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The Teaching Bioshelter: A Missing Resource for Sustainability Education

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Abstract: The new educational revolution of Educating for Sustainability needs to be taught in a new, revolutionary teaching space; a teaching bioshelter. Drawing on the five ecological principles of the Center for Ecoliteracy, this new teaching space should reflect ecocentric design principles, rather than the previous anthropocentric industrial designs of our current school and college classrooms and campuses. A solar-powered, living classroom, a system of systems, such as a teaching bioshelter, opens new educational horizons by providing continuously available and hands-on learning environments not currently available to the Educating for Sustainability (EfS) curriculum. Fortunately, the architectural and technical design work for these kinds of spaces was pioneered nearly 50 years ago by numerous cutting-edge research groups, such as the New Alchemy Institute. It is suggested that these two ecological flows, of design and education, be joined to enhance and expand the mission of Educating for Sustainability.

Keywords: teaching bioshelter, classroom for EfS curriculum, teaching systems thinking, the third teacher, hands-on sustainability education, humanities and EfS, ecocentric design

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Figure 1: Photo credit: Scott Stokoe.

"What children learn does not follow as an automatic result from what is taught, rather, it is in large part due to the child's own doing, as a consequence of their activities and our resources."

Loris Malaguzzi, The Hundred Languages of Children

There is an educational revolution underway in western culture. Fired and directed by the rising challenges of social and environmental sustainability, the Educating for Sustainability (EfS) movement is dedicated to transforming educational systems using content and pedagogy required for the coming cultural transition (Federico, Cloud, Byrne, & Wheeler, 2003). Thus, there is significant focus today on both the content and the style of this educational transformation. However, there is another element of the educational system that is not currently engaged in this pedagogic reformation. This element was identified by the Italian educator and thinker, Loris Malaguzzi, an Italian early childhood educational innovator who recognized that not all learning flows from well-intended adults.

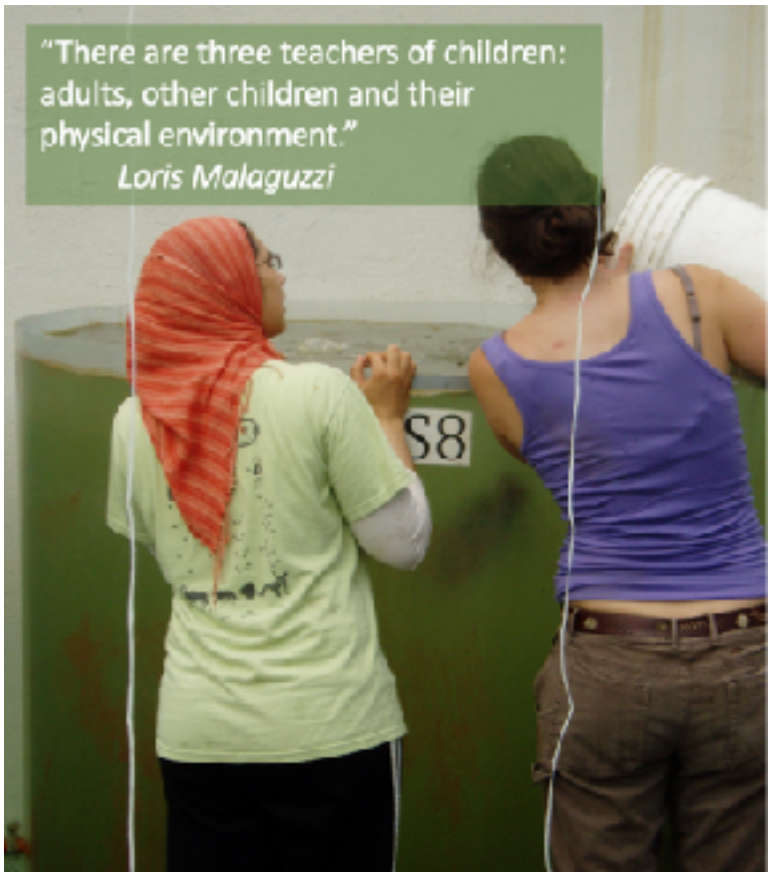
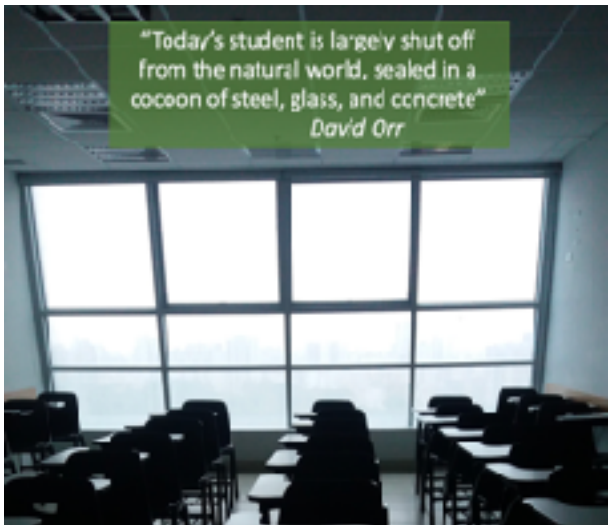


Figure 2: Aquaculture tank in a teaching bioshelter. Photo credit: Scott Stokoe.

Referred to as "the third teacher," Malaguzzi realized that beyond the adult activity and contact with other learners, students learn by interacting with the physical world around them (Biermeier, 2015). It is this material learning environment, as a conscious and developed educational element, that has not kept pace with the cascading flow of curricular evolution in EfS. From his ground-breaking work in early childhood education, Malaguzzi identified physical experiences and manipulables as a crucial and often overlooked component of educational design. His contributions made significant impacts in pre-school and early elementary education (Biermeier, 2015). However, as we move to the upper grades, the intellectual experience is held to be primary, often at the expense of physical, tactile and sensual reinforcement of ideas. The school building and campus, except perhaps for whiteboards and screens, are often ignored as an educational affordance. By the time we get to high school, the "third teacher" is all but lost to the educational process. There are exceptions, such as field trips and lab experiences, yet, for secondary and higher education, the field of education typically undervalues and underutilizes the role of the physical environment, including the school architecture and grounds, in a student's learning process. From Malaguzzi's perspective, one of the three teachers is diminished, if not lost.

Western civilization is now facing what many consider to be an existential cultural crisis (Orr, 1992) based on the current western dualistic anthropocentric perspective. Educating for

Figure 3: Photo credit: Rubén Rodriguez



Sustainability can and must rise to meet this challenge. But what if the learning environment is actually holding back the teaching of ecological literacy and systems thinking, the fundamentals that are the heart of EfS pedagogy? What if the majority of the nation's classrooms continue to reflect the values and assumptions of the failed industrial paradigm? And that the imbalanced emphasis on the mind, to the exclusion of the physical world, only serves to validate the current dualistic anthropocentric perspective? Perhaps it is time to pursue a classroom, a resource room, a living laboratory that reflects ecological principles; a teaching space based on a system of systems; an educational milieu that offers the values and concepts that are the core of EfS. To provide this ecological "third teacher" will require us to follow the lead of many successful indigenous cultures who have always embraced an ecocentric perspective. We must create a design process that resonates with the values and processes of ecological principles. Fortunately, we do not have to start from scratch. This ecological design process was successfully pioneered decades earlier by numerous organizations and designers. The work of one of these groups holds particular promise for the development of a new teaching space for the EfS movement.

Figure 4: New Alchemy Institute "Ark."
Photo credit: Earle Barnhart

In the late 1960's a small group of scientists began to explore an ecological basis for culture. Founded on Cape Cod, the New Alchemy Institute (NAI) pursued research focused on a radical design of renewable energy and sustainable agriculture systems (J. Todd, Todd, & Todd, 1980). Their work ranged from organic agriculture, tree crops and aquaculture to wind and solar energy systems and design. One of their most recognized and celebrated innovations was the creation of a new kind of building, a building based on ecological principles and the synergistic integration of food and energy systems. To highlight the importance of this innovative design process, they called this new building a bioshelter.

This building has qualities that seem familiar on the surface. Many people see it as a "greenhouse". Yet the building design reflects a transformative set of values and rules, while still producing energy, food and clean water. To distinguish this ecologically designed space from traditional greenhouse spaces, the creators designated it a "bio-shelter". This shelter-of-life reflected an iconoclastic shift for western design in the role of humans in the material world. Rather than an anthropocentric perspective of "owning" and "using" the natural

environment, these researchers chose an ecocentric design framework that abided by the rules and limits of ecosystems, a design criteria that placed humans back into the living systems of the planet (T. Todd, Todd, & Todd, 1984). This same ecocentric shift, twenty years later, is a core component of the EfS revolution, one of the signiture qualities that distinguishes EfS from environmental education (Federico et al., 2003). EfS developers and practitioners have broadly adopted this new perspective. An excellent example of this shift to ecological values is exemplified in the work of the Center for Ecoliteracy.

Established in 1995, the Center for Ecoliteracy of Berkeley, California, has been developing educational content for schools to incorporate the ecological paradigm into classroom teaching. In the process, they have developed an outstanding distillation of ecological thinking and values into a simple list that can be used throughout the K-12 curriculum. Titled the "Five Ecological Principles" (Stone, 2012) these concepts echo the same ecocentric perspective that guided the design, decades earlier, of the NAI bioshelters (see below). What NAI brought to building design in the 1960's and 70's became a defining focus of EfS practitioners like the Center for Ecoliteracy in the 1990's. Both provide a more sustainable way forward through an ecocentric framework.

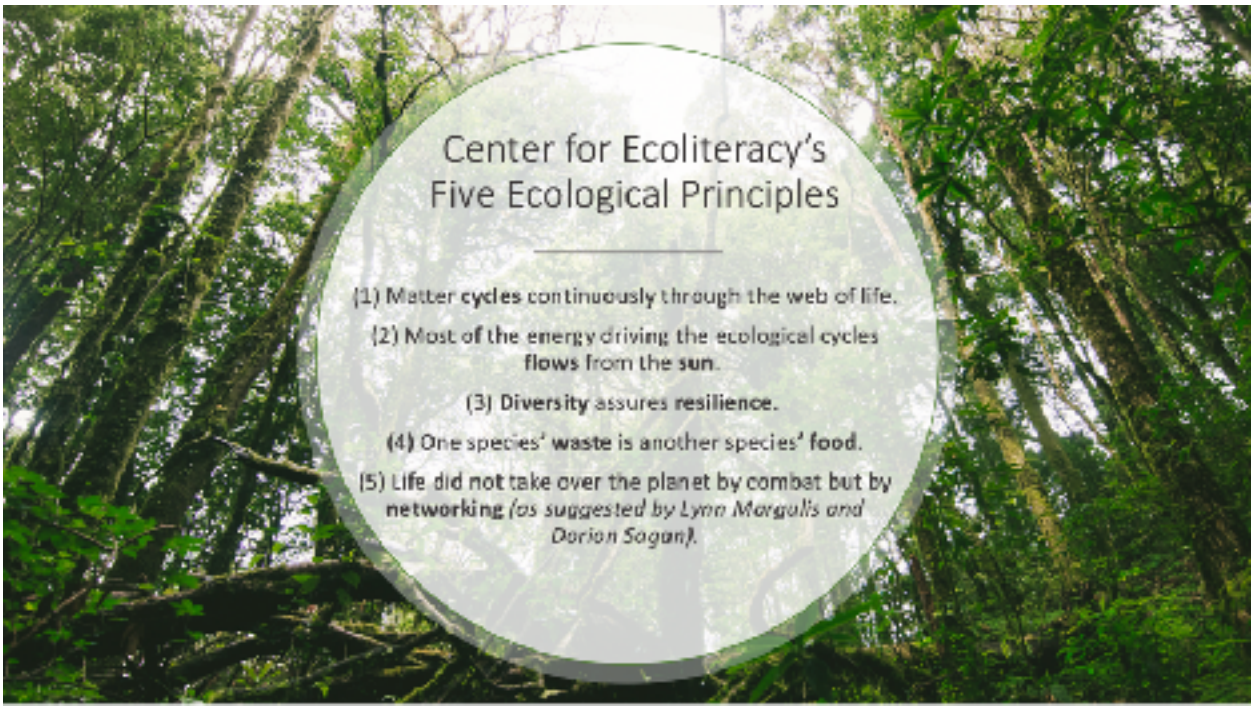


Figure 5: Content: Center for Ecoliteracy, Backgroumd Photo credit: Dhruva Reddy

Due to the scientific research mission of their work, none of the New Alchemy bioshelters were ever dedicated solely to the mission of educating for sustainability for the general population. This potential had to wait for the EfS revolution. I suggest that the label of "teaching bioshelters" be used to designate a new teaching space that combines the physical and intellectual achievements of NAI with the pedagogic developments of EfS. Rather than research and production, this bioshelter is dedicated to education. The mission of the teaching bioshelter is to

provide the physical and intellectual affordances for the teaching of ecological literacy and systems thinking and thus provide the missing physical experience of the "third teacher" for EfS.

Nearly every single classroom in the nation today separates the learner from the living world (Orr, 1992). Very few schools have accessible, manipulable and working renewable energy systems available to the teachers and students. Most of the flows of materials through the school, including food, wastes and water, are handled by employees and kept away from students. By design, the living world is almost completely barred from most human spaces, including school buildings. This means students are denied exposure to the living systems upon which they and all life depend. True ecological literacy called for by EfS will require personal and extended exposure to and taking responsibility for living systems (Orr, 2004). A teaching bioshelter provides these affordances to create the necessary deep and meaningful ecological experiences that lead to literacy.

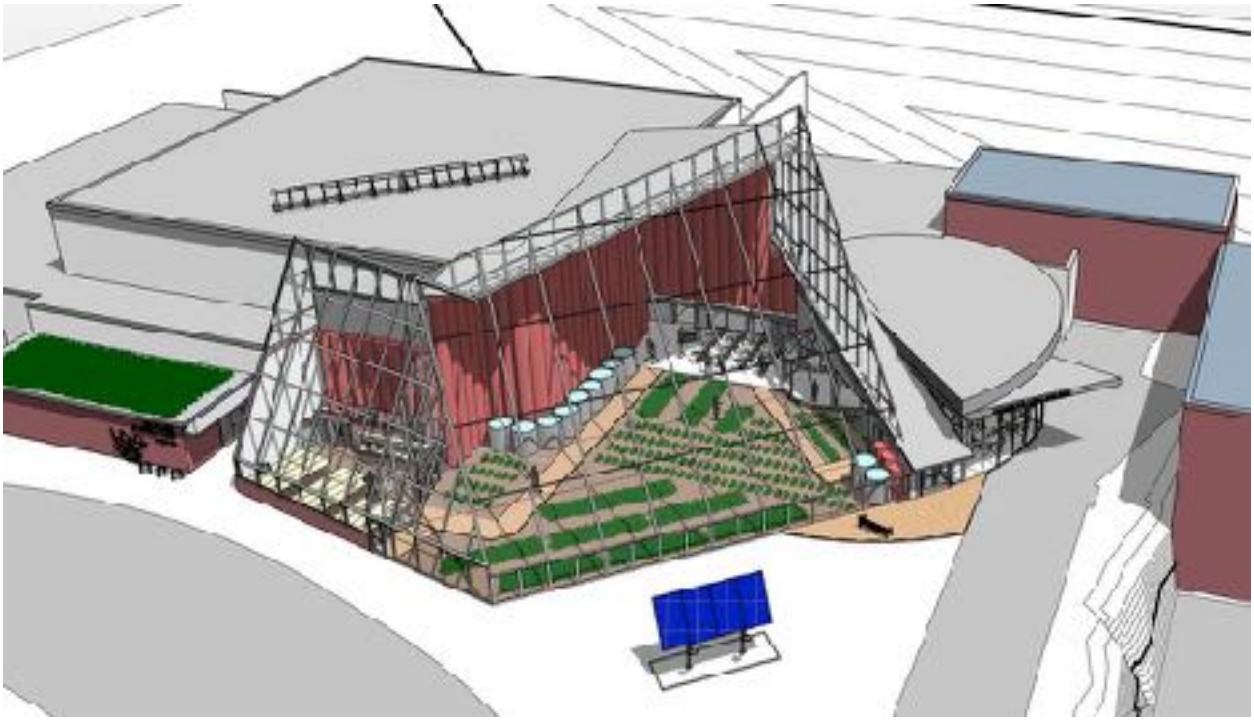


Figure 6: A proposed teaching bioshelter. Design: Scott Stokoe, Rendering: Banwell Architects.

Imagine a teaching bioshelter being attached to an existing school building. Imagine that this space is devoted to creating educational experiences that support and expand the intellectual experience now being pioneered by EfS across the entire curriculum. Imagine that the experience is scaled large enough to remove any sense of mastery or control of the key ecological systems in this space, a true shift from an anthropocentric learning environment to an ecocentric learning environment. By providing students manual and personal, as well as intellectual experiences of ecological literacy and systems thinking in real life, the teaching bioshelter represents the

physical corollary to the pedagogic transformation being undertaken by EfS. It would become the "resource room" for all EfS learning across the entire school curriculum.

Over the past decades, two New England colleges have developed teaching bioshelters at their campuses. Use of these bioshelters was based on singular faculty interest and did not reflect an institutional vision nor commitment to EfS. The lack of institutional curricular commitment to EfS goals and values resulted in the underutilization of these facilities. However, with the rise of current EfS efforts, there is an emerging interest in creating new learning environments to better support EfS pedagogy. A northern New England public high school has begun a long-term process for developing such a teaching space. The present effort includes a teaching bioshelter design and the utilization of professional curricular design help in creating and incorporating EfS units for existing teachers and classes. From these preliminary efforts and experiences, I have identified some important insights that can guide the development of a teaching bioshelter at a school or college, in pursuit of an EfS curriculum.

Figure 7: Vermiculture. Photo credit: Scott Stokoe.

First, an EfS curriculum should create the demand for infrastructure development. Each school or college must have a demonstrated need for a new teaching space based on the active development of EfS curricula in the institution. A chemistry lab in a school without a chemistry program and curriculum will very quickly become a storage space. At a minimum, this EfS curricular commitment must include universal applications of ecological literacy and systems thinking throughout the entire institution's offerings. This level of educational change will likely require the entire organization, including administrators, teachers, families as well as students, to shape and embrace this educational evolution. Without this commitment, the investment in a teaching bioshelter is not prudent.

Second, teaching in the bioshelter is an opportunity to bring a material and manipulable experience to the intellectual process. This integration brings an authenticity not normally found in written, oral or visual experiences and engages learning pathways that can more deeply instill the informational content of the lesson plan. However, it requires a facility and pedagogic skill set beyond the usual academic achievement, for both students and teachers. Faculty will need time for skill-building and curriculum development that will effectively utilize physical experiences for learning. Although the sciences frequently use this approach in lab activities, it can also be a powerful and meaningful expansion for humanities education as well. To fully utilize this resource, the curricular effort must include the arts as well as the sciences. Imagine an American environmental history unit based on students growing and processing a crop of cotton.

Figure 8: Integration of aquaculture and agriculture. Photo credit: Scott Stokoe.

With students responsible for growing cotton in the teaching bioshelter and then processing the raw material for market, these students would have a very different understanding of agricultural slavery, the value of technology and their impact on socio-economic American history. With the participation of all departments and disciplines, the full potential of a teaching bioshelter can be realized, but it will require conscious and meaningful educational change.

Third, this pedagogical shift represents an enormous challenge. Few teachers have had these kinds of educational experiences included in their own education. The teaching bioshelter requires practical and applied skills not included in pre-service teacher training. It relies either on the individual experiences of the teachers or will require a "media specialist" similar to a librarian, for example, to create and maintain the affordances of the bioshelter. This is a significant barrier for the inclusion of this radical teaching resource. It will require either additional resources for a new position or a faculty committee to step up with training and commitment, to plan, develop and manage the various systems and elements of a teaching bioshelter. No matter how high, this challenge can be addressed as a part of an institutional commitment to the adoption of EfS, but it must be clearly understood and provided for before construction. This places a burden for change on local educational communities, communities that are consistently under-resourced and under ever expanding expectations. Yet, individual teachers, principals and schools have already begun to explore this new terrain of EfS. Professional curriculum development help is making excellent headway in bringing change to our schools. Various EfS resource non-profits exist and are actively providing support and vision. Furthermore, professional standards and benchmarks are emerging (Cloud, 2017). These same organizations can provide the training and support for effective inclusion of a bioshelter resource center at a school or college.

The list of potential teaching bioshelter-based educational experiences is long. Some of the immediate themes with high social impact are renewable energy, water, and sustainable food and waste cycling systems. The energy systems could include passive solar heating, energy conservation, biofuels, energy storage systems, photovoltaics, and wind systems. Food systems could include both aquatic and terrestrial systems with the special opportunity for integration of these two. These activities could include solar gardening, integrated multi-trophic aquaponics, algaculture, ecological pest management, and soil-based nutrient cycling. A working water system, from collection, storage and processing to water-use and water treatment systems and practices, could be taught. And finally, working examples of waste processing and their role in

closing material loops could be made available. These could include composting systems, anaerobic digesters, human waste capture and processing, and vermiculture. All of these systems and technologies will play a part in a more sustainable future. Yet, they are rarely accessible to students and teachers in our extant school architecture and curricula. A teaching bioshelter can take a lead role in addressing these deficiencies.

Although these topics might appear to be focused solely on science and technology, the opportunity to develop environmental humanities for this space are limitless. With the "greening of the humanities" underway in higher education, we are witnessing a rise in academic connections to the material world in the arts and humanities, such as environmental history, ecocriticism, ecological ethics and ecological economics (Parini, 1995). This transition will support the social and political changes that will be necessary, by applying ecological principles to human systems as well as physical systems. The development of humanities units for use in the bioshelter would flow directly from the existing humanities curriculum. Specific topics or content that are already being taught can be linked to specific activities and experiences in the teaching bioshelter, as in the previously mentioned cotton unit for American history. Other examples might include a contemporary fiction English class growing a crop of potatoes in the bioshelter while reading about and analyzing the role of environmental services of earth that are found in the novel "The Martian." A high school economics class could study the limits and restraints on unlimited growth by studying the carrying capacity of a food or energy system in the teaching bioshelter. The importance of the humanities in developing a more sustainable culture is often overlooked. Many believe that it is our value and cultural system that must evolve to a more ecological basis before effective and lasting physical and technological fixes will succeed; that not only must the humanities participate in this epistemological shift, some believe that the humanities are well suited to lead this change (Glotfelty & Fromm, 1996). Thus, the humanities will find great educational opportunities, as well as the sciences, in this new teaching space, based on the adoption of EfS.

A teaching bioshelter at a school or college must be the outgrowth and product of the development of a system-wide adoption of EfS curricula. To build a new structure without school-wide adoption of EfS would be imprudent. But as the EfS revolution unfolds, more and more aspects of the educational system will become involved and modified to serve this new mission. Malaguzzi's vision of the "third teacher," the non-curricular component of the educational experience must be harnessed by providing a teaching bioshelter as the logical extension of an EfS curriculum. This physical manifestation of ecological principles provides both the content and the culture of sustainability necessary to prepare our students for the social and environmental challenges that lay ahead.

Figure 9: Setting up aquaculture tanks. Photo credit: Scott Stokoe.

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