(where it is presumably absorbed) and as they take in useful energy from the environment.

ENTROPY, EDUCATIONAL ORGANIZATIONS, AND LEADERS

Entropy as conceptualized in each of the above frameworks has different properties and effects on organizations. However, with each approach, entropy serves both *destructive* and *constructive* functions. The concept of entropy helps explain why organizations seem to change gradually over time and why organizational change efforts often meet with resistance and require energy/effort. For school leaders, entropy may help explain why change initiatives lose their effectiveness with time, why teachers resist change efforts, or why unanticipated consequences arise from change efforts. It may also be used to inform leadership decisions regarding the most appropriate response to change dynamics with the larger school organization.

—Michael A. Owens and Bob L. Johnson Jr.

See also boundaries of systems; bureaucracy; management theories; organizational theories; systemic reform

Further Readings and References

Beer, S. (1966). *Decision and control: The meaning of operational research and management cybernetics*. New York: John Wiley & Sons.

Bertalanffy, L. (1968). *General systems theory.* New York: Braziller.

Clausius, R. (1865). On several convenient forms of the second fundamental equations of the mechanical theory of heat. In J. Tyndall (Trans.), *The mechanical theory of heat with its applications to the steam-engine and to the physical properties of bodies.* London: John van Voorst.

Gladyshev, G. P. (1999). On thermodynamics, entropy and evolution of biological systems: What is life from a physical chemist's viewpoint. *Entropy 1*, 9–20.

Jantsch, E. (1980). *The self-organizing universe.* Oxford: Pergamon.

Scott, W. R. (2002). *Organizations: Rational, natural, and open systems* (5th ed.). Englewood Cliffs, NJ: Prentice Hall.

ENVIRONMENTAL SUSTAINABILITY

Environmental sustainability involves the adoption of a new vision and practice that responds to the profound challenges posed to contemporary societies by short-term and environmentally destructive practices. The first worldwide forum that combined environmental sustainability and education took place at the 1975 International Workshop on Environmental Education held in Belgrade, Yugoslavia. The workshop, sponsored by the United Nations, put forth a document known as the Belgrade Charter that offered a global framework for environmental education. Since then, numerous international declarations have exhorted governments and organizations worldwide to redirect their educational efforts toward protecting the integrity of the environment and its natural resources for present and future generations. In practice, the vast majority of educational institutions have focused on complementing the study of the natural sciences with outdoor education as a way of expanding classroom instruction. Since the 1990s, however, a growing number of academic institutions have extended this focus to include an overall philosophical umbrella centered around "place"; this focus includes, among other areas, the convergence of multiple disciplines along environmental themes, the promotion of environmental protection in career and technical education, and the greening of the day-to-day operations of K–16 campuses.

EARLY PEDAGOGUES AND THE ENVIRONMENT

The efforts by the United Nations and other international organizations to promote environmental sustainability are the most recent manifestations of theory and practice advocated by educational leaders worldwide since at least the eighteenth century. Swiss educators Jean-Jacques Rousseau and Johann Heinrich Pestalozzi were two of the earliest pedagogues who advocated that children should have direct sensory contact with the natural world to develop a healthy personality. German educator Friedrich Froebel, the founding father of the kindergarten movement, further developed these ideas. Influenced by Christian ideals, Froebel believed that God was the unifying force that brought together humankind and nature, and it was incumbent upon educators to nurture in children a strong sense of continuity with the natural world. Froebel was one of the first to discuss a pedagogy of place as a way of promoting individual autonomy and ensuring the unity of selfhood with the living and nonliving world. Another leading educator who

recognized the pivotal role that the natural environment plays in enhancing the cognitive and emotional well-being of children was the Italian pedagogue Maria Montessori. Without subscribing to the romanticism and mysticism characteristic of Froebel, she nonetheless agreed that involving children in real stories of the universe opened endless possibilities that would inspire their imagination.

For Montessori, the universe story provided the background for much of the content of the elementary curriculum. According to her, this content helped facilitate a biological and psychological connection between children and nature, and ultimately satisfied children's search for a sense of meaning and purpose in the world. A contemporary of Montessori's from a different part of the world was the poet and educator Rabindranath Tagore. He challenged the anthropocentrism of his contemporaries by stating that to take destructively and wastefully from nature was in fact severing humanity from itself. Founding Santiniketan, a school near Calcutta, India, in 1901, Tagore believed that learning should integrate the intellectual, emotional, physical, and spiritual domains. Like Froebel and Montessori, Tagore supported gardening as a key strategy for allowing children their first glimpses of the wonders of nature, the interdependence of living things, and an incipient sense of responsibility and duty. Gardening also was a way to involve children in the ongoing cyclical process of birth, growth, decay, and rebirth of life. He also encouraged the idea that in order to love something, one needed to truly know it. For instance, children could not learn to care for the forest from afar; they needed to walk, sing, eat, meditate, laugh, and sleep in its midst. Tagore even suggested that children should walk barefoot in the forest, as feet were the limbs best adapted for intimately knowing the earth by their touch.

Froebel, Montessori, and Tagore were certainly not the only educators to advocate the integration of nature in schooling, but they are emblematic of those who considered the experiences of children incomplete if they were not associated with the mysteries of the natural world. Whereas their philosophies have greatly influenced primary-level education, they have yet to exert any widespread influence at the secondary and tertiary levels.

A PEDAGOGY OF PLACE

A pedagogy of place has been variously called ecological education, place-based education, community-oriented schooling, ecological education, bioregional education, and environmental education. Advocates of this pedagogy have put forward four main reasons for the inclusion of place and environmental protection in modern education. First, place and the environment unveil a key omission in modern education: it celebrates everything human but fails to acknowledge the complete dependency of the social world on the natural one. As a result, students grow up without an understanding of the importance of the environment. Second, place helps overcome the fragmentation of knowledge typical of modern education. This fragmentation prevents children from understanding the complexity and diversity of natural places, such as wetlands—among the most important ecosystems on earth, wetlands are vital for filtering water and air, preventing floods, providing a habitat for a wealth of flora and fauna, and reinvigorating the economy—which can only be responsibly analyzed through an interdisciplinary curriculum. Third, place challenges the abstractness of modern education by lending specificity to the theoretical and intangible concepts learned in the classroom. And fourth, place offers students the opportunity to develop a sense of stewardship toward nature through experiential activities (e.g., field trips, community service, service learning) that have the environment as its main focus.

Gardening offers a clear illustration of a pedagogy of place. Following the teachings of early pedagogues of nature, schools worldwide have set up organic gardens maintained by staff and students. Thereby, students learn the manual skills related to cultivation and harvesting and, depending on the program, may also learn skills related to food preparation and entrepreneurship (through selling the produce or prepared foods). Often, schools adopt the garden as a thematic unit for the curriculum:

- In natural sciences students explore plant and insect identification, biology, and ecosystem functioning.
- In math they average crop yields, calculate volume and weight of seeds and produce, and measure quantities for recipes.
- In social studies they analyze the social and economic consequences of capital-intensive versus labor-intensive farming and of synthetic-based versus natural-based agriculture.
- In language arts they focus on ancient and modern stories, poems, and legends around food cultivation and harvesting.

- In fine arts and performance arts they deal with painting, dance, theater, sculpture, and other art forms that center on gardens and food.
- Through community service students donate the harvest, share their knowledge and skills, and make exhibits for various community events.

School gardens can also bring together the school and community in ways that privilege ancestral knowledge and practices, some of which may originate in indigenous communities. The role of elders is particularly important given that often they are the sole repositories of a community's lore. Through such collaborations, schools have recovered and included in their regular schedules festivals, dances, games, and other communal celebrations that acknowledge the relationship between the community and its surroundings; legends, stories, and poems that describe the dramatic transformation suffered by natural habitats under industrialization and the expansion of urban areas; and other noncommodified forms of knowledge such as ethnobotany, which values plants for other than their edible use. Students thus learn to cultivate plants that can be used for medicines, clothing, shelter, household goods, and religious ceremonies.

ECOLOGICAL CAREER AND TECHNICAL EDUCATION

In addition to organic gardening and agricultural skills, proponents of connecting schooling and nature support making other vocational activities an integral component in the development of an ethic of care. Introducing students to career and technical activities that help preserve the natural environment prepares a new generation of adults with vital skills for preserving the integrity of the natural environment. This is particularly important for children from low-income families—generally the chief enrollees in vocational education programs—who tend to live in rural and urban neighborhoods that are disproportionately exposed to dangerous environmental conditions (e.g., water and air pollution; hazardous levels of asbestos, lead, and other materials in homes; inadequate sewage systems; heavy deforestation). With their newly acquired skills, students can pursue postsecondary education or employment opportunities that can ameliorate these conditions.

Some examples of alternative occupations being taught in secondary-level vocational education are ecological architecture, through which students learn to design, build, and renovate homes and other buildings using sustainable, recyclable, and energy-efficient materials; ecotourism, in which they learn to promote the cultural and natural beauty of the area while minimizing the human footprint; self-sufficient, organic farming that integrates livestock and agriculture; outdoor education for young children to teach them to appreciate nature; the design of energy-efficient computer and electronic equipment; solid waste recycling; and park management.

Just as in any form of economic production, each of these examples involves a transformation of energy and matter, which inevitably carries with it an environmental impact. Teaching students how to do life-cycle assessments—which measure the environmental cost of a product from the moment the raw materials are extracted to the moment the product is thrown away and decomposes—and to come up with less damaging alternatives can greatly increase their ecological awareness and skills while increasing their future employability.

GREEN CAMPUSES

Academic institutions consume vast amounts of water, food, energy, toxic materials, and other products, and generate large quantities of organic and inorganic waste. Yet increasingly around the world educational institutions are recognizing that they can model the art of living responsibly by minimizing the environmental impact of their physical campuses. Perhaps the earliest international effort in this regard occurred in Talloires, France, in 1990, where representatives of universities worldwide got together to discuss ways in which their institutions could use their daily operations, teaching, research, and outreach to implement programs that promote resource conservation, energy efficiency, recycling, and waste reduction. This movement has been influencing K–12 schools to follow suit. Some of the targeted areas include the following:

- Water and energy: Reduction of water and energy consumption through campaigns that address the behavior of students and staff; the installation of water- and energy-conserving fixtures (e.g., low-flow toilets and faucets, room-occupancy sensors); the use of drought-tolerant plants and native species in landscaping; and the incorporation of passive solar building design into future buildings.

- Food: Offering food services that privilege organically and locally grown items, that use fewer processed foods, and that offer more vegetarian menu options.
- Procurement: Purchasing reusable, recyclable, and nontoxic products and those made from recyclable materials; buying non–chlorine-bleached paper; acquiring energy-efficient computers and other electronic equipment; and purchasing wood products harvested sustainably.
- Solid waste: Reduction of solid waste generation through the composting of food waste from cafeterias and a campuswide recycling program that covers paper, glass, aluminum cans, and plastics.
- Transportation: Offering reduced-price and preferential parking for carpools, subsidizing staff and student use of public transportation, and retrofitting fleet vehicles to use clean fuels (e.g., solar energy, natural gas).

In terms of a pedagogy of place, K–16 school campuses offer myriad possibilities for studying their locality. Teachers and students can explore such questions as, Where do the water, electricity, and food used on campus come from, and at what environmental cost? How clean is the water? What are the principal sources of energy (e.g., hydroelectric, coal, natural gas, methane)? How much water and electricity are consumed annually and at what financial cost? How does this campus compare with institutions of similar size? What forests were cut down to supply the institution with paper? How many vehicles travel to campus daily and how much pollution is generated? Where do the campus garbage and sewage go? How much of the garbage is deposited in a landfill, incinerated, recycled, and composted? The sources of the energy and materials that enter the campus, and the sites where the wastes are eventually deposited, are some of the least discussed issues in the curriculum, yet they constitute exceptional opportunities to discuss from an interdisciplinary perspective the relationship between the student, the campus, and the larger ecosystem.

—Alberto Arenas

See also adolescence; aesthetics, in education; affective education; child development theories; civics, civic education; community education; contextual knowledge; curriculum, theories of; elementary education; extracurricular activities; learning, theories of; life-span development; middle schools; Montessori, Maria; motivation, theories of; philosophies of education; reform, of schools; science, in curriculum

Further Readings and References

Arenas, A. (2003). School-based enterprises and environmental sustainability. *Journal of Vocational Education Research, 28*(2), 107–124.

Froebel, F. (1912). *Froebel's chief writings on education* (S. S. F. Fletcher & J. Welton, Trans.). London: Edward Arnold.

Montessori, M. (1964). *The Montessori method.* New York: Schocken Books. (Original work published in English in 1912)

Tagore, R. (1923). *Personality: Lectures delivered in America.* London: Macmillan.

University Leaders for a Sustainable Future. (1990). *The Talloires declaration.* Washington, DC: Author.

EQUALITY, IN SCHOOLS

Equality connotes sameness and the absence of discrimination, while *equity* refers to fairness and social justice. By the twentieth century, schooling had been identified as crucial in connection with an individual's economic and social success; consequently, schooling assumed an importance for fulfilling the practical expression of equality.

Beginning with the 1954 U.S. Supreme Court decision in *Brown v. Board of Education,* and continuing with a steady increase in federal government programs in the 1960s and the education finance reform efforts in the 1970s, a major portion of mid- and late-twentieth-century education policy was directed at achieving greater equality. Equity in education has revolved around such issues as gender, race, socioeconomic status, disabilities, and fiscal equity.

GENDER

The goal of gender equity is to build learning environments where neither boys nor girls feel confined by stereotypes and expectations about who they are. Both boys and girls exhibit different strengths and have different needs; thus gender stereotypes can shortchange both genders. The research findings on the cost of gender bias are (a) concerning grades and tests, females receive better grades; males receive lower grades and are more likely to be grade repeaters, (b) with academic enrollment, females have increased their enrollment in science and mathematic course in recent years; however, male enrollment is higher in physics, calculus, and more advanced courses, (c) college programs