

Place-based Learning: Interactive Learning and Net-Zero Design

By Alec Holser and Michael Becker

Food and conservation science curriculum, net-zero design and student-based building performance monitoring have come together in the unique and innovative new Music and Science Building for Oregon’s Hood River Middle School. The school’s Permaculture-based curriculum both informed the building design and was also transformed through the integrated design process. The building both houses the school’s science program and acts as a teaching tool integrated into the curriculum. This project won the first 2030 Challenge Design Award, is one of the first net-zero K-12 projects completed in the country and is currently under review for LEED Platinum certification. It offers a tangible demonstration of how decentralized energy and water systems, aquaculture, biological energy systems, year-round food production and performance monitoring can be incorporated in K-12 design and woven into school curriculum.

Permaculture aims to create stable, productive systems that provide for human needs, where each element supports and feeds other elements, ultimately aiming at systems that are self-sustaining. In keeping with these principles, the site combines native plants and plants to be used for instructional purposes including food production, fiber and building materials and plant-based dye, creating a landscaped area that responds to the

natural climate. In the greenhouse, an organic composter that uses waste produced in the cafeteria provides fertilizer for use in the outdoor vegetable garden. A large fish tank in the greenhouse forms the basis for a living machine that processes fish waste that also fertilizes plants grown for food. The students have the opportunity to market and sell their produce at the Gorge Grown Farmer’s Market, hosted at the school every Thursday. Not only

does the market complete the cycle of growth from seed to table, it also creates an opportunity to strengthen the community to which the school is inextricably tied by hosting the public on the campus and fostering the social interactions that ensue. The site also features an amphitheater overlooking the greenhouse that can be used as an outdoor classroom, performance space and gathering place.

The concept of Permaculture is brought into the new building through a design that aimed to collect and use resources to ensure that they will have a net-zero impact on the environment. Most buildings consume energy resources that combine to total around 40% of this country’s carbon footprint. At Hood River Middle School, the new building conserves resources with a well insulated building envelope, efficient mechanical systems that include a geothermal heat source, radiant slab heating and displacement ventilation. What energy the building does use is produced by photovoltaic solar panels on the roof.



HRMS students grow their own vegetables for school meals.



Net zero design and student based building performance monitoring.



Design of the building envelope sought to achieve the highest degree of thermal efficiency while remaining sensitive to the historic context.

These systems are integrated into the curriculum in a number of ways. Sections of the wall and floor assemblies for the building remain exposed through glass, so students can see how they were constructed. Students have access from the science classroom to the heart of the building's geothermal and water system, the pump room, labeled and metered specifically to be used for classroom demonstration and instruction. Part of the science curriculum now includes regular metering and analysis of the building's energy performance through a real-time building dashboard, tracking actions in order to reduce consumption. The building controls system is set up to allow students to create scientific experiments by changing set points to observe the actual effects.

Passive systems that use natural systems to enhance the quality of

the interior environment and make the building function more efficiently were used extensively on the building. Daylight modeling suggested use of well-placed skylights and clerestory windows, ensuring that classrooms were evenly lit and allowing lighting to remain off during many daytime hours. Trellises covered with deciduous vines are placed outside south facing windows to block summer heat gain, but make it available in the winter. A one-foot thick air plenum under some of the solar panels passively pre-heats air before sending it into the ventilation

system. Natural ventilation takes advantage of the 'stack effect' with low operable windows and roof vents to passively cool or warm the space as required. This system has a 'red light/green light' indicator that informs students when the outside air temperatures are appropriate for opening the windows and vents, further promoting student interaction with and awareness of their built environment.

The building and site also incorporate a number of innovative water systems. Rainwater is collected from the roof in a 14,000 gallon tank to be used for toilet flushing and irrigation. Site runoff is treated on site in a bio-swale rather than connecting to the municipal sewer and stormwater system. Water from a nearby stream is used to cool the radiant slab. Even a trip to the bathroom can reinforce the concepts of conservation of resources, as students will find low-flow sinks, dual flush toilets and waterless urinals there. The various water systems are also metered on the building dashboard for student analysis and experiment.

Conservation of resources also extended into the building material



The interface between the building and its environmental and cultural landscape is important for the curriculum at Hood River Middle School.



HRMS links community to school.



HRMS boasts translucent skylights, clerestory and traditional windows.



Signage is displayed throughout the facility demonstrating the sustainable design strategies incorporated in the building design.

choices. A large wood framed shed built in the 1940's that was originally used as a bus barn was deconstructed piece by piece to make room for the new building. Much of the bus barn was reused in the construction of the new building, including joists that were re-milled and pieced together to create the trusses that constitute the building's exposed roof structure. 98% of the material from the bus barn was reused or recycled. Recycled material was also heavily used throughout the building from the 'paperstone' recycled paper countertops to the wall

board made from 95% recycled gypsum. These lessons are reinforced to the students with designated areas for recycling bins set up for student use.

The desire to use the building as a teaching-tool to illustrate the concepts of Permaculture inspired the design not only to integrate the building into the curriculum but to attempt to influence the relationship between the building and its users. Hood River Middle School students produced a video about their experiences with energy, water, waste, and food to demonstrate how this program has impacted them. ■

Alec Holser, AIA, LEED AP, is a founding principal of Opsis Architecture an award-winning architecture firm in Portland, Oregon. Alec brings more than 25 years of experience designing award-winning new and renovated educational facilities. He leads the Opsis K-12 design studio and focuses on designing fluid learning spaces that respond to individual learning styles of students. Alec was the lead designer for the innovative design of the Medford, Oregon Roosevelt and Jackson Elementary schools, winners of the 2010 Innovation in Learning Award presented at CEFPI 2010. Alec brings a highly collaborative design process to each project by involving the full range of building users, greater community and designers in an integrated design process. Alec Holser served as the lead designer and principal in charge for the Hood River Middle School project.

Michael Becker, recipient of the Oregon Middle Level Teacher of the Year award for 2008, has been a public school teacher for 11 years. For the last seven years at HRMS he has been developing the Outdoor Classroom Project, a Permaculture inspired, integrated approach to accelerating through the Oregon State Standards. The new "Green building" is a key piece in the evolution of our program, using, "Transparent Educational Design" to help design systems that teach. Michael has taught multiple classes and workshops for college level students on using Permaculture to design more resilient educational systems and has spoken at numerous conferences on the subject.



The Music and Science Building replaced a 1940s bus storage barn previously located at the site. This structure was carefully deconstructed, and the new building's wood scissor trusses were created from the materials set aside.