BORROWING EARTH: A CURRICULUM FOR DEVELOPING
ENVIRONMENTAL LITERACY IN THE MIDDLE SCHOOL

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ABSTRACT

BORROWING EARTH: A CURRICULUM FOR DEVELOPING ENVIRONMENTAL LITERACY IN THE MIDDLE SCHOOL

By Kristen Harfmann

Humans have a history of dominating Earth’s ecosystems and causing extensive damage to the planet. Unfortunately, if this pattern continues, humanity will face an environmental crisis because Earth will no longer be able to sustain human life. With strategic measures and the development of more sustainable ways of life, however, the ability of Earth to support human life will be improved. Education is an ideal instrument for bringing about this shift because middle school children are capable of thinking critically and developing solutions to the environmental issues that threaten humanity.

The proposed curriculum focuses on the issue of sustainability and addresses factors such as culture and the environment, human impact on the environment, reduction, and the development of an action plan. The selected environmental issues of deforestation and extinction, pollution and waste, population growth, global warming, and over-consumption were chosen because I believe they are the most important and the most easily comprehensible to middle school students. In addition, these issues lend themselves exceptionally well to action plans, which are an important aspect of the curriculum. Students will also investigate the role that culture plays in human relationships to the environment and will study human impact on the Earth.

With emphasis on constructivism, experiential learning, inquiry, decision-making, and project-based community-oriented learning, the curriculum uses a methodology that is highly effective and will result in the development of life-long learning and action. Because knowledge is an unlimited resource, it is the key to developing more sustainable ways of life on Earth. As they develop environmental literacy, students will become more active citizens and will help society progress toward sustainability.
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The following curriculum document represents a merging of scholarly research with creative design. As I developed the ideas to be presented in the curriculum, I began by evaluating my personal belief system and formulating a rough mental image of the curriculum as well as its implementation in a middle school classroom. With this vague conceptual framework in mind, I began to conduct research and to do extensive reading in both disciplines: pedagogy and curriculum design, and environmental issues and ecology. This research expanded my knowledge base and added structure to my own vision of the curriculum to be developed.

Throughout the document, I have included a variety of citations from my research in order to substantiate the claims I have made and to give credibility to my ideas. These citations are limited, however, as the result of my goals and intentions for this endeavor. As I developed this curriculum, I deliberately limited the number of research citations so that the document would not resemble a simple report on the ideas of other scholars in the fields of environmental education and curriculum development. My personal ideas played a central role in the development of the curriculum, so too much emphasis on the research of others would betray the premises upon which I developed the curriculum.

For the sake of analogy, consider the curriculum to be a house. The research involved in the project is the internal structure of the walls, the unseen beams holding up the floors and ceilings and giving the house its shape. When one enters the house, however, it is not these beams that one sees; it is instead the color of the walls, the hardwood floor, and the arrangement of the windows in each room. My creative ideas
and personal ideologies are these elements of design in the curriculum. While the house would not be able to stand without the support of the underlying structural elements, it is the elements of design that give it its character and originality. For this reason, I have chosen not to focus too heavily on citing research so as to not take away from one’s ability to analyze the design of the curriculum and to view the house as a whole.
Part 1: Environmental Issues

Introduction

As humans, we exist as part of a fragile ecosystem called the Planet Earth. The earliest cultures relied on the natural environment to sustain their hunter-gatherer way of life. They took only what they needed from the natural environment, and often worshipped or held ceremonies to show respect for the natural world. As agriculture became a more integral part of the lives of many cultures, humans continued to depend on the Earth. The sunlight, water, and rich soil provided by the Earth allowed humans to grow many crops and livestock to sustain themselves.

Although humans have always had close connections, both physical and spiritual, with the Earth, we are part of a delicate balance on this planet. The modern day ecosystem is in a state of disequilibrium because humans are exploiting and destroying the planet in order to support their needs and desires. If this pattern of destruction continues, humans will soon face an insurmountable crisis because Earth will no longer be able to support them.

The disaster facing humanity in the near future can be prevented, however, through careful planning and the evolution to a more sustainable way of life. As the youngest members of society, children are capable of the foresight and planning required to accomplish this task. For this reason, environmental education will become an increasingly important element of the education system. By educating young people
about the importance of adopting a sustainable lifestyle, we have the chance to save the planet before the damage is too great to be repaired. For this reason, an environmental curriculum focusing on developing a sustainable future for life on Earth is invaluable.

Overview of Environmental Issues

In order to rationalize the importance of developing a solid environmental curriculum, it is first necessary to develop an awareness of the environmental issues facing humanity. While there is a long and growing list of issues that face the environment, certain issues are easier for children to understand, so the curriculum will focus on these issues. There are five particular issues that lend themselves quite well to investigation and action by middle school students; the five issues upon which the curriculum is based are: 1) deforestation and extinction; 2) pollution and waste; 3) population growth; 4) global warming; 5) and over-consumption.

1) Deforestation and Extinction: Deforestation and extinction go hand in hand because as forests are cleared, many species lose their habitats and become extinct. The primary causes of deforestation are agriculture, timber harvesting, livestock grazing, and the building of roads. Deforestation is particularly detrimental in tropical regions, because rainforests contain an abundance of biodiversity; once deforested, these regions become prone to erosion and desertification. Half of the world’s original tropical forests have disappeared as the result of human activity. Although increased awareness has led to the movement to replant deforested areas, only one acre is replanted for every six acres that are deforested (Dunn, 1997).
Extinction is a direct consequence of deforestation, and it is estimated that up to 100 plant and animal species become extinct every day. The primary causes of extinction are lack of knowledge on the part of humans, habitat loss, hunting, agriculture, and the introduction of non-native species. With extinction comes the loss of biodiversity, which in turn leads to lost opportunities for scientific discovery. Of all the species that have existed on the Earth, 90 percent are now extinct (Dunn, 1997). It is estimated that fourteen million plant and animal species currently live on Earth, and of these at least 12,000 are threatened with extinction (Callahan, 2004).

2) Pollution and Waste: Pollution and waste production and disposal are issues that plague the Earth because instead of reducing waste, humans are continuing to generate more with each passing day. Even though we are already running out of room to dispose of our trash, we continue to produce more disposable and single-use items instead of reusing the same items. In 1960, Americans generated an average of 2.7 pounds of trash per person every day; in 1991, they generated an average of 4.3 pounds per person every day. This increase reflects the shift toward a “throw-away” society, and it will catch up with us.

Although recycling programs are becoming more prevalent, landfill space is decreasing even more rapidly. This issue is particularly important because it is perhaps the one with which children can most easily identify. Every individual is responsible for generating garbage every day, and middle school students would find this topic especially interesting because of its relevance to their own lives.
3) **Population Growth:** The global population is currently six billion, and it is expected to reach 10.5 billion by the year 2050 and eventually level off around 11 billion (Hernandez, 1999). This growth rate is the result of a decreasing death rate and increasing life expectancy due to modern technology and medicine. Population growth is greatest in developing countries because of lack of knowledge about birth control and a lower average education level. Population growth in developed countries such as the United States has slowed down because of more widespread use of birth control and higher average education levels that delay childbearing for women.

Uncontrolled population growth exacerbates the effects of other environmental problems such as waste, pollution, deforestation, and global warming. With more people on the planet, there is inevitably more food necessary, more waste produced, and greater overall impact on the environment. By slowing population growth, the effects of environmental issues will be less significant.

4) **Global Warming:** Climate change is the result of increased levels of carbon dioxide, methane, chlorofluorocarbons, and other gases released into the atmosphere by humans. The total atmospheric concentration of carbon dioxide has increased by 30 percent in the last 100 years, and to stabilize the levels there would need to be an 80 percent reduction in carbon dioxide emissions immediately. Of all the carbon dioxide put into the atmosphere by humans, 80 percent is the result of burning fossil fuels, and the other 20 percent is the result of deforestation. The United States is disproportionately responsible for this phenomenon: with five percent of the world’s population, the United
States contributes 22 percent of the world’s carbon dioxide from burning fossil fuels (Dunn, 1997).

Methane accounts for 15 percent of the increase in global climate, and is released into the atmosphere by livestock and as a result of deforestation. Chlorofluorocarbons (CFCs) account for 24 percent of the warming trend, and are used in refrigerators and in Styrofoam containers. The global temperature is expected to rise by 7.2 degrees Fahrenheit by the year 2050, and this will lead to a rise in sea level and a 21 percent decrease in arctic ice.

5) Over-consumption: Of the issues chosen for this curriculum, over-consumption is perhaps the most vague because it refers to a lifestyle rather than to a specific phenomenon. This issue also carries over into many other areas of environmental concern, and it encompasses such things as depletion of natural resources, and food and water supplies. It also applies to the mentality that many humans in developed countries have; this mentality is one of insatiability. Globally, 20 percent of the world’s people in high-income countries account for 86 percent of the total private consumption expenditures (Behind, 2003). The average United States citizen consumes 30 times as much as a citizen of India, and if everyone on Earth consumed at the rate of North Americans, it would take four planets like Earth to provide the materials and energy required to sustain human life (Population, 2002). Many people hold the belief that it is our right to dominate the ecosystem of Earth and use any means necessary to satisfy our desires. Items such as beef, sugar, and bananas, which were once considered luxury items because of their high cost and inefficient means of production have now come to be
seen as necessities (Behind, 2003). This shift has occurred at a great cost to the environment, and the issue reflects an attitude which will be further discussed later in the proposed curriculum.

**Culture and the Environment**

In studying the impact that humans have on their natural environment, one cannot deny the influence of cultural views. The disparities between consumption patterns in North America and those in less developed countries is evidence of this fact: the ideology associated with one’s culture plays an important role in determining the relationship one has with the environment. Because of this important connection between culture and the fate of the natural world, the curriculum must focus on illuminating and challenging the cultural ideology of Americans that underlies attitudes toward the environment.

One aspect of American culture that is of particular importance is the assumptions and attitudes that shape actions regarding the environment. When the American colonists came to the New World, they adopted a frontier mentality that drove them to explore and dominate “unsettled” land. To this day, Americans still hold this frontier mentality, and this has led to the attitude that humans, especially those from North America, are set apart from the laws of nature and have the right to dominate every region of the Earth (Hernandez, 1999). This mentality is one that children should have the opportunity to examine and question as they embark upon their environmental education journey.

Another aspect that will be explored is the value system of American culture. When compared to other cultures, Americans have an insatiable desire for material
possessions. This is evident in the fact that wealth and power are more important to Americans, whereas family and contentment are more important to other cultures. Unfortunately, this desire for wealth contributes to the over-consumption that plagues the environment and threatens the Earth’s ability to sustain human life. This is an important aspect of American culture that should be challenged as children develop ways to reduce human impact on the environment.

Perhaps the most significant aspect of culture that plays a part in the future of life on Earth is the emphasis on technology and development. Americans tend to have the motto, “development at any cost.” Along with this belief goes the idea that harm to the Earth is simply the inevitable price we must pay to have an industrial civilization. This motto, however, is based on the faulty assumption that resources are unlimited and that technology is capable of solving all humanity’s problems (Hernandez, 1999).

While technological advancement and development is part of human nature and does bring with it many benefits to humanity, there is a point at which the consequences must be realized. The costs of technology will take their toll on the environment, and eventually, on humans. Therefore, it is necessary that children begin to explore the future of technology and the assumptions that guide decisions about industrial development. It is only through foresight and planning that humans will be able to sustain life on Earth and slow the deterioration of the planet Earth.
Human Impact on the Earth

Before students begin investigating ways to reduce human impact on the Earth, it is important that they understand the role humans play in the global ecosystem. This requires that students develop a broad understanding of basic ecological principles. At this stage it is necessary to explore the concept of carrying capacity, or the number of living people that can be supported on Earth. Once students have gained an understanding of the factors that play a part in the ability of the Earth to support life, they will be able to explore ways to preserve the environment.

It is also important that students develop an awareness of the current trends in human impact on the environment, such as those outlined previously. A consciousness of these issues will allow students to grasp the significance and relevance of preserving the natural environment. This part of the curriculum is intended to be an information-gathering phase during which students will increase their knowledge of relevant environmental issues as well as ecological issues and the role that humans play in the global ecosystem.

Moving Toward a Sustainable Future

The goal of the curriculum is to allow students to explore ways to increase the chances of sustaining life on Earth for future generations. Sustainable development is defined as something that must be embraced by the economies of the world so that they meet the needs of today’s generation without compromising or stealing from future generations (Hernandez, 1999). Using this as a framework for the curriculum, students
will investigate answers to the question, “How can we create a more sustainable future for life on Earth?” There are five aspects of this action plan that serve as starting points for the curriculum:

1) Citizenship: Before global change can take place, students must learn to view themselves as citizens of a society that is responsible for preserving the environment. This citizenship involves developing awareness of environmental issues and taking responsibility for personal action. Just as citizens of the United States have the responsibility to vote in elections, citizens of the global ecosystem have the responsibility to do their part to preserve it.

As students begin to view themselves as citizens with responsibilities regarding the future of the planet, they will evaluate their actions according to their impact on the environment. For example, students must identify actions such as eating beef, driving cars with poor gas mileage, and buying items with excessive packaging as irresponsible and resistible; likewise, they must identify actions such as recycling, using public transportation, and buying energy-efficient appliances as responsible and irresistible. This concept of citizenship is crucial to the future of the environment because it shows students that their actions have effects that extend beyond their own lives; therefore, it is important that individuals realize that they owe it to their fellow citizens to act responsibly with regard to the environment.

2) Attitude/Value Shift: To ensure the sustainability of life on Earth, humans must learn to change their attitudes about the natural environment. This can be done by
questioning one’s own beliefs and learning to distinguish between wants and needs. Because over-consumption is caused by greed and lack of foresight, challenging the validity of one’s desires will be effective at reducing human impact.

While changes in the value system of society do not occur instantaneously, an awareness of the detrimental effects of the desire for wealth and technological advancement can go a long way toward developing sustainability. As students solidify their understanding of the cultural forces that govern human activity, they will be more equipped to challenge and counteract those forces. This gradual shift in attitudes and values is necessary if life is to be sustained on Earth.

3) Humans as Members of a Biological Ecosystem: In addition to understanding the ecological principles that are responsible for supporting life on Earth, students will realize that humans are not exempt from the biological rules that apply to all other living organisms. This powerful concept will be very effective at ensuring sustainability of life on Earth. When students come to the realization that carrying capacity applies to human life on Earth, they will undoubtedly ask what happens when Earth can no longer support human life. This question will lead to an understanding of the relevance of paying attention to the effects of human activity on Earth, because resources are not unlimited.

It is important that students view themselves as members of the global ecosystem, rather than as rulers of it. Humans are members of the food chain and are susceptible to all biological principles that apply to other organisms. As soon as humans recognize their place in the web of life, they will be on the road to sustainability.
4) **Individual Action:** Sustaining life on Earth means that every individual must take action to reduce human impact and destruction. Middle school students are capable of developing ways to take individual action to preserve the environment. The curriculum emphasizes personal contribution and impact, so individual action is an essential part of the puzzle. During their studies, students will identify ways they can personally contribute to reduction efforts and make a difference.

5) **Larger Scale Action:** While individual action is important, larger scale action is also important. Students must develop an understanding of the legislation pertaining to the environment, as well as the political issues surrounding decisions about the environment. Students may also explore ways to take action on a community level, or even possibly on a larger scale.

**Conclusion**

The question of how life on Earth can be sustained is one that will continue to be important for years to come. Because of human activity and carelessness, the Earth is in peril and faces an uncertain future. This future depends on the awareness and action of dedicated members of society.

Middle school students represent a group of citizens who are capable of understanding environmental issues and taking action to preserve the environment. Through effective instructional practices, educators can work toward sustaining life on Earth by influencing those young people who can make a difference.
Part 2: Pedagogy and Ideology

Introduction

Education is a force that has the power to transform and improve the society in which we live. Because of its role in bringing about change and reform, education is the perfect tool to use in order to address the environmental issues currently plaguing our society. A curriculum based on these issues is central to bringing about the desired shift toward sustainability.

Knowledge: An Unlimited Resource

The key to environmental education lies in the fact that in our world of limited natural resources, knowledge is one resource that is unlimited. While the Earth’s supplies of oil and coal will eventually be depleted, knowledge will never be threatened by such a fate. Knowledge, indeed, only grows in availability as we make new scientific discoveries and expand our understandings of the universe and the world in which we live. Therefore, education is the means by which knowledge may be spread and further developed. As people grow in their awareness of environmental issues, they are renewing this human resource.

Knowledge is a resource which can never diminish in abundance, as it is impossible to lose the awareness that one has gained about an issue. Consider the analogy of an artist mixing paint to produce a desired shade of color: the desired color
represents a person’s understanding and belief system, and each component color represents the bits of awareness that contributed to the development of that person’s understanding. Once a drop of a yellow paint (a new awareness) is added to the mixture, it becomes an inseparable part of the final product. No matter how many other colors are added after the yellow drop, the yellow will permanently remain part of the mixture and can never be retrieved. This analogy illustrates the irreversibility of the awareness process: once one has awareness of an issue, it contributes to that person’s understanding and belief system and cannot be isolated or removed regardless of what is later learned.

The only force threatening the spread of knowledge is the desire for ignorance, or the denial of reality. If awareness contributes to the development of knowledge and understanding and cannot be lost, then it is clear that education and increased awareness are powerful tools for moving toward sustainability. Once someone constructs a new understanding about a concept, it is natural to internalize the knowledge and move toward action. Therefore, as knowledge is developed and spread through education, our society will move closer to sustainability through environmental action.

**Developing Environmental Literacy**

One goal of the environmental curriculum is to promote and foster environmental literacy in students. This means moving beyond the traditional role of education to celebrate human progress and developing an educational framework that portrays human dependence on nature. If environmental education is something that teaches students how they are connected to the natural world, then all education is to some extent
environmental. To educate students without making them aware of their place in Earth’s ecosystem is not truly educating them. Because environmental issues are only growing in importance and the future of life on Earth depends on addressing these issues, denying students access to this awareness and understanding is selling them short and doing society a tremendous injustice.

Environmental education is education for the future because it encourages students to challenge the status quo and critically evaluate themselves in relation to the global issues facing society. It challenges students to envision the future and ask themselves how they can achieve the future they want through finding sustainable ways of life. Finally, this form of education invites students to develop alternatives to solve environmental problems and take action to improve life on Earth (Hernandez, 1999).

Environmental literacy is perhaps the most important step toward developing a sustainable future for human life on Earth. According to the United Nations Educational, Scientific, and Cultural Organization (UNESCO), the objectives of environmental education are awareness, knowledge, attitudes, skills, and participation (Hernandez, 1999). As students participate in environmental education, they will begin to develop environmental literacy. While life on Earth has not previously required this environmental knowledge, the future of life on Earth depends on it.

**Ideology and Methodology of the Curriculum**

In order to be effective, the environmental curriculum should be based on constructivism, experiential learning, inquiry, decision-making, and project-based
community-oriented learning. These characteristics will allow students to learn effectively and develop meaningful knowledge regarding sustainability of life on Earth.

**Constructivism:** The constructivist model of education suggests that learning cannot be separated from the social context in which it takes place. Students develop meaningful understandings of scientific concepts through modifying their existing schema, or mental structures, and actively building new knowledge. The features of the constructivist model are active engagement with phenomena, use and application of knowledge, multiple representations, use of learning communities, and authentic tasks. Therefore by interacting with others and with science materials, students can construct new understandings about scientific concepts (Krajcik, 2003).

An environmental curriculum should build upon students’ existing knowledge using a constructivist teaching approach. With this approach, students will be encouraged to recall previous experiences with environmental issues, and their schema form the foundation for the construction of new understandings about the Earth and the importance of preservation. Through actively engaging in experiments and investigations and collaborating with others, students will be able to construct meaningful understandings as they achieve environmental literacy.

**Experiential Learning:** Environmental education must be experiential in order to move students toward environmental action. By participating in hands-on activities and exploring the concepts as they learn them, students will be more engaged in learning and will retain their knowledge in order to apply it outside the classroom. This engagement
in experiential learning will ensure that the goal of changing human behavior is achieved (Heimlich, 2002).

The steps in experiential education are: 1) creating an opportunity, 2) involving the learner in an experience, 3) processing the experience, 4) generalizing the experience to other situations, and 5) applying the knowledge (Heimlich, 2002). By creating the opportunity for learning and involving the learner in an experience, the educator guarantees engagement of the students. By processing the experience, students are able to discover what they learned, and are then able to generalize the experience to other situations. The most important step is applying the knowledge, because this is the action phase. When students have engaged in experiences together and have learned by hands-on activities, they are more able to apply their knowledge. This is an appropriate method for environmental education because application of knowledge is the key to change and the development of sustainable living.

**Inquiry:** Most of the learning that takes place as a result of the curriculum will be through inquiry. According to the National Science Education Standards, inquiry includes making observations, posing questions, examining what is already known, planning investigations, reviewing what is already known in light of experimental evidence, using tools to analyze and interpret data, proposing answers and predictions, and communicating the results. The standards require that students use scientific inquiry and develop the abilities to think and act in ways associated with inquiry so that they come to view science as inquiry (National Research Council, 2001).
Environmental education is well suited for inquiry learning because the issues to be studied offer many opportunities for posing questions and investigating. Because there are multiple answers when it comes to environmental policy, open-ended inquiry is an excellent way for students to explore sustainable alternatives to our current ways of life. Through scientific prediction and experimentation, students will be able to engage in meaningful learning about sustainability and the Earth.

**Decision-making:** Decision-making is defined as, “the act of choosing [a course of action] among a set of alternatives under conditions that necessitate choice” (Heimlich, 2002, p. 97). This aspect of education is central to the issue of environmental sustainability because individuals must choose among alternatives in order to ensure the future of life on Earth. John Dewey’s “Reflective Thinking Process” for good learning consists of four phases in decision-making: 1) problem phase, 2) criteria phase, 3) solution phase, and 4) implementation phase (Heimlich, 1999). During the problem phase, students identify the problem to be addressed and analyze it. In the criteria phase, students determine what would satisfy the problem; then, in the solution phase, students develop alternatives for meeting the criteria. Finally, students carry out their decision during the implementation phase.

The goal of environmental education is to bring about change in human behavior, and this is achieved through action. Decision-making is directly linked to action because without the ability to make decisions among alternatives, students will not be able to take action. For this reason, decision-making is a crucial element in the environmental curriculum.
Project-based learning: Project-based learning holds a great deal of promise for the future of environmental education. This form of learning emphasizes depth over breadth of coverage, the comprehension of concepts over knowledge of facts, and the development of problem solving skills over the development of isolated skills. Student interest is of top priority, and technology is skillfully woven into the curriculum. The teacher is viewed as a facilitator rather than as an expert, and students carry out self-directed activities in order to learn (Newell, 2003).

In project-based learning, students work to solve a problem, which is defined as anything involving doubt, uncertainty, or difficulty (Barell, 2003). Learning is contextual because students are involved in the process. Collaboration is an important aspect of project-based learning because students can learn from each other and share ideas; this also ensures that all students are actively involved in the learning process. Project-based learning is learner-driven and life-long because it encourages students to develop curiosity and the ability to question things in the world around them. When students participate in this form of learning, they are more motivated because they see the relevance of the concepts to their lives, and this allows the learning to be transformational (Newell, 2003).

The benefits of project-based learning to the field of environmental education are numerous. Of particular importance is the fact that it encourages students to develop those habits of mind that are necessary for developing more sustainable ways of living. In order to understand the importance of sustainability, one must be willing to think critically and question the rationale behind our current ways of living. Project-based
learning allows students to practice asking questions, thinking critically, and collaborating. These skills may then be applied toward the goal of sustainability.

**Community-oriented:** Sustainability cannot be achieved by a single student in a single isolated classroom. In order for this goal to be reached, the curriculum must include an element of community participation and action. As part of the learning process, students will venture into their surrounding community and conduct investigations, interviews, take field trips, and implement the sustainable solutions they develop.

Involvement with the community is also important because the curriculum emphasizes citizenship and membership in a global society with the responsibility of developing sustainable ways of life. There is no better way for students to understand the importance of citizenship than to witness firsthand the role it plays in the community to which they belong. By becoming involved and invested in the community, students are more likely to feel a sense of responsibility regarding the sustainability of their individual actions. For this reason, the curriculum is community-oriented and encourages students to see themselves as active members of their community.

**Subject Integration**

The curriculum consists of a series of integrated units, and each unit addresses one of the central environmental issues upon which the curriculum is focused. Organized in this way, the curriculum will appear to students and teachers to be more coherent and applicable to the real world, where problems do not exist in isolation. While it may seem
that the environmental curriculum is primarily a science curriculum, it is in fact integrated across the disciplines. Individual units may not integrate all four subjects, but there will be equal distribution of subjects throughout the units.

**Social Studies:** The curriculum provides many opportunities for integrating social studies. Most obvious is the emphasis on citizenship, which can be explored from the perspective of social studies as well as from the perspective of environmental sustainability. In addition, it would be beneficial for students to study the history of human interaction with the environment and the role that culture plays in environmental relationships and action. Another area of integration involves environmental policy and lawmaking. Because sustainability is an issue that faces our society and our culture, it is inevitably and undeniably connected to the study of social studies as well as to science.

**Language Arts:** As they progress through the curriculum, students will do a lot of reading and writing about the environmental issues facing the planet. The curriculum provides many opportunities for students to engage in persuasive writing about environmental action. Students will also have opportunities to evaluate the media’s portrayal of various events, so they will have the chance to practice evaluating the writings of others.

**Mathematics:** Mathematics is a subject that is very closely tied to the concept of sustainability. The idea of population growth involves studying graphs and trends, which are important mathematical concepts. Students will also have plenty of opportunities to make predictions and calculations having to do with the carrying capacity of the Earth
and the rate at which humans are destroying it. The very idea of sustainability is based on predictions of the future of life on Earth, and these predictions are based on mathematical calculations using the information we have about human impact on the Earth.

**Conclusion**

The key to developing sustainable life on Earth is educating young people about the environmental issues that face our society and jeopardize its future. By focusing on constructivism, experiential learning, inquiry, decision-making, and project-based community-oriented learning, the curriculum has the ability to impact students’ minds and move them to action. The curriculum integrates all subjects so that students see the interconnectedness of the disciplines and can practice dealing with a problem the way they would deal with it in real life. These characteristics of the curriculum enable it to be transformative and bring society closer to sustainability.
Part 3: Implementing the Curriculum

Intended Audience

The environmental curriculum previously described is intended for a middle school classroom, ideally grades five or six, in the United States. It has been developed with this age group in mind because in grades five and six children are beginning to seek understanding about how they fit into the society around them. At this time, children are very capable of analyzing environmental issues and developing action plans. The curriculum is intended for students in the United States because of the impact that culture has on the environmental impact of humans. Citizens of the United States have a disproportionately high impact on the environment compared to that of other cultures, so it is important that the students who participate in the curriculum share a common cultural experience and perspective.

Content To Be Learned

During the course of their participation in the curriculum, students will:

1) **Analyze** the interactions of other cultures, including their own, with the natural world;

2) **Explore** the impact that humans have on the Earth, both on an individual and a global scale;
3) **Cultivate** awareness of the importance of conservation and develop an appreciation for the ecosystem of the planet;

4) **Identify** ways that human impact may be reduced in the future; and

5) **Create** action plans to work toward preserving the future of the natural world.
Learning Sequence: Sustainability

I. Theme 1: Culture and the Environment
   i. Unit 1: Underlying Assumptions and Ideologies of Various Cultures
   ii. Unit 2: Technology
   iii. Unit 3: Development/Advancement

II. Theme 2: Human Impact on the Environment
   i. Unit 4: Current Trends
   ii. Unit 5: Carrying Capacity of the Earth
   iii. Unit 6: The Role of Humans in the Global Ecosystem

III. Theme 3: Reduction
   i. Unit 7: Deforestation and Extinction
   ii. Unit 8: Pollution and Waste
   iii. Unit 9: Population Growth
   iv. Unit 10: Global Warming
   v. Unit 11: Over-consumption

IV. Theme 4: Action Plan
   i. Unit 12: Citizenship
   ii. Unit 13: Attitude/Value Shift
   iii. Unit 14: Humans as Members of a Biological Ecosystem
   iv. Unit 15: Individual Action
   v. Unit 16: Larger Scale Action
Concept Map: The central idea is sustainability and consists of four major themes and their corresponding units of study.
Sample Integrated Unit

The following unit is an example of a unit that integrates mathematics and science in the curriculum. Designed to take place in a two-week span of time, this unit could be used to teach students about the pollution and waste component of reduction. This unit is representative of the type of integration and methodology that would characterize the other units in the curriculum.

**Unit 8 Title:** Trash Talk

**Goals of the Unit:** As a result of this unit, students will be able to explain the phenomenon of excess trash production and its impact on the environment. They will also be able to define recycling and make generalizations about trash production in our society. As part of their exploration of this topic, students will create and analyze pie graphs and bar graphs and use these to interpret data and make observations. Finally, students will develop action plans to reduce waste production in their school and evaluate them in terms of potential effectiveness. By the end of the unit, students will have a deeper understanding of environmental issues and of their role as individuals that make up the ecosystem of the Earth.

**Key Concepts in Science:**

- Excess trash production (as individuals and as a society)
- Landfills and biodegradability
- Recycling and its benefits
- Human impact on the environment
• Possible solutions and action plans
• Inquiry in science

**Key Concepts in Mathematics:**

• Creating and analyzing pie graphs
• Creating and analyzing bar graphs
• Collecting data and choosing an appropriate representation method
• Inquiry in mathematics
• Communicating mathematical ideas and drawing conclusions

**Lessons in the Integrated Unit:**

**Lesson 1: Visualizing Trash**
- While listening to a book being read aloud, students will record their visualizations of the text.
- On their own, students will record three visualizations they make while reading an article from *Ranger Rick* magazine.

The content of this lesson does not require previous knowledge, although students should be familiar with the idea that they can transfer reading strategies they learn to other types of text to help them comprehend what they read.

**Lesson 2: Biodegradability**
- When provided with a bag of trash, students will identify the length of time it takes each item to decompose in a landfill.

Students will use any background knowledge they have to complete this lesson. They will call upon previous experiences with litter and decomposing trash to determine how long it takes trash to decompose. This lesson serves to prepare students for the rest of the unit and engage them with the topic by relating it to their personal experiences.

**Lesson 3: Piles and Piles of Garbage**
- Using data they have collected for three days, students will calculate how much garbage they produce each day.
• Using data they collected after sorting their garbage, students will create a pie graph to depict what portion of their trash each type of material represents.
• Students will identify the information obtained from a pie graph and will make three observations based upon their graphs.

This lesson requires students to determine how much garbage they produce on a daily basis, but does not require previous knowledge of garbage. In order to complete the graphing part of the activity, students will have learned about basic ways of representing data in tables and expressing statistics such as mean, median, and mode. This knowledge will help them analyze their data. The questions at the end of the lesson also build upon students’ prior knowledge of ecosystems and humans as member of Earth’s ecosystem.

Lesson 4: And A Side Order of Garbage
• Using data collected by group members, students will create a bar graph depicting the amount of garbage generated by various fast food restaurant chains.
• Using their bar graphs, students will make three observations about fast food restaurants and garbage production.
• Students will explain the impact that fast food restaurants have on the environment and analyze alternative solutions.

This lesson introduces students to bar graphs, which follows logically after they learn about pie graphs in the previous lesson. Students also use the data analysis skills they learned in lesson three to analyze their data in this lesson. This lesson is deliberately very similar in format to lesson three because it is intended to allow students to build knowledge directly from the previous lesson. Both lessons cover similar content and allow students to explore garbage production in our society and represent this phenomenon graphically.

Lesson 5: EXPLAIN
• During class discussion, students will identify the main ideas they noticed through their explorations.
• Using their main ideas, students will make generalizations about garbage production, proportions of different types of trash, food packaging, and individual trash production in our society.
• Based on their generalizations, students will analyze the impact they have on the environment both as a society and as individuals.

The content that students explored in the previous two lessons is used in this lesson as students explain the phenomenon of garbage production. Students will use the data and observations they made during their explorations to make generalizations in this lesson. This allows students to bring together all the
knowledge they have gained so far in the unit and generate some main ideas about garbage.

Lesson 6: ReCYCLE
- While listening to a book being read aloud, students will record sequences of events.
- On their own, students will record sequences in the paper cycle while reading information from a website.
- During class discussion, students will define recycling and analyze its benefits.

In this lesson, students build upon the explanations they developed in the previous lesson to define recycling. The lessons are in this order because students first form generalizations about garbage production, and then define recycling as one possible solution. Students use knowledge they acquired through their explorations and their explanations in the last lesson to further explain garbage and recycling.

Lesson 7: Taking Action
- In small groups, students will create a waste reduction plan for their school.
- During class discussion, students will analyze ways that individuals can affect the environment by taking personal and local action.

After students have made generalizations about garbage production and defined recycling, they are prepared for this lesson which requires them to apply their knowledge. They will use everything they have learned in the unit and put it into action by developing an action plan. This should allow their thinking to shift from observing and defining to taking action and making a difference.

Lesson 8: Trash to Treasure
- Using miscellaneous collections of trash, students will create something that could be useful to them in their everyday lives.
- During class discussion, students will analyze the impact of reusing things on the environment.

This lesson requires students to apply their understanding of recycling to invent something from trash. By this stage in the unit, students should have a firm understanding of the problem of excess trash production. This knowledge will enable students to look at trash in a different light and use their creativity to find ways to reuse things they would normally throw away.

Lesson 9: EVALUATE
- Using the business letter format, students will write a letter to local officials, state legislators, and Congress proposing a law to reduce trash production.
• In their writing, students will provide justification and explain the rationale behind the proposed law.
• After proposing a law, students will identify ways in which their law could help the environment.

The final lesson in the unit, this lesson is an evaluation of the understanding students have gained over the course of the two weeks. Students must bring together all the knowledge they acquired and demonstrate their understanding by writing a letter about the issue they have studied. This builds upon all the activities in the unit to allow students to see the big picture and conclude the unit.
Visualizing Trash

1. **Lesson Goal/Short Summary:** Students will become familiar with the topic of study for the integrated unit. Beginning the unit with a picture book about trash allows students to start to think about the role of trash in their lives. The vivid descriptions in the book will make students think twice about things they throw away every day, and will help them to build upon their background knowledge for the rest of the unit. This picture book will also capture students’ interest and help to teach the skill of visualizing while reading.

2. **Objectives:**
   a. While listening to a book being read aloud, students will record their visualizations of the text.
   b. On their own, students will record three visualizations they make while reading an article from *Ranger Rick* magazine.

3. **Materials Needed:** A copy of the picture book *I Stink!* by Kate and Jim McMullan; students need copies of the article from *Ranger Rick* magazine; pencil and paper to record their visualizations.

4. **Procedure:**
   a. To begin the lesson, ask students how many of them are in charge of taking the garbage down to the roadside at home every week. This will engage students before the lesson begins.
b. Tell students that today is the first day of our integrated unit on garbage so that they understand that for the next two weeks they will be studying garbage. This sets the stage for the lesson as well as the unit as a whole.

c. Read *I Stink!* aloud and think aloud while visualizing the garbage truck and garbage in the story.

d. When halfway through the book, pause to ask students if they understand how visualizations are made in the story.

e. When reading the second half of the book, pause occasionally and ask students to write down visualizations they make during the story.

f. After finishing the picture book, distribute the *Ranger Rick* article. Working independently, students will read the article and record all their visualizations. During this time monitor students and answer questions.

g. When students have finished reading the article, lead a class discussion by asking students what they visualized in the article.

h. To conclude the lesson, ask students to think tonight when they go home about where their trash goes after it is picked up by the garbage truck once a week. This will prepare them for the rest of the unit.

5. **Questions to Begin the Activity:**

   a. How many of you are responsible for taking your trash to the roadside once a week?

   b. How many trash cans do you have?
c. How does the amount of trash your family puts by the roadside compare to that of your neighbors?

6. **Questions to End the Activity:**
   
a. How did visualizing help you to understand this picture book? How did it help you understand the article?

b. Where do you think that your trash goes after it is picked up by the garbage truck?
Biodegrading

1. **Lesson Goal/Short Summary**: Students will access their prior knowledge about trash and biodegradability by completing an activity that requires them to guess how long it takes various types of trash to decompose in a landfill. This activity will create interest in the topic of garbage and will stimulate students to ask questions and begin wondering about the impact that garbage has on the environment. After this activity, students will be prepared to explore the topic through inquiry lessons about garbage.

2. **Materials Needed**:
   a. Banana peel (one per group)
   b. Plastic bag (one per group)
   c. Plastic bottle (one per group)
   d. Aluminum can (one per group)
   e. Glass bottle (one per group)
   f. Styrofoam (one per group)
   g. Copy of activity (one per group)

3. **Procedure**:
   a. To begin the lesson, ask students what they think happens to trash in a landfill. Also ask students to recall times they have seen partially decomposed litter and discuss what it looked like and what type of trash it was.
b. Put students in groups of four and give each group a plastic bag containing a banana peel, a plastic bottle, an aluminum can, a glass bottle, and a Styrofoam cup.

c. Students will guess how long it takes the objects in their bag, including the bag itself, to decompose. They will record their guesses on a group worksheet.

d. When the class has completed the activity, discuss their guesses. Students will justify their guesses and explain their reasoning. Then tell the class the correct lengths of time for each item to decompose: banana peel (two years), plastic bag (10-20 years), plastic bottle (100 years), aluminum can (500 years), glass bottle (1000 years), and Styrofoam (10,000 years).

e. To conclude the activity, the class will discuss how their guesses compared to the actual lengths of time. They will also discuss things they found surprising or unbelievable.

4. **Questions to Begin the Activity**:
   
a. What do you think happens to trash in a landfill over time?

b. Have you seen partially decomposed trash before? What type was it and what did it look like?

5. **Questions to End the Activity**:
   
a. How did your guesses compare to the actual answers?

b. Why do you think some types of trash decompose more quickly than others?
c. How might this information influence the way you think about trash when you throw it away?

d. What was shocking or unbelievable to you about the information in this activity?
To Decompose or Not to Decompose?

With your group members, examine the objects in your plastic bag, including the bag itself. Guess how long it takes for each of the following items to decompose in a landfill and be prepared to justify your responses:

1. Banana peel: __________
2. Plastic bag: __________
3. Plastic bottle: __________
4. Aluminum can: __________
5. Glass bottle: __________
6. Styrofoam: __________
Piles and Piles of Garbage

1. **Lesson Goal/Short Summary:** Students will determine how much garbage they generate in a three-day period and will calculate what percentage of their garbage is food waste, metal, glass, paper, and plastic. Through making predictions about their own trash production, students will explore the phenomenon of trash production on a personal level. As they collect their own trash, students will acquire a common set of experiences upon which to build their knowledge about garbage and its effect on the environment. This lesson fully integrates science and mathematics because students engage in an inquiry lesson that involves the science concept of garbage and the math concept of pie graphs.

2. **Objectives:**
   
   a. Using data they have collected for three days, students will calculate how much garbage they produce each day.

   b. Using data they collected after sorting their garbage, students will create a pie graph to depict what portion of their trash each type of material represents.

   c. Students will identify the information obtained from a pie graph and will make three observations based upon their graphs.

3. **NCTM Content Standards:**

   a. Data Analysis and Probability (Grades 3-5): collect data using observations, surveys, and experiments.
b. Data Analysis and Probability (Grades 3-5): represent data using tables and graphs such as line plots, bar graphs, and line graphs.

c. Data Analysis and Probability (Grades 3-5): describe the shape and important features of a set of data and compare related data sets, with an emphasis on how the data are distributed.

4. **NCTM Process Standards:**

   a. Connections: Recognize and apply mathematics in contexts outside of mathematics -- students will be using mathematics skills in a science lesson about garbage and the environment, so they will see how they can use mathematical ideas in their own lives.

   b. Representation: Create and use representations to organize, record, and communicate mathematical ideas -- students will generate graphical representations of their data sets and will communicate their findings with the class.

   c. Representation: Use representations to model and interpret physical, social, and mathematical phenomena -- students will use graphical representations to model the physical and environmental phenomena of garbage production, and from these representations they will interpret their impact on the environment.

5. **NCTM Principles for School Mathematics:**

   a. Curriculum Principle: This lesson focuses on the important mathematical concepts of graphical representation and interpretation. In addition, the
curriculum is coherent because this lesson builds upon students’ knowledge of mean, median, range, and mode; the lesson is followed by a lesson about bar graphs, so skills are effectively organized for student learning.

b. Learning Principle: The learning principle is part of this lesson because students will learn about graphing with understanding. Because of the inquiry nature of the lesson as well as the integration into a science concept, students will see the context of their learning and will learn with greater understanding.

6. **Materials Needed:** Students will each need one large plastic garbage bag, and each group of four students will need five containers for sorting their trash. Each student will need five different colored markers and a copy of the activity handout. The class will need one bathroom scale per group in the classroom for students to weigh their trash.

7. **Procedure:**

   a. Students will make hypotheses and begin collecting their own trash on the first day of the unit, so they will have completed this phase of the lesson at the start of day three.

   b. Students will combine their trash with that of their group members and determine how much trash the group produced by having one student first weigh him/herself, then weigh him/herself holding the trash bag, and
subtracting to find the difference. They will record this information on their activity sheets.

c. Working as a group, students will sort their trash into five piles: food waste, metals, glass, paper, and plastic. They will then determine the weight of each type of trash using the above method. They will also record this information on their activity sheets.

d. Students will calculate the amount of trash produced by each person each day by dividing the total amount of trash by the number of days and number of people in the group.

e. Then students will determine what portion of the total amount of trash is represented by each of the five types of trash by dividing the individual weights by the total weight of the trash.

f. Following the steps on the activity sheet, students will create a pie graph to represent the trash produced by their groups.

g. When groups have finished creating their pie graphs, have a class discussion about general observations they can make using their graphs. Groups will share their findings with the class.

h. Instruct students to think of a pie graph they can construct using another data set that they generate. They will need to make three observations based on their pie graphs.

8. **Questions to Begin the Activity:**

   a. How much trash do you think you produce in one day?
b. What type of trash do you think constitutes most of your personal trash production?

c. Do you think you produce more or less trash than your family members?
    Your friends?

9. Questions to End the Activity:

a. Did your results support your predictions?

b. Were you surprised by how much trash you produced?

c. What implications do you think this information has for the environment?

d. Can you imagine if everyone in the world produced as much trash in one day as you did? Can you visualize this amount of trash?
Piles and Piles of Garbage

1. How much trash do you think you generate every day? Make an estimate of its weight in pounds: __________________

2. Of the five types of trash (food waste, metal, glass, paper, and plastic), which type do you think constitutes most of your own personal trash? _______________ Which type do you think constitutes the smallest portion of your personal trash production? _______________

3. For the next two days, you will collect all your trash in a large bag. Save everything you would normally throw away during this time period. Form a hypothesis describing what you expect to find out about your own personal trash production in a two-day period of time:

4. Combine your trash with that of your group members in one large garbage bag. Choose one group member to weigh him/herself on the scale. Record his/her weight. Then have this student hold the group's trash bag and weigh him/herself again. Record this weight. Now,
subtract the two weights to determine the weight of the group’s
trash.

a. Weight of person:________________

b. Weight of person with trash bag:________________
c. Calculated weight of trash bag:____________

5. Now sort your group’s trash into the five containers for food waste,
metal, glass, paper, and plastic. Determine the weight of each type of
trace using the method above.

a. Weight of food waste:____________

b. Weight of metal:____________

c. Weight of glass:____________

d. Weight of paper:____________

e. Weight of plastic:____________

6. Determine how much trash is produced by each person each day by
dividing the total amount of trash by the number of people and
number of days:________________________

7. Calculate the percentage of the total amount of trash that each type
represents by dividing the weight of each type by the total weight:
8. Imagine that each type of garbage represents a piece of a whole pie.

Use the picture of a pie below to show the relative sizes of the pieces that represent each type of garbage (use a different color for each type):

a. Food waste: __________ %

b. Metal: __________ %

c. Glass: __________ %

d. Paper: __________ %

e. Plastic: __________ %
6. You just created a pie **graph** to show the relative amounts of each type of trash produced by your group. Pie graphs are used to show relative parts of a whole, just as pieces of pie represent parts of the whole pie.

Which piece of pie in your drawing above is the largest? ___________

What does this tell you about that type of garbage? ________________

7. Come up with three more observations you can make based on your pie graph:

8. Did the results of your experiment support your hypothesis? Explain.

9. What did you find surprising about your findings?

10. The average North American makes enough garbage in one year to fill a dump truck. Do your findings support this fact? How?
And A Side Order of Garbage

1. **Lesson Goal/Short Summary**: Students will become familiar with the amount of trash generated by fast food restaurants and will compare various chains using bar graphs. This hands-on inquiry activity integrates both science and mathematics concepts by combining a study of garbage produced by fast food chains with a study of bar graphs. By working in groups and visiting different fast food chains, students will share in a common set of experiences to help them to explore the impact of trash on their own lives. This lesson prepares students for the next phase of the learning cycle during which they will define trash, recycling, and the impact of trash on the environment.

2. **Objectives**:
   
a. Using data collected by group members, students will create a bar graph depicting the amount of garbage generated by various fast food restaurant chains.

   b. Using their bar graphs, students will make three observations about fast food restaurants and garbage production.

   c. Students will explain the impact that fast food restaurants have on the environment and analyze alternative solutions.

3. **NCTM Content Standards**:
   
a. Data Analysis and Probability (Grades 3-5): collect data using observations, surveys, and experiments.
b. Data Analysis and Probability (Grades 3-5): represent data using tables and graphs such as line plots, bar graphs, and line graphs.

c. Data Analysis and Probability (Grades 3-5): describe the shape and important features of a set of data and compare related data sets, with an emphasis on how the data are distributed.

4. NCTM Process Standards:

a. Connections: Recognize and apply mathematics in contexts outside of mathematics -- students will be using mathematics skills in a science lesson about garbage and the environment, so they will see how they can use mathematical ideas in their own lives.

b. Representation: Create and use representations to organize, record, and communicate mathematical ideas -- students will generate graphical representations of their data sets and will communicate their findings with the class.

c. Representation: Use representations to model and interpret physical, social, and mathematical phenomena -- students will use graphical representations to model the physical and environmental phenomena of garbage production, and from these representations they will interpret their impact on the environment.

5. NCTM Principles for School Mathematics:

a. Curriculum Principle: This lesson focuses on the important mathematical concepts of graphical representation and interpretation. In addition, the
curriculum is coherent because this lesson builds upon students’ knowledge of mean, median, range, and mode; the lesson follows a lesson about pie graphs, so skills are effectively organized for student learning.

b. Learning Principle: The learning principle is part of this lesson because students will learn about graphing with understanding. Because of the inquiry nature of the lesson as well as the integration into a science concept, students will see the context of their learning and will learn with greater understanding.

6. Materials Needed: Students will collect packaging from fast food restaurants the night before the lesson. Each student will need a copy of the activity handout.

7. Procedure:

a. In groups, students will formulate hypotheses about the relative amounts of trash produced by various fast food chains. Each group member will eat at a fast food restaurant the night before the lesson and save all trash served with their meals. They will be instructed to determine in their groups who will attend each restaurant, so that each student visits a different chain, but all students will order comparable meals.

b. Students will compare their trash with that of their group members and complete the activity as a group.

c. As a group, the students will create a bar graph to compare the amounts of trash generated by each fast food restaurant chain.
d. When groups have finished creating their bar graphs, have a class
discussion about general observations they can make using their graphs.
Groups will share their findings with the class.
e. Instruct students to think of a bar graph they can construct using another
data set that they generate. They will need to make three observations
based on their bar graphs.

8. **Questions to Begin the Activity:**

   a. When was the last time you visited a fast food restaurant and ordered a
      meal? Can you recall how it was packaged?
   b. Which fast food restaurants do you think produce the most trash?
   c. Why do you think fast food restaurants serve so much trash with the
      meals?

9. **Questions to End the Activity:**

   a. Which fast food restaurant produced the most trash? Did your results
      support your hypothesis?
   b. Did anything about the experiment surprise you?
   c. What impact do you think fast food restaurant trash has on the
      environment?
   d. Can you think of ways that fast food restaurants could use less packaging
      with their food?
And A Side Order of Garbage

1. Fast food restaurants are notorious for producing a lot of unnecessary trash for the sake of convenience. Make a hypothesis about which fast food restaurant chain serves the most trash with its food, and be sure to include reasons that you believe this chain serves the most trash:

2. With your group members, choose four fast food restaurants to investigate. Each group member will visit one of the chains and order a comparable meal (your group should decide what all of you will order). Save all the trash served with your meal and bring it to class tomorrow to share with your group.

3. Compare the garbage you obtained with that of your group members. List all types of garbage collected by your group members from the fast food restaurants:
4. What surprises you about the amount or types of garbage produced by fast food restaurants?

5. Use the grid paper to compare the amount of garbage produced by each fast food restaurant. For each restaurant, shade in a box for each piece of trash collected to form a column of shaded boxes above the restaurant name.

6. By shading in boxes to represent pieces of trash at each restaurant, you have created a **bar graph**. Bar graphs are used for comparing data among groups, in this case different fast food chains. What observations can you make about the various fast food restaurant chains from looking at your bar graph?
7. Did your results support the hypothesis you made at the beginning of the experiment? Explain.

8. How do you think the amount of trash produced by fast food restaurants affects the environment?

9. Can you think of alternatives or ways that fast food restaurants could reduce the amount of garbage they serve with their food?
EXPLAIN Part 1

1. **Lesson Goal/Short Summary**: The class will discuss what students learned in the exploration phase of the learning cycle. Students will analyze the data they collected and will share their findings with the class. Using their new knowledge, students will make generalizations about garbage production. Their experiences in the explore phase will prepare them to explain the phenomenon of garbage production.

2. **Materials Needed**:
   a. Chalkboard
   b. Chalk

3. **Procedure**:
   a. To begin the lesson, tell students that they are going to use their findings from the last two days of experimentation to make some conclusions about garbage.
   b. Give each group five minutes to discuss what they learned from the investigations.
   c. Ask each group for one important idea they developed and write it on the chalkboard. Then ask if each group agrees or disagrees, and add comments to the idea as necessary.
   d. Continue in this fashion until all groups have share all their findings about garbage production, the proportions of different types of trash produced, total trash production per person, and packaging of food.
e. At the end of the lesson, the class will have constructed a list of important ideas and discoveries they made in their investigations. They will record these concepts in their science notebooks as the main ideas of the learning cycle on garbage.

4. **Questions to Begin the Activity:**
   a. What are the main ideas your group discovered through the investigations you conducted?
   b. Can you make generalizations about the information you collected and analyzed?

5. **Questions to End the Activity:**
   a. What impact does garbage have on the environment?
   b. What role do you as an individual play when it comes to garbage production?
   c. Are you surprised by anything you’ve learned so far?
1. **Lesson Goal/Short Summary:** During the second part of the explain phase of the learning cycle, students will learn the reading skill of sequencing while defining and learning about recycling. Because recycling is a multi-step process, students will be able to use the skill of sequencing to explore a website that discusses paper recycling. In this way students will become familiar with recycling and will be able to define the process and its importance.

2. **Objectives:**
   a. While listening to a book being read aloud, students will record sequences of events.
   b. On their own, students will record sequences in the paper cycle while reading information from a website.
   c. During class discussion, students will define recycling and analyze its benefits.

3. **Materials Needed:** A copy of the picture book *Where Does Our Garbage Go?* By Paul Showers; students will need access to computers where they can use the website [http://www.bfi-salinas.com/kids/index.html](http://www.bfi-salinas.com/kids/index.html). Pencil and paper to record sequences of events; a chalkboard and chalk.

4. **Procedure:**
   a. Introduce students to the lesson by asking them to think of processes that require a sequence of steps. This will get students focused on the topic of sequencing and its role in recycling.
b. Read *Where Does Our Garbage Go?* aloud and model the reading strategy of sequencing by drawing a ladder on the chalkboard and illustrating sequences in garbage disposal in a landfill.

c. After each step in the sequence, check for understanding by asking if students have questions about how the sequence of events involved in disposing of trash in landfills was determined.

d. At the part of the book that discusses steps in recycling, tell students to help construct another ladder to sequence the steps in different types of recycling.

e. As students identify the steps they identify in the text that was read, record these steps on the board.

f. When finished reading the book, ask for questions to make sure that students understand how sequencing was used to understand the text about garbage disposal and recycling.

g. Students will then use computers to access the website and construct a sequencing ladder about the paper cycle.

h. When students have completed their sequences, define recycling as a class and discuss the benefits of recycling to the environment; students will record these benefits.

i. Give students the assignment of writing detailed step-by-step instructions for completing a simple task such as brushing their teeth, getting on the school bus, etc. They will be required to write out the sequence of steps
and also illustrate the process using a ladder like the ones we used during modeling and guided practice.

5. **Questions to Begin the Activity:**
   
   a. What activities can you think of that require following a specific sequence of steps?
   
   b. Why are sequences important? What would happen if you performed the steps of a sequence out of order?
   
   c. What sequence do you think your garbage goes through after you throw it away?

6. **Questions to End the Activity:**
   
   a. How did sequencing help you to understand the process of recycling?
   
   b. How does recycling benefit the environment?
Taking Action

1. **Lesson Goal/Short Summary:** The elaborate phase of the learning cycle will give students the opportunity to apply what they have learned about garbage and the environment to develop a school waste reduction plan. By developing such a plan, students will understand the importance of taking action on a local level, and they will use the knowledge they have acquired to assess the trash production in their school.

2. **Materials Needed:**
   a. Poster board
   b. Markers

3. **Procedure:**
   a. To begin the lesson, ask students if they can think of ways that individuals can impact the environment.
   b. Put students in groups of four and explain that they will be developing school waste reduction plans. Instruct them to use the knowledge they have gained over the course of the unit to think of ways to reduce the amount of trash produced at their school.
   c. Each group will design a poster advertising their plan: the poster should include the name of their plan, its components, and any other useful information.
d. When all groups have finished their posters, each group will share its plan and poster with the class. Group members will explain the rationale behind their plan and discuss how they would implement it in the school.

e. When all groups have presented their plans, we will discuss what impact the plans might have on the trash production at the school as well as on people’s attitudes toward the environment.

4. **Questions to Begin the Activity:**

   a. What role do individuals have when it comes to reducing garbage production and protecting the environment?

   b. How could you take action on a local level?

   c. What effect might a school waste reduction plan have on the environment?

5. **Questions to End the Activity:**

   a. Are your waste reduction plans feasible? Why or why not?

   b. How will your plans affect the environment?

   c. How might people’s attitudes toward the environment change if you implemented a school waste reduction plan?

   d. What difficulties might you encounter as you implemented your plan? How would you solve these problems?
Trash to Treasure

1. **Lesson Goal/Short Summary**: During this phase of the learning cycle students will apply their knowledge of the problem of excess garbage production as well as recycling to create something out of garbage. Using a pile of garbage, students will use their creativity to construct something that could be useful to them in their everyday lives. This activity allows students to apply what they have learned to discover that in many cases the things we throw away are still useful in some way.

2. **Materials Needed**:
   a. Miscellaneous trash (clean)
   b. Glue
   c. Tape
   d. String

3. **Procedure**:
   a. To begin the lesson, ask students if they can think of ways that various objects such as plastic bags or tin cans can be reused.
   b. Students will each receive a small bag containing several pieces of trash, and will be instructed to create something out of their trash.
   c. Working individually, students will invent things that could be useful to them in their everyday lives and construct these items out of their trash.
d. When students have finished their creations, each student will have the opportunity to share his/her invention with the class and explain how he/she would use it.

e. To conclude the lesson, students will discuss how their knowledge of the amount of trash production enabled them to think about ways to reuse things. Also discuss the impact that reusing things could have on the environment.

4. Questions to Begin the Activity:

   a. Can you think of ways to reuse items such as plastic bags that are typically thrown away after one use?

   b. How might reusing things affect the environment?

5. Questions to End the Activity:

   a. How did your awareness of the problem of trash production enable you to look at your bag of trash in a different light?

   b. How can your trash invention be used in your life?

   c. If more people reused objects the way you just did, what impact might this have on the environment?

   d. How could you transfer this activity to your everyday life? In other words, how could you reuse things you normally throw away?
EVALUATE

1. **Lesson Goal/Short Summary:** In this final stage of the learning cycle students will write letters to congressmen and in doing so will address the issues they have learned about in the integrated unit. In their letters, students will give reasons why there should be a law restricting individual garbage production in the United States. By giving reasons, students will demonstrate a clear understanding of the impact of garbage on the environment and the importance of reducing this impact. This activity, in addition to being a chance for the teacher to evaluate students’ learning, will serve as a way to show students the importance of taking individual action on environmental issues.

2. **Materials Needed:**
   a. Instructions for the letter (one per student)
   b. Writing supplies such as dictionary, thesaurus, etc.

3. **Procedure:**
   a. Ask the class if they think laws regarding environmental issues should be more numerous and more enforced. Also ask students to consider the impact they might have by writing letters to congressmen.
   b. Each student will receive a copy of the instructions for writing the letter. They will work individually to write their letters and turn them in at the end of the day.
   c. While students are working, be available to answer questions and monitor the letter-writing process.
4. **Questions to Begin the Activity:**

   a. Do you know of any laws currently in existence to protect the environment?

   b. Do you think additional laws restricting garbage production would help to reduce the impact of trash on the environment?

   c. What impact might you have if you wrote a letter addressing the issue of garbage and sent it to congress?

5. **Questions to End the Activity:**

   a. How were you able to address the issues we’ve discussed in your letter?

   b. If you were a member of congress, how would you respond to the letter you wrote?

   c. What do you think would happen if more people took this type of action on environmental issues?
Letter to Congress

Use the knowledge you’ve acquired during this unit to write a letter to Congress. Make sure you use the business letter format, and include the following things:

- Three main ideas we discussed having to do with garbage, such as the amount of garbage production, types of garbage that are especially problematic, recycling, etc.
- Your law proposal with at least three justifications stating why you feel this law is necessary
- The impact this law might have on the environment, and why this is important
- Any other information that might make your case more convincing or support your law proposal
Scoring Rubric for Letter

Correct use of the business letter format; correct spelling and grammar  _____/10

Effective discussion of three main ideas about garbage and recycling  _____/25

Valid justification for the necessity of the proposed law  _____/20

Thorough discussion of the impact the proposed law could have on the environment  _____/25

Overall effectiveness, creativity, and convincing nature of the letter  _____/20

Total Points  ____/100

Additional Comments:
References


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