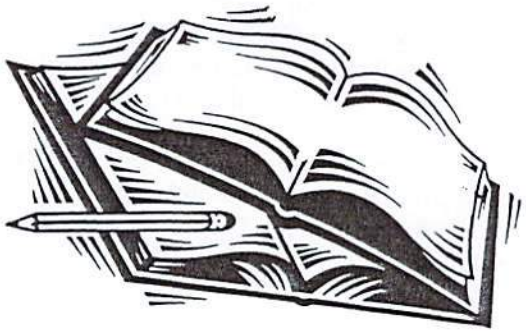
The argument is that these concepts or themes apply in all areas of science, and these themes can help integrate and interweave all science subjects.

It is this report, Science for All Americans, which has stimulated a number of faculty at the University of Utah to establish the Center for Integrated Science Education (CISE), which is described elsewhere in this newsletter. J.D. Andrade, Director of the Center, is most interested in speaking to groups about integrated science education and hands on science, and on the conclusions and recommendations of the Science for All Americans project. He can be reached at the Center for Integrated Science Education, University of Utah, (801) 581-4379.

Elementary School Science for the 90's

by Susan Loucks-Horsley
and seven other authors

Published by the Association for Supervision & Curriculum Development, Alexandria, VA and by The Network in Andover, Massachusetts. Copies available for $13.95 from The Network, Andover, Massachusetts, (508) 470-1080.

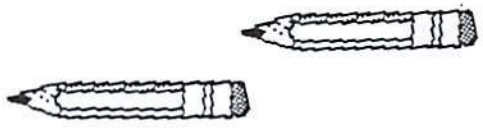


Elementary School Science for the 90's is a very current, practical, and insightful treatment of the evolving changes in elementary science education. The book consists of 13 chapters:

- Make Science a Basic
- Build Curriculums that Nurture Conceptual Understanding
- Connect Science to Technology
- Include Scientific Attitudes and Skills as Important Goals
- View Science Learning from a Constructivist Perspective
- Use a Constructivist-Oriented Instructional Model to Guide Learning
- Assess What is Valued
- Connect Curriculum, Instruction, and Assessment
- Use a Variety of Assessment Strategies
- Assess Programs as well as Students
- View Teacher Development as a Continuous Process
- Choose Effective Approaches to Staff Development
- Provide Teachers with Adequate Support to Implement Good Science Programs

There is also a wide variety of resource and support material listed. The book is brief, concise, exceptionally well written, and recommended to all elementary teachers and all principals and supervisors.

J. Andrade, University of Utah Center for Integrated Science Education, has several copies which he would be happy to loan. He can be reached at 581-4379.



Book Reviews Continued

The Unschooled Mind: How Children Think and How Schools Should Teach

by Howard Gardner
Basic Books, 1991

Howard Gardner is a well-known education psychologist at Harvard University who has studied learning for decades. His book, Frames of Mind, is considered a classic. In this book he argues that there are various ways in which different individuals learn -- there are a least seven different approaches to learning. It is well recognized that certain students have aptitudes in music, mathematics, manual dexterity, sports, art, etc. Although all of these are represented in the public education process, it is argued that some students become short changed because their approaches to learning are deemphasized or not available.

Gardner expands upon these studies in his current book, which is specifically directed to studies of learning by preschool and elementary children. The entire book is recommended reading for all educators.

The bottom line of the book, however, is that young children learn most effectively by two processes:

1. By discovering something for themselves, generally be experimentation in some form or another;
2. By watching an adult do something, that is they learn by emulation or by apprenticeship.

He further argues that simple reading, being told about things, viewing demonstrations, and our other standard approaches to education are ineffective.

He argues strongly that the new trend toward interactive science centers and science museums is very effective and healthy for elementary education. He argues further that such activities and experiences must be available in every school and indeed in every classroom.

The book strongly supports the growing trend towards hands-on experience and experiment based science education in the classroom as well as in museums and science centers.

Viewpoints 8 (10) (1992)

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