Science in the Natural World

This might appear to be a strange title, after all doesn't all science take place 'in the natural world?' Where else could it be taking place? When we examine science more closely we might start to wonder; it is often be divorced from the natural world leading to results which cause more harm than good. What would science in the natural world look like?

The Real World Learning Network has been exploring the teaching of science outside. It started by researching what the big sustainability issues a scientific understanding can help address. We decided to use the research on Planetary Boundaries by the Stockholm Environment Institute to frame our work. The Planetary Boundaries show the resilience of nine environmental areas and measure whether they are within the planet's ability to sustain them or not. For example, biodiversity is listed as beyond safe operating capacity but global freshwater use remains within the safe operating capacity (see www.stockholmresilience.org for more).

Planetary Boundaries offer a useful approach to deciding what science needs to be understood to support a sustainable planet. But herein lies the danger of reductionist science; we try to understand the details of each boundary rather than the overall patterns and processes which link them together. And we are led down the path of individual scientific solutions to global issues rather than more holistic approaches which address social and economic issues as well as environmental. The Real World Learning Network has done much to explore the teaching of Planetary Boundaries, however, for learning to be effective we need to understand the whole system.

By closely observing the natural world we see that nature operates through a set of interoperating principles. Fritjof Capra calls these Living Systems and is based on the principles of ecology (see boxed text). The Real World Learning Network has synthesised these principles to four that can be easily understood and integrated into science education.

Principles of Ecology

Networks: All living things in an ecosystem are interconnected through networks of relationship.
Nested Systems: Nature is made up of systems that are nested within systems. Each individual system is an integrated whole and — at the same time — part of larger systems.
Cycles: Members of an ecological community depend on the exchange of resources in continual cycles. Cycles within an ecosystem intersect with larger regional and global cycles.
Flows: Each organism needs a continual flow of energy to stay alive. The constant flow of energy from the sun to Earth sustains life and drives most ecological cycles.
Development: All life changes over time. Individuals develop and learn, species adapt and evolve, and organisms in ecosystems coevolve.
Dynamic Balance
Ecological communities act as feedback loops, so that the community maintains a relatively steady state that also has continual fluctuations. This dynamic balance provides resiliency in the face of ecosystem change.

(Source: Centre for Ecoliteracy)

Cycles: nature operates within cycles, nothing is created nor destroyed. Diurnal patterns of sunrise and seasonal cycles take place and are celebrated. Nitrogen, phosphate, carbon and oxygen cycle through processes such as transpiration, decomposition, weathering and photosynthesis.

Change: nothing stays the same, there is constant evolution as biodiversity adapts and variations emerge; energy transfers and changes as it flows from sun to leaf to insect; molecules of carbon, hydrogen and oxygen constantly come together and break apart as they form the structures of all materials.

Stability: nature is in dynamic balance; ecosystems to not evolve towards monopolies with few dominant species; all things are interdependent based on the causes and conditions which created them.

Energy flow: energy originating from the sun cascades through systems changing from light to chemical energy via photosynthesis and into mechanical energy through digesting plants to create carbohydrates which power our bodies.

These principles are not just natural principles; they act as metaphors and frames for how we develop our communities and economies. A stable community, for example, is one which responds to feedback, realises its interdependence with the world around and within it, and develops its own social assets to be resilient in an ever changing world. It can be seen that these system principles are derived from nature, can be studied scientifically but when applied to communities they become powerful metaphors for a creative, positive and sustainable future.

When we take on this study of systems science we understand the processes and patterns of relationships that enable nature to sustain life. We also understand how reductionist science has ignored these basic principles and lead humanity towards ecological, and ultimately self, disaster. Recognising these fundamental causes of many of our world problems offers the hope for change. This is why a real world learning of science in and from the natural world is so important; for nature not only opens us up to our place in the world it also teaches us the principles for living sustainability.

Images: fragile universe, Steve Wall, Flickr, Creative Commons license (https://www.flickr.com/photos/stevewall/)