DOCUMENT RESUME

ED 376 075 SE 055 339

AUTHOR	Raines, Julianne
TITLE	The Biosphere Project: An Interdisciplinary Approach to a Survival City.
INSTITUTION	Maine Center for Educational Services.
PUB DATE	Jul 94
NOTE	9p.
PUB TYPE	Reports - Descriptive (141)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Biology; *Ecology; Environmental Education; High Schools; Interdisciplinary Approach; Learning Activities; Simulation; *Student Projects
IDENTIFIERS	*Biosphere

ABSTRACT

This report describes a classroom project that groups sophomore biology students into "companies" bidding for a "contract" to build a self-sufficient, enclosed city by producing a manual and model of their version of a biosphere. Students must develop technological support systems, social and economic parameters, and systems that meet physical and emotional needs for residents of the biosphere. The report provides a general description of the project and includes the parameters of the problem students must solve. Several goals of the project are described. Students use computer technology to produce the manuals, must learn to work in groups, and are introduced to the use of community resources. Four paragraphs of procedural information address the tasks of choosing groups, getting students together to work on the project, doing the project for the first time, and working with librarians. Resources instructors can make available to the class are suggested. (LZ)

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"The BIOSPHERE PROJECT"

An Interdisciplinary Approach to a Survival City

Julianne Raines
Yarmouth High School
West Elm Street
Yarmouth, ME 04096
(207) 846-5535

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General Description

Student "companies" bid for a "contract" to build a self-sufficient, enclosed city by producing a manual and model of their version of a biosphere. Following an ecology unit involving two outdoor labs and experiments with ecosystems in bottles, I present this scenario (adapted from Environmental Demonstrations, Experimentations & Projects by T. R. Brehman) to the Sophomore Biology classes at Yarmouth High School: The air, water and soil will soon be too polluted and the survival of the human race depends upon the building of a biosphere. The remnant chosen to enter this city will be there for an indefinite period of time. Companies are formed and named; decisions are made as to the proposed population and city sizes; and representative geographical location in the world; and then each member takes on specific topics to research which are outlined in a guideline. The resulting manual is presented as a proposal for the contract to build this city. With nothing allowed in or out once it has been built and occupied, some of the problems to be solved include :

* technological support systems like energy production, water and air purification, waste disposal, food production, essential industries, architectural design, transportation
* Social and economic parameters like the governmental structure, education, communication, population control, consequences for rule violations

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* Physical and emotional needs such as recreation, culture, religion, medical and handicapped provisions

In addition to the technical manual, there is a scaled model to be built with as much detail as possible.

Goals

There are several goals imbedded in this project. Aside from the obvious ones of getting the students to think about the interconnectedness of everything and to apply some of the ecological principles we studied, and all the problem solving and brainstorming that will automatically happen, there was the incorporation of computer technology. The computer designed manual must include all explanations, diagrams and blueprints of support systems as well as a scaled drawing of the entire city inside and out with, of course, appropriate footnotes and bibliography. For students who have never done much beyond word processing on computers, this proves to be a challenge and an eyeopener! Then there is the aspect of working as a group - those who don't like to work with others quickly find that it's impossible for them to complete their own sections without consulting the other members and if your groups are crafted carefully , you can be sure that almost every student will be engaged. I'd be the first to admit that it isn't always ideal - all my classes are heterogeneous and despite my best efforts, there is sometimes a "dysfunctional" group - but this then affords a lesson in the realities of life and learning to get along even with difficult people. In fact, one of the goals of this project was the continuation of the development of group process skills and to that end a portion of the grade comes from a rubric designed to judge exactly how far they have progressed in that area .

Another major goal is to introduce students to alternative resources. Much of what they have to know or research can not be found in the encyclopedia, nor is it all laid out in a book or Cliff notes! They are forced to go to the community and to local industries , and to interlibrary loan with the University. Many get creative and write letters to places even I hadn't thought of - for example, the Astro Dome for dimensions of the dome to see if their outside structure was physically possible to construct (feasibility is one of the parameters of the project) .

Procedures

1. This project was beer conducted with 96 Sophomore Biology students placed in groups of 3, 4 or 5 (4 is ideal) . The groups are heterogeneous and there's something for everyone from the hands-on model building to the technical manual designs ; from science to social studies(STS !) I have tried having them choose their own groups , I've picked randomly from a hat, and I've designed the groups to balance abilities and prevent all lower achieving students from ending

up together. No system is perfect and because in other less involved projects they have chosen their groups, most seem fairly satisfied to have me do the choosing.

2. Getting together as a group is always a problem. Time in class varies - mostly there are a few intense group brainstorming times to share information , make decisions and coordinate various aspects of the project with the actual manual writing and model building outside class. I introduce the project in October and have intermediate due dates for different aspects and the final project isn't due until May, when the models are displayed in our school Products Fair. This is the ideal lesson plan for those substitute days because any time you are out, they can work in their groups - no time wasted on busy work and the students are always begging for more time together. I also use it when there's extra time left in a class or half the class is gone on a field trip - there are many ways to build in time without sacrificing other content you wish to pursue. Another approach would be to make this a quarter project or a mini-course. It could also be done as an interdisciplinary unit in conjunction with another subject area teacher be it math or social studies or English.

3. I strongly suggest doing it with only one class of students the first time - it would let you see what they can produce

from what you gave them vs what you thought you wanted - and then you can modify the instructions to better meet your particular goals, as well as allow you to see what the time schedule will be both for the student's completing the work and you grading it.

4. I let my librarian know when the project was starting so she could be forewarned of the deluge of students that would come asking for obscure material and we have put things on reserve so that no one group can "hog" all the best books.

Resources

Students are encouraged to use local and university libraries, visit industries, consult other teachers and community members, and write to agencies like the EPA. I have collected articles on Biosphere II for them to consult and have begun a list of the best resources used by the students. I also notified the school librarian and the town library of the project and they have been on the lookout for appropriate material ever since.

The only costs are to the students and the models must be made from recyclable or recycled materials. I encourage them to be creative and emphasize that they are not to spend a lot

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of money. My only expense has been to buy film to take pictures of all the models to add to my "exemplar" notebook for next year's class to get an idea of what is expected. I also do not return the manuals but use them as examples as well.

A guideline booklet for the students and evaluation tools are available, including a way to judge group process skills.

The space requirements are determined by number and size of models displayed. This past year we had to line them up in the hall - they were marvelous!

Conclusion

This has been a project that has allowed the more academic students to "stretch" to even higher levels of achievement and those less scientifically interested to exceed their own expectations. Our school believes that all students can learn at their own high level and this is one project that allows them to do just that.

Facilitating a complex group project of this type and then evaluating it is time consuming. However, just watching normally unproductive students come "alive" in the group sessions as they struggle to solve problems and begin to see the interconnectedness of virtually everything and seeing the

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excitement over their models and the obvious pride in the resultant products is worth the extra work. I can't say enough about this project. It's challenging to the teacher and student alike. It is so interdisciplinary that even though it is in the third year of full implementation, it is still evolving as new ramifications are realized and new applicable technologies are developed.

Bibliography

Brehman, Thomas R. Environmental Demonstrations, Experiments and Projects for the Secondary School New York: Parker Publishing Co., Inc., 1973

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