Engaging Middle School Students in Hands-on Science and Engineering through Sustainable Design Thinking

Engaging Middle School Students in Hands-on Science and Engineering through Sustainable Design Thinking ☐Calendars

NOTE (07.16.14): Per Donna, session date and time still tbd.

Alec Holser, Opsis Architecture; Michael Becker, Hood River Middle School; Hood River Middle School Students, Hood River Middle School

How do we design curriculum and facilities that reach out and connect young adults to provide engaging experiences in science and engineering that will be critical for creating a sustainable future? Using the Hood River Middle School FACS Food and Conservation Science program and the LEED Platinum/ Net-Zero Energy Science and Music building as a platform for understanding, conference participants will work with an exceptional group of middle school students in a hands-on group design workshop to create a fully integrated learning eco-system. The facilities architect, engineer and the program's teacher will provide the technical framework, while students facilitate side by side with conference participants in groups to discover how connections between systems are the foundation of integrated design.

Objectives:

- Attendees will meet an exceptional group of young students who completed an intensive design/build process that immersed them in the science and engineering disciplines.
- Attendees will gain perspective on how sustainable architecture can influence educational curriculum and captivate the interests and imaginations of a diverse student body.
- Attendees will explore ways they can use building and landscape architecture to create a living laboratory
- Attendees will learn about the specific technical innovative sustainable design strategies to achieve a net-zero educational facility

Hood River District Students

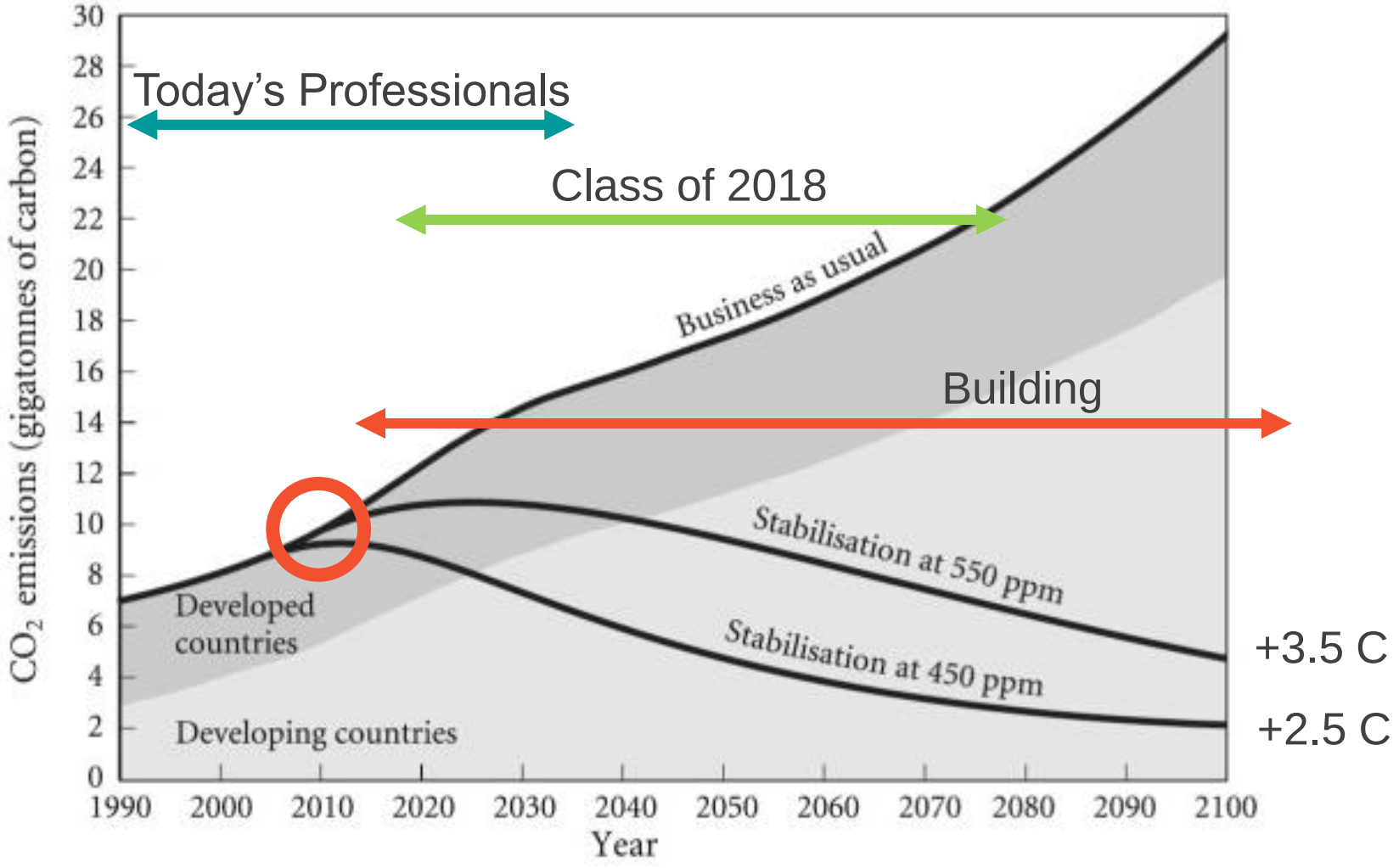
Michael Becker

Hood River Middle School

Alec Holser

Opsis Architecture

Future Greenhouse Emissions



UK Department of Environment

Hood River County
SCHOOL DISTRICT

Basically, the earth needs a new operating system, you are the programmers, and we need it within a few decades.

- Paul Hawkins 2009

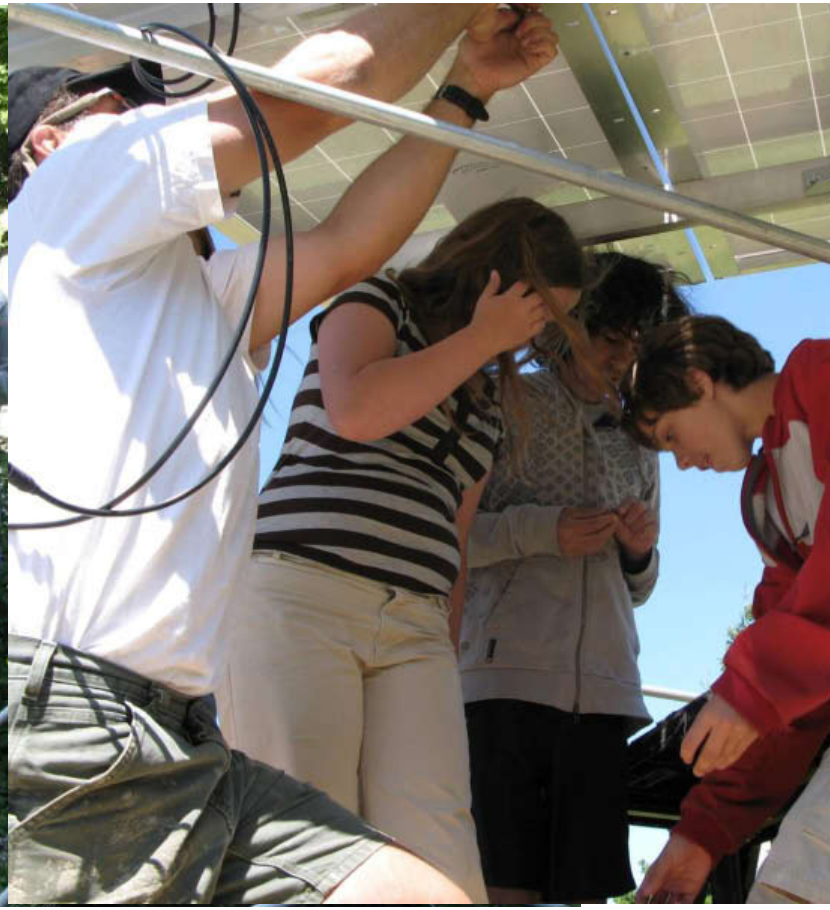
Hood River Middle School

National Historic Register Building


grup
2
grup
5

Hood River Middle School 1998

Outdoor Classroom Project



Oregon Department of Education

STEM Curriculum

OREGON DEPARTMENT OF EDUCATION

Standards By Design:

Seventh Grade for Science

Science

Seventh Grade

Seventh grade science students refine their understanding of how the components and processes within living and non-living systems interact and affect their characteristics and properties. They learn about gravitation, forces, and laws of motion. They study atoms, elements, and compounds. They develop an understanding of reproduction, inheritance, phenotypes, genotypes, chromosomes, and genes. Students learn about the processes plants and animals use to obtain energy and materials for growth. They study how Earth's atmosphere, land forms, resources, and climate change. Students deepen their understanding of scientific inquiry as the investigation of the natural world based on observation and science principles that includes proposing questions or hypotheses, collecting, analyzing, and interpreting multiple forms of data to produce justifiable evidence-based explanations. They build their understanding of engineering design as a process of identifying needs, problems, and constraints, and developing and evaluating proposed solutions.

*It is essential that these standards be addressed in contexts that promote scientific inquiry, use of evidence, critical thinking, making connections, and communication.

7.1 Structure and Function: Living and non-living systems are composed of components which affect the characteristics and properties of the system.

7.1P.1 Explain that all matter is made of atoms, elements are composed of a single kind of atom, and compounds are composed of two or more different elements.

7.1L.1 Compare and contrast sexual and asexual reproduction. Explain why reproduction is essential to the continuation of every species.

7.1L.2 Distinguish between inherited and learned traits, explain how inherited traits are passed from generation to generation, and describe the relationships among phenotype, genotype, chromosomes, and genes.

7.2 Interaction and Change: The components and processes within a system interact.

7.2P.1 Identify and describe types of motion and forces and relate forces qualitatively to the laws of motion and gravitation.

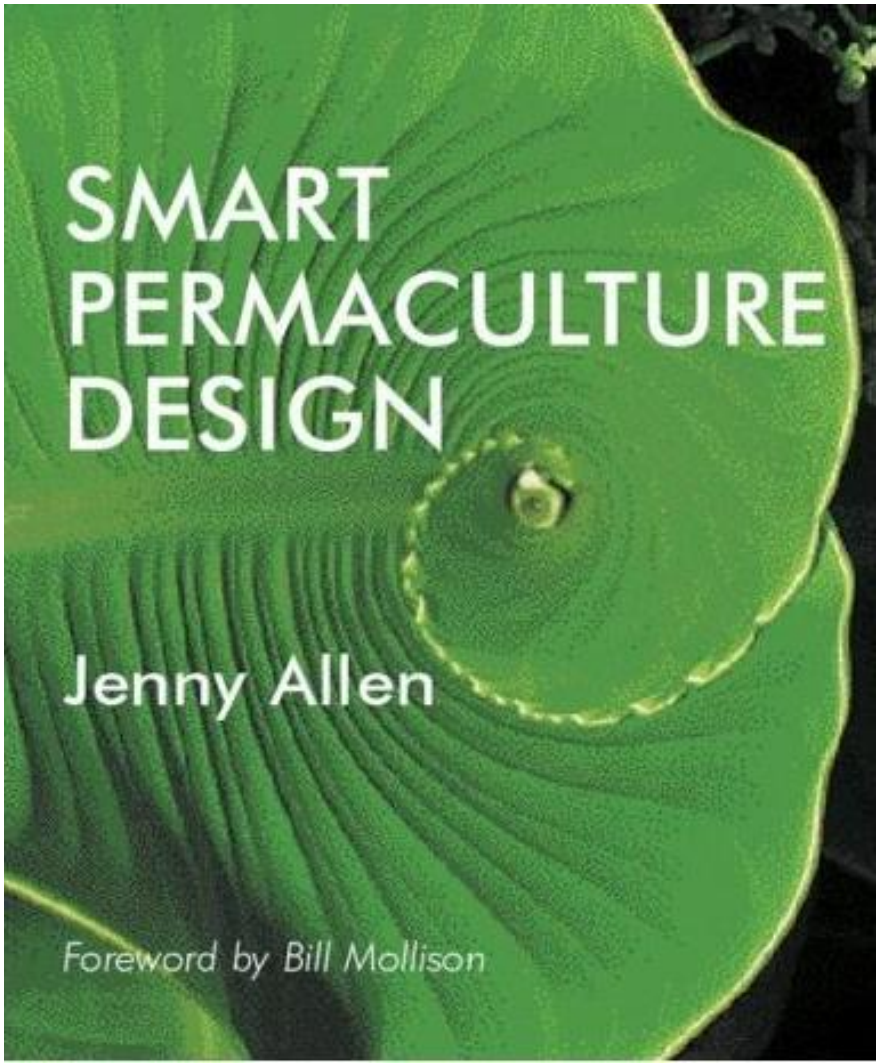
Science Numbering Key Example: K.2P.1
K = Grade
2 = Core Standard strand (strands are 1=Structure and Function; 2=Interaction and change; 3=Scientific Inquiry; 4=Engineering Design)
P = Science Discipline (disciplines are P = Physical; L = Life; E = Earth and Space; S = Scientific inquiry; D = Engineering Design)
1 = Number of the content standard for this grade, strand, and discipline

FACS -Food and Conservation Science

Food, Energy, Water, Waste

A Connective Approach

- Live things
- Independent leadership
- Hands-on interdisciplinary learning
- Project based learning
- Design Thinking – non linear / not preconceived



Our HRMS Roadmap

Relative Location

Each Element Provides Many Functions

Each Function Supported by Many Elements

Efficient

Energy Planning

Use Biological Resources

Care of People / Care of Earth

Obtain a Yield

Energy

Cycling and Recycling

Intelligent Redistribution

Small Intensive Systems

Accentuate

Succession

Diversity is Stability

Edge Effect

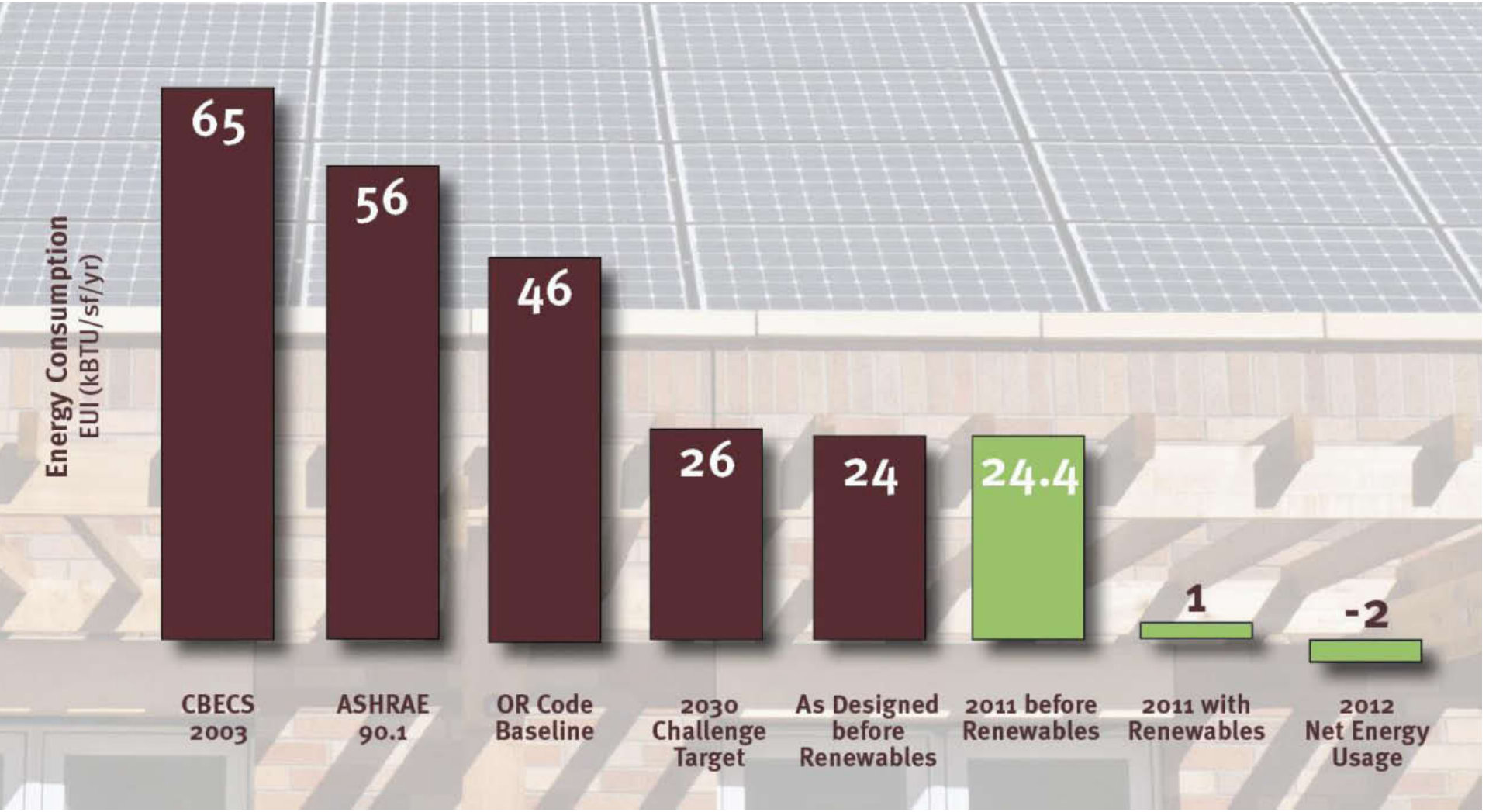
Creative Problem Solving

Defining A Sustainable Vision

Eco-Charrette

Path to Net-Zero

Goals



Path to Net-Zero

Platinum Goals → Net-Zero:

Sustainable Sites: Open space, stormwater management, reduce heat island effect

Water Efficiency: Low water landscaping, efficient fixtures

Energy & Atmosphere: 67% energy use reduction

Materials & Resources: Recycle construction waste, use recycled/regional/rapidly renewable materials

Indoor Environmental Quality: Daylight and views, increased ventilation, enhanced thermal comfort

Produce as much energy as the building consumes

33%

energy production

Path to Net-Zero

Goals

Net-Zero Water

- Rainwater collection and storage
- Efficiency of use, treatment for use
- On site wastewater and stormwater treatment

Net-Zero Energy

- Reduce use through efficiency measures
- Produce energy through renewable technologies (solar and wind power)

Net-Zero Site

- Restorative and Food Productive Landscape
- Maximize learning opportunities

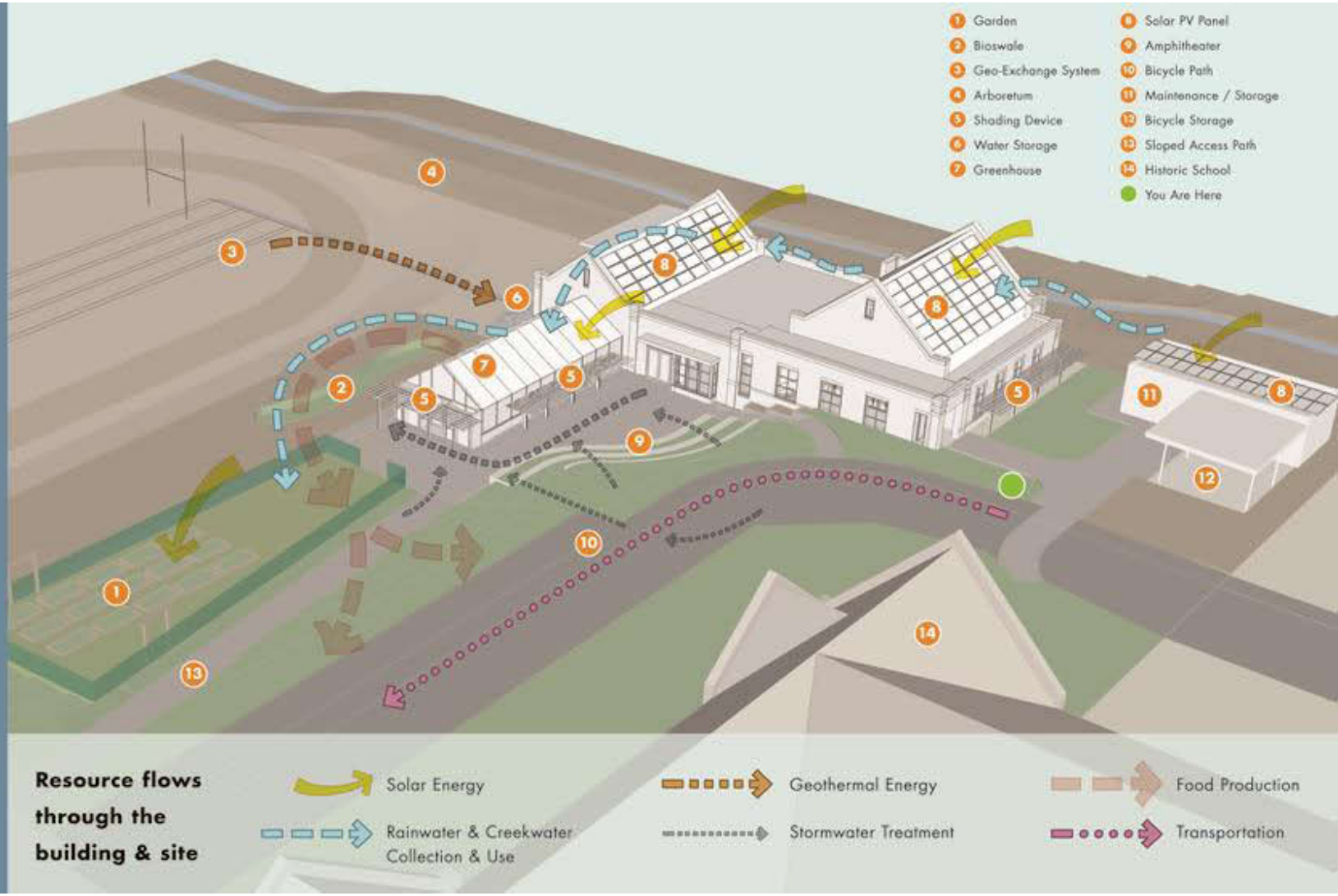
Resource Flows

Goal

Reduce the use of resources and increase environmental awareness through design, construction and use of the building and grounds.

Methods

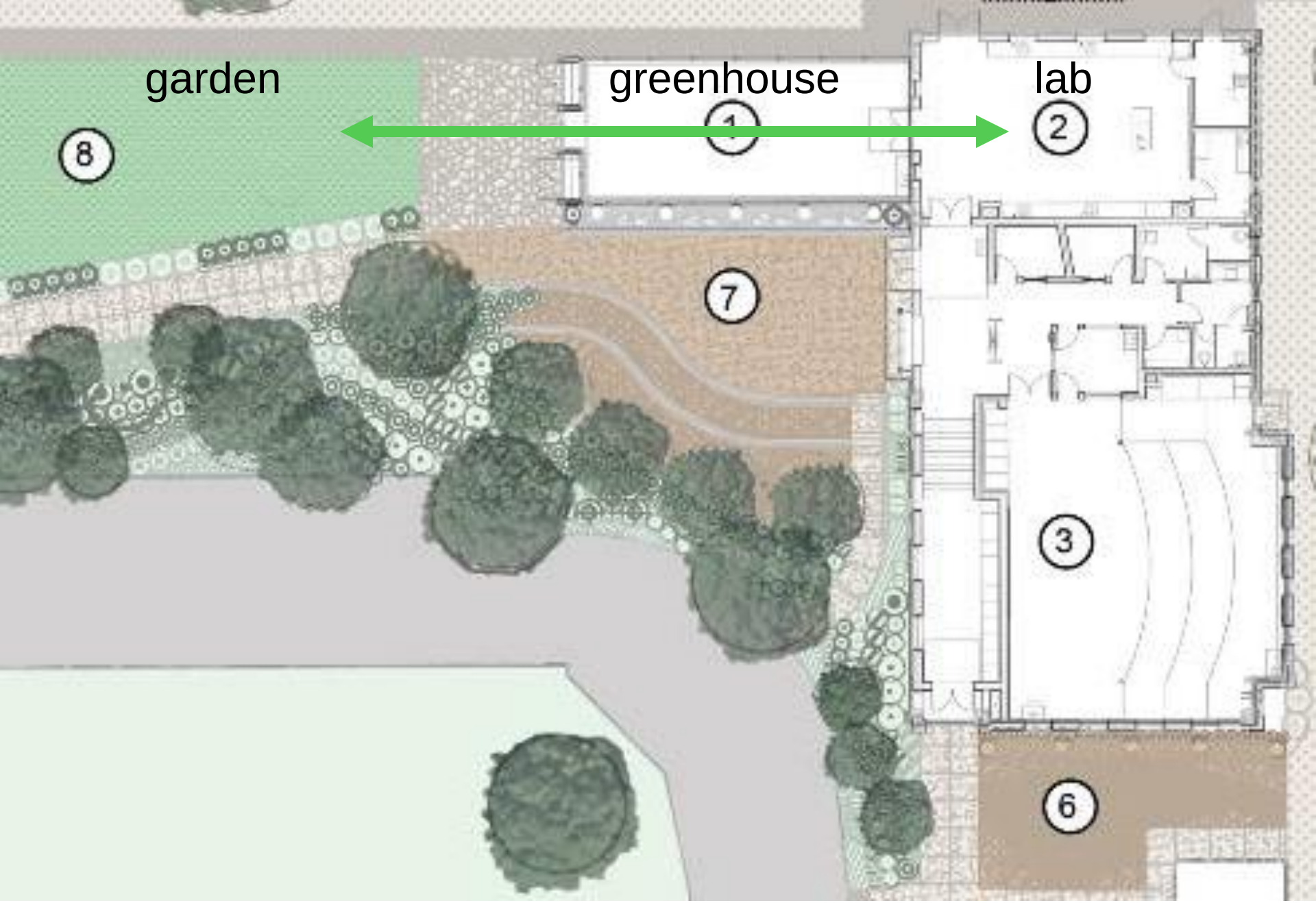
- Create a net-zero energy building that uses no more energy than it creates through efficient building systems and responsible use of resources available on the site.
- Create a building that teaches sustainable concepts and systems.
- Reduce impact on the water cycle.
- Reduce use of building material through the use of recycled and re-used materials.
- Create an environment that is conducive to health and learning by making good use of daylight, acoustical properties and natural ventilation.
- Create a site that can be used to produce food, provide habitat for native species, compost waste and bring community together.



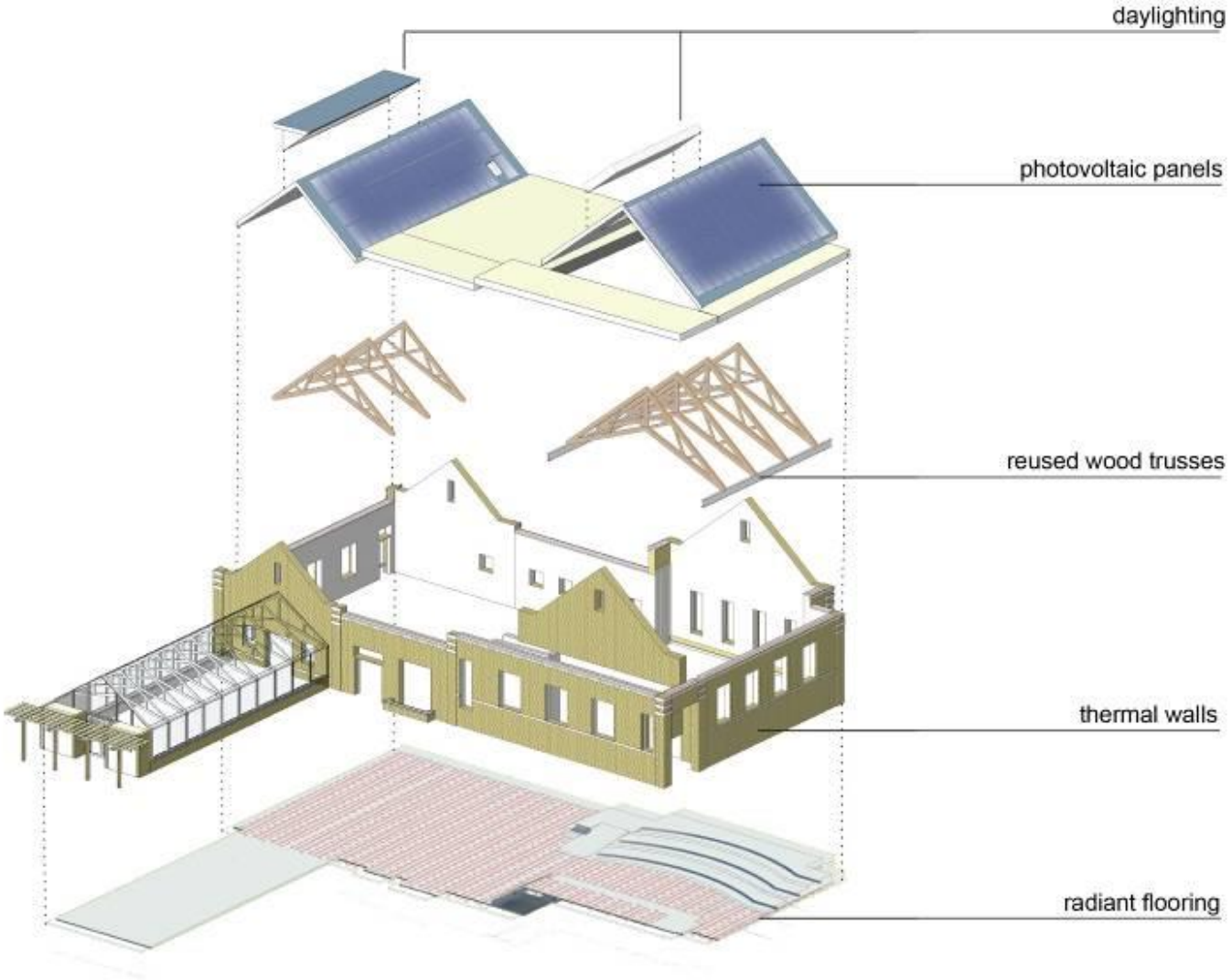

MUSIC AND SC

Project Site

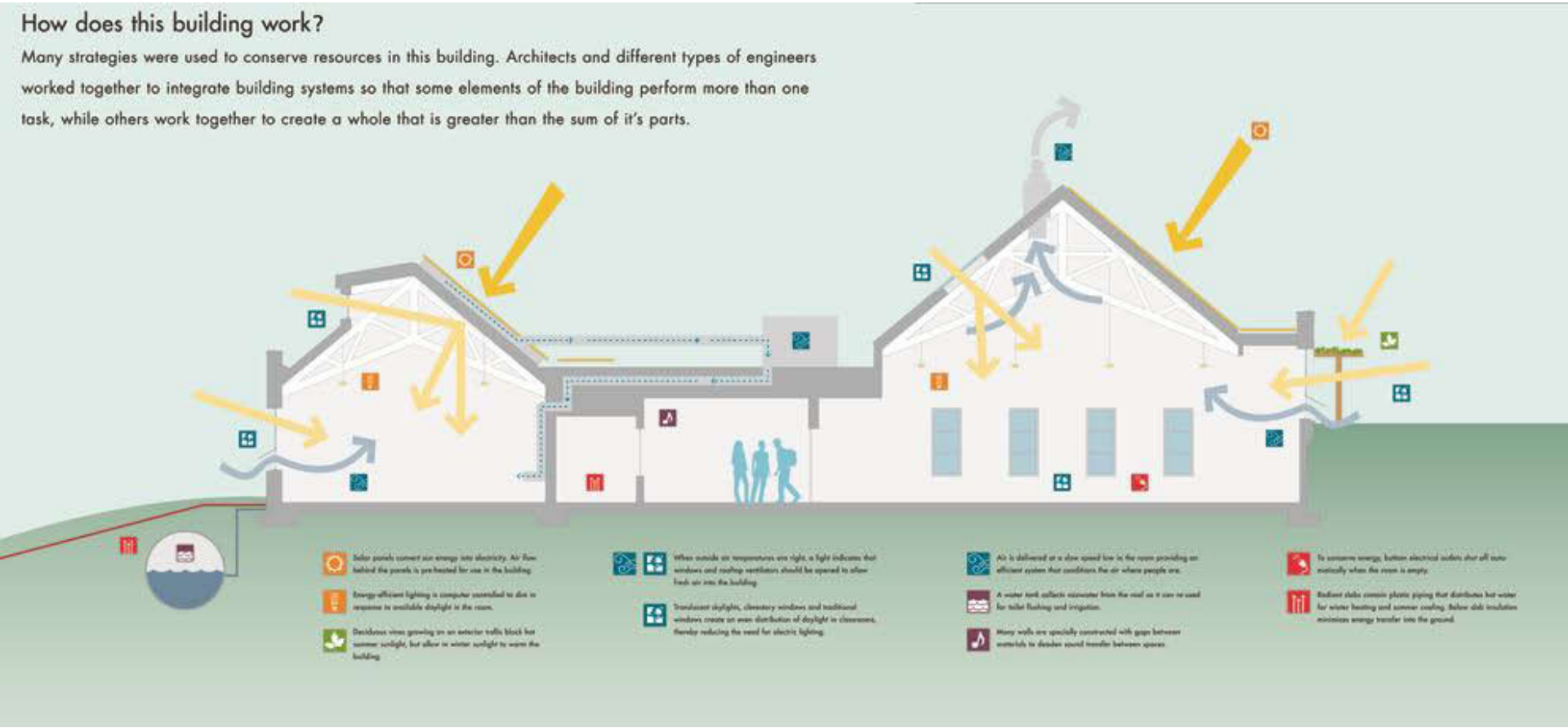
1 Greenhouse
2 Science Classroom
3 Music Classroom
4 Bicycle Parking
5 Recycling Storage
6 Plaza
7 Amphitheater
8 Vegetable Garden
9 Bioswale
10 Underground Cisterns
11 Existing Historic School


garden
greenhouse
lab
1
2
3
6
7
8

Integrated Design



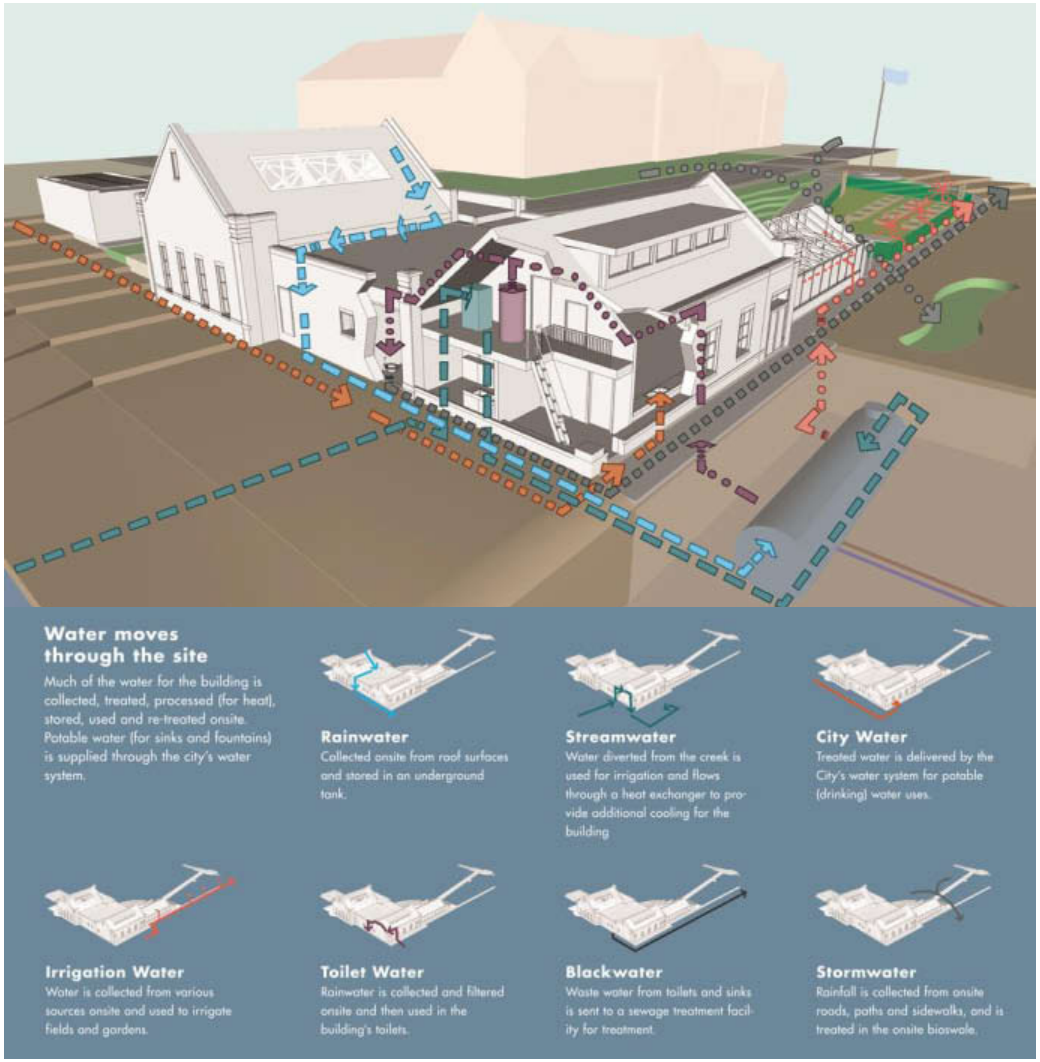
Integrated Design

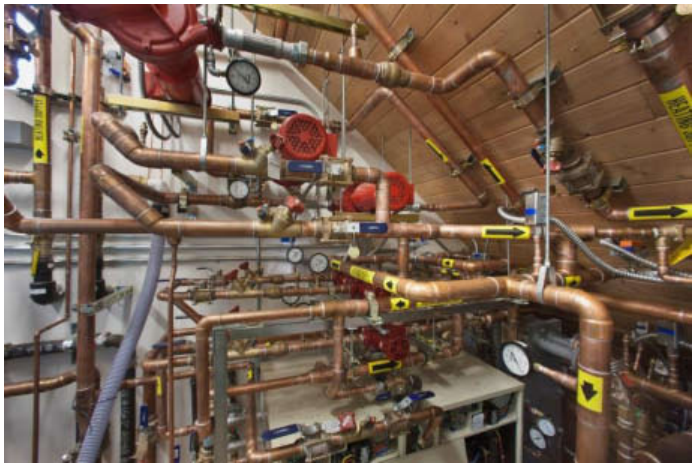


Dashboard

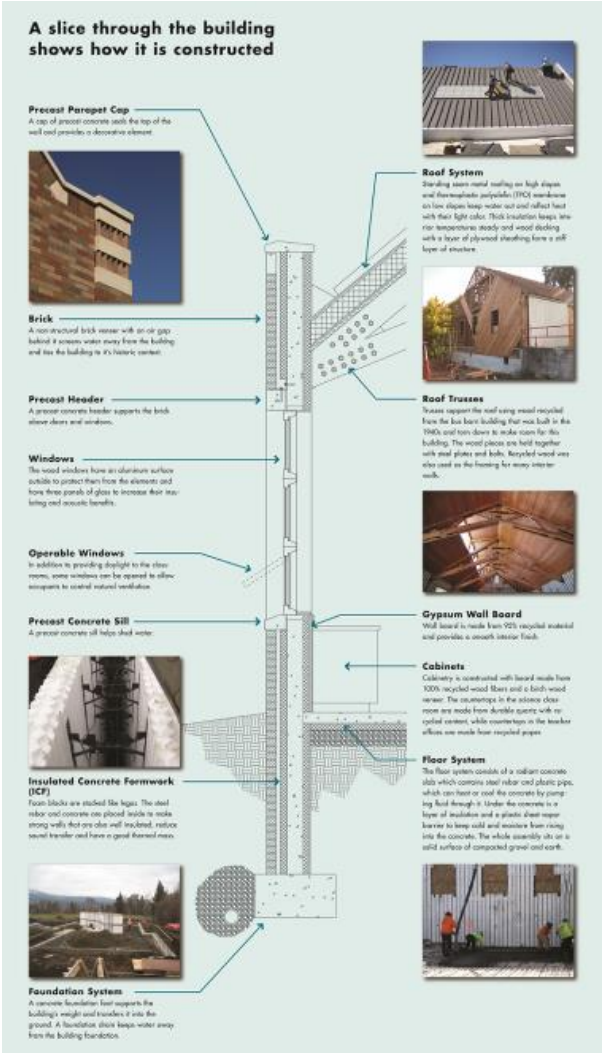

Earthright™ Energy Dashboard
Current energy use at Hood River Music Science
May 2, 2012, 7:02 PM
Electricity
Solar
Water
kW
kWh
L/h
L
Today's Use
6am
Noon
6pm
Current Location:
Hood River Music Science
72 people, 5331 Sq. Feet
Did you know?
Solar panels produce electricity for use in the building or elsewhere. Whilie there is no battery system to store energy on site, the goal is for the panels to produce as much energy over the course of a year as is needed to power the building.
Home
Green Facts
Electricity
Solar
Water
Weather
Powered by Delta Controls. Copyright (c) 2010.

Water Cycles





Building Materials




SKATEBOARD
SECURITY RACK

Garden Flow - Permaculture

Water

Cycles and Patterns
Quality and Quantity
Catchment
Storage
Movement
Conservation

Energy

What is it?
Where does it come from?
Production Issues
Independent production
Conservation measures
Energy budget (net zero)
Passive solar
Solar hot water
Choices
Harness human energy
- Commerce
- Enthusiasm

Increase in health/productivity

Food

Nutrition
Exercise
“Slow” food
Inclusion/infusion into curriculum
Relation to culture
Availability
Awareness
Sense of caring

Sense of Place

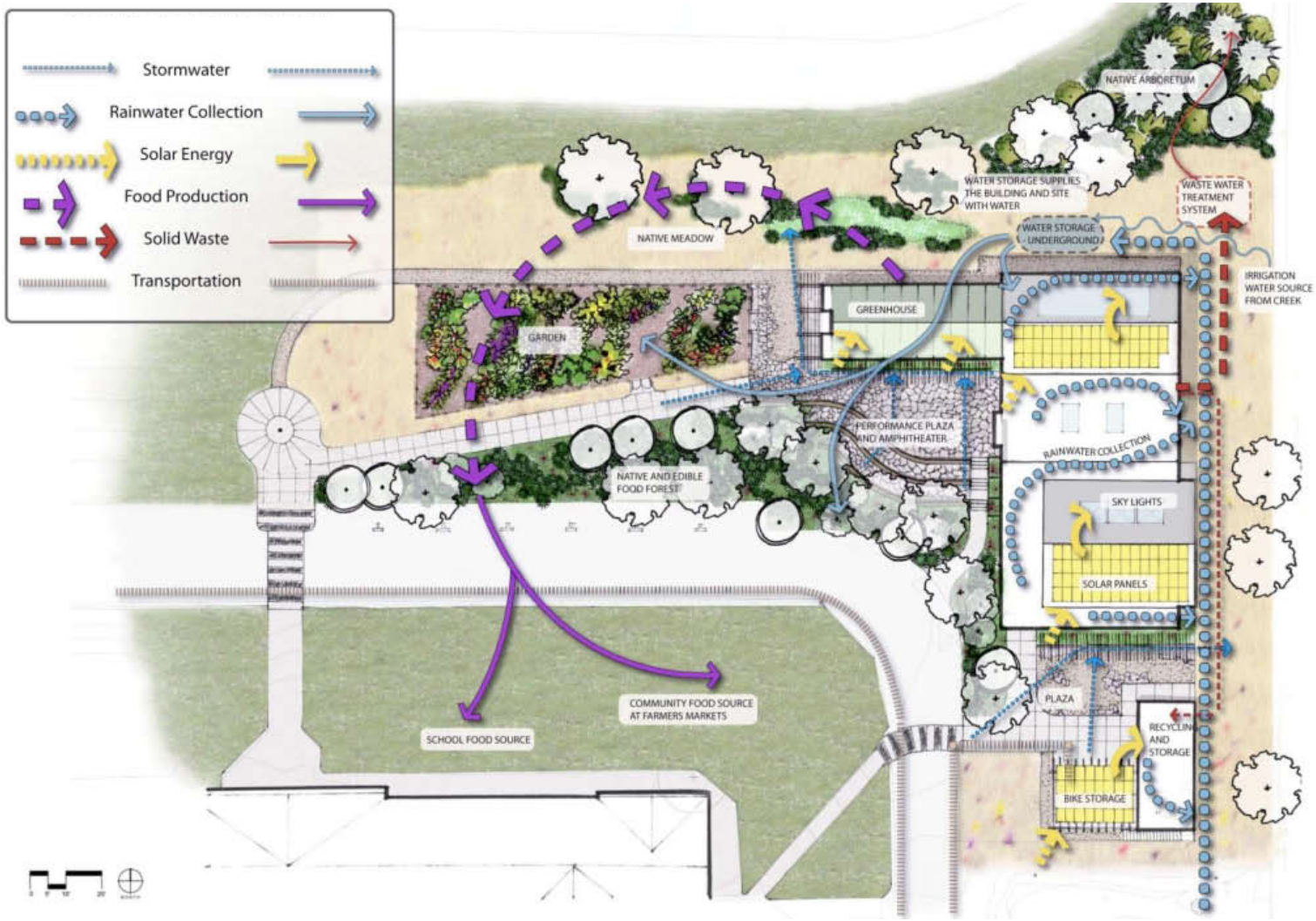
Change over time : Human ability to effect change : Belonging : Pride in job well done : Sense of wonder and joy : Demonstration to others : Wellspring of ideas : Observation inspiration : Relationship with land : Beauty

Waste

Compost
Recycling
Raw/real food
Reduction of transport
Grown nutrients/fertilizer

From The Permaculture Classroom by Michael Becker

Resource Flows




Welcome!
¡Bienvenidos!


Welcome!

Garden and Produce

Getting Dirty

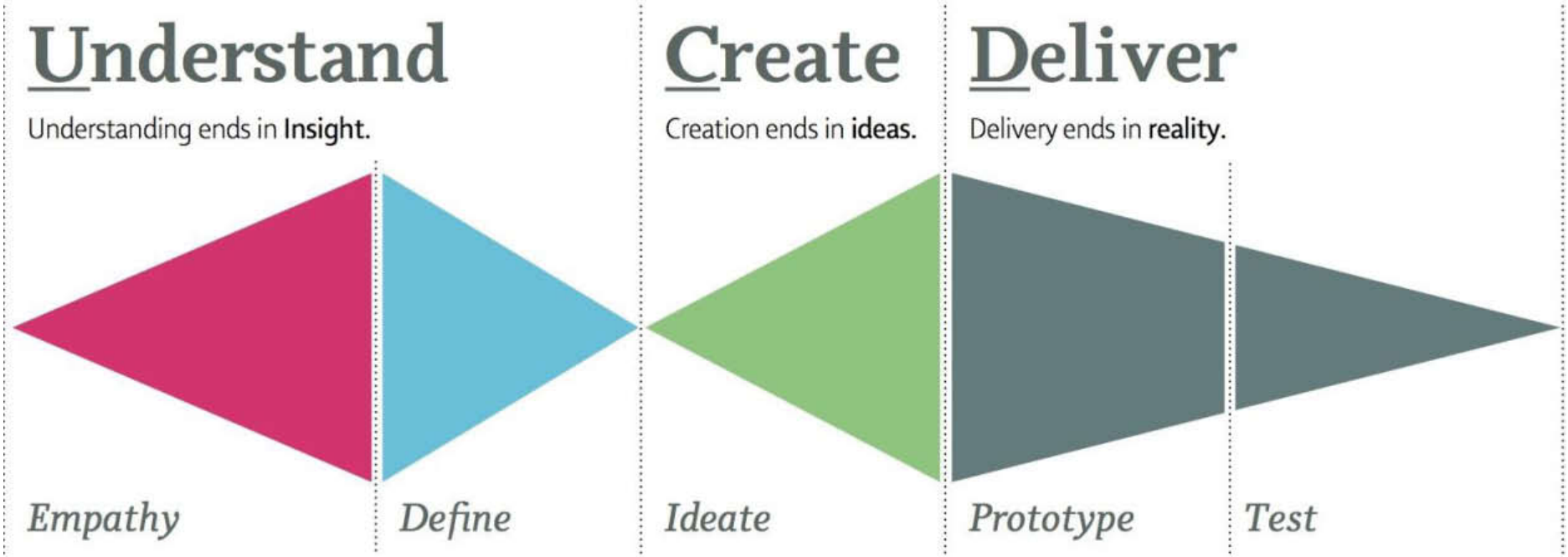
Worm Bins

From Garden To Market

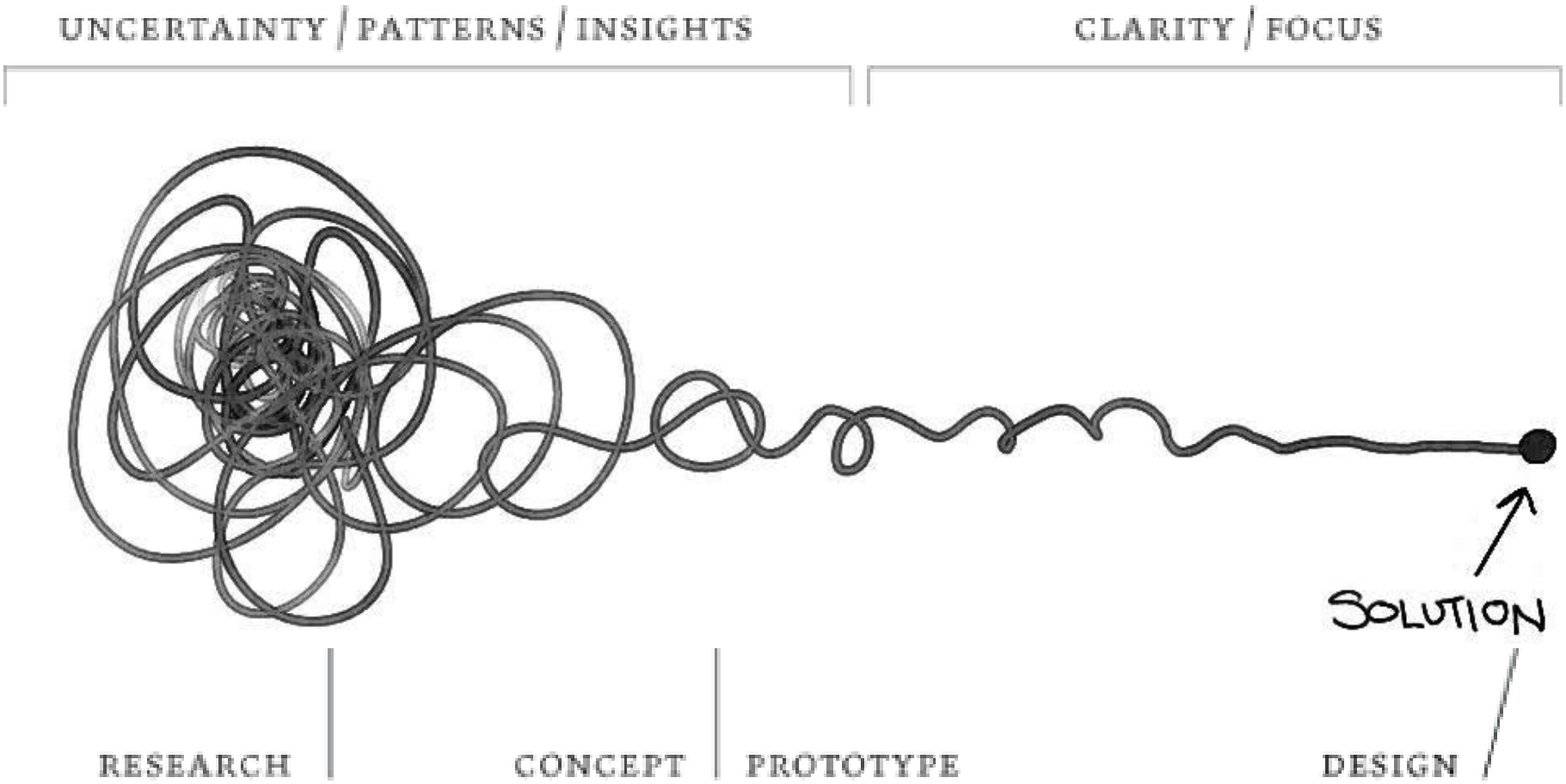
LOCAL
GORGE GROWN

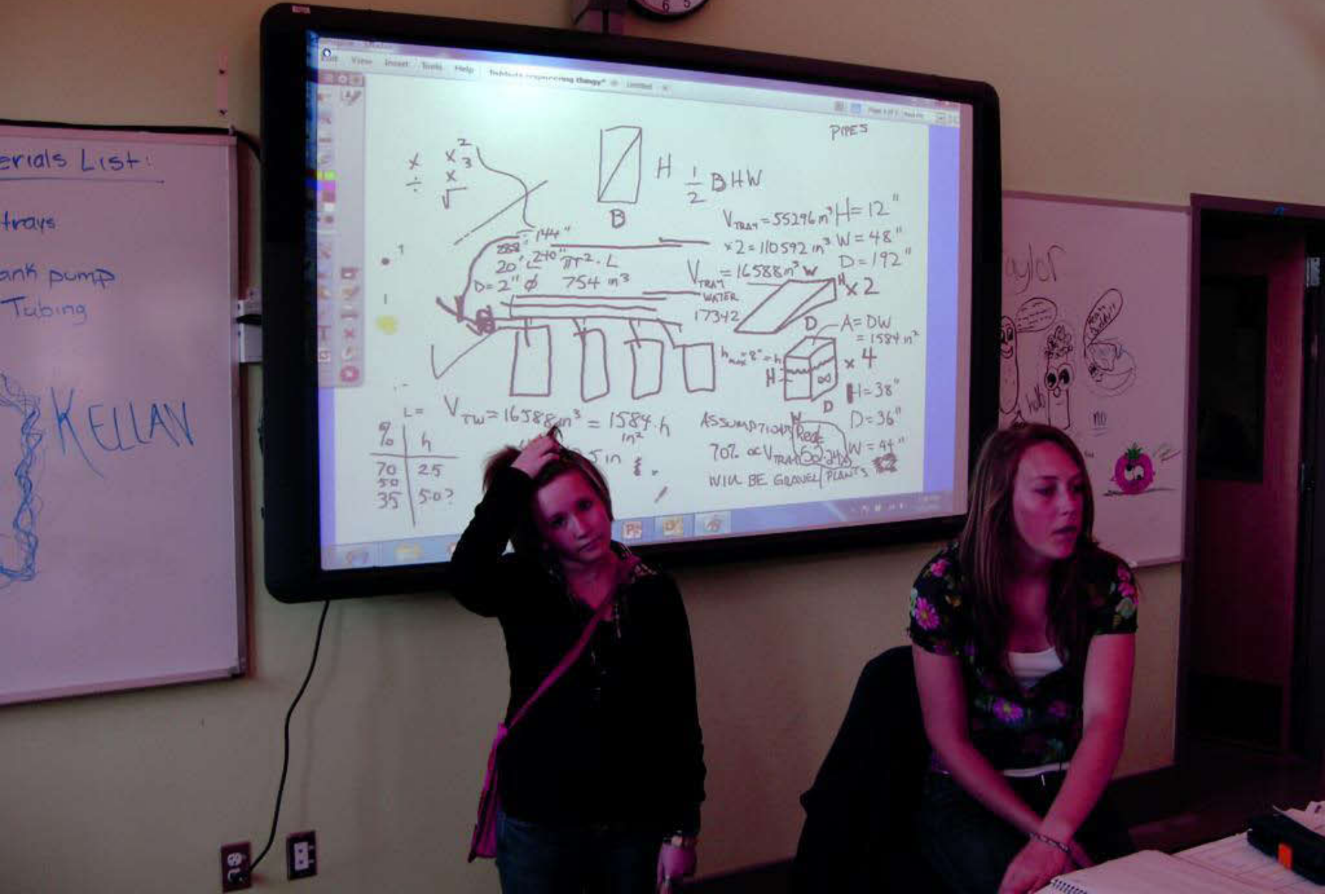
Community Kitchen

Design Thinking

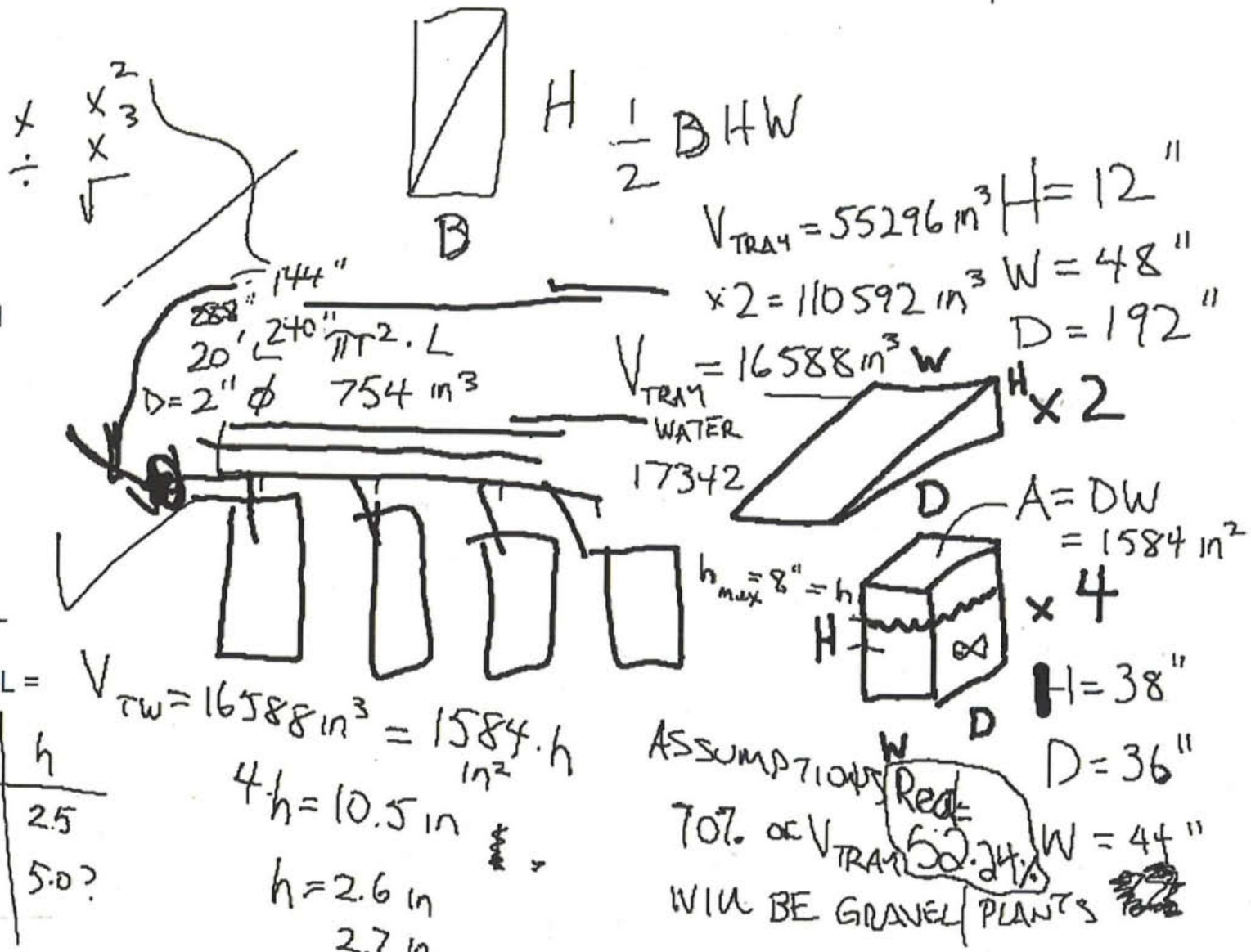


Design Thinking

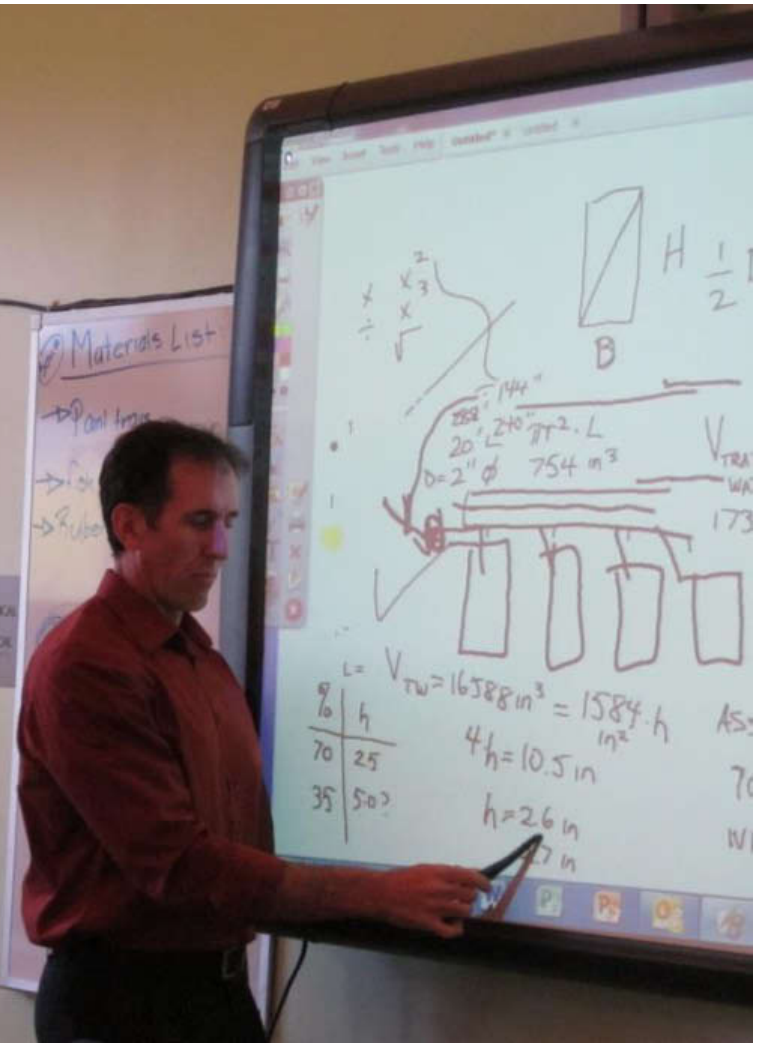



PIPES
H
1/2 BHW
B
144"
20'
D=2" ϕ
754 in³
V TRAY = 55296 in³
×2 = 110592 in³
H=12"
W=48"
D=192"
V TRAY WATER = 16588 in³
17342
×2
A=DW
=1584 in²
×4
H=38"
D=36"
W=44"
70% of V TRAY
WILL BE GRAVEL
PLANTS
V TW = 16588 in³ = 1584 in² · h
L=
% | h
70 | 25
50
35 | 50?
ASSUMPTION
Red
Kellan

PIPES


H
1/2 BHW
B
V_TRAY = 55296 in³
x 2 = 110592 in³
V_TRAY = 16588 in³
WATER
17342
H = 12"
W = 48"
D = 192"
x 2
A = DW
= 1584 in²
x 4
H = 38"
D = 36"
W = 44"
144"
240"
20'
D = 2" ϕ
πr² · L
754 in³
h max = 8" = h
V_TW = 16588 in³ = 1584 · h
4h = 10.5 in
h = 2.6 in
2.7 in
L =
% | h
70 | 2.5
50
35 | 5.0?
ASSUMPTIONS
70% of V_TRAY
Real 50.24%
WILL BE GRAVEL
PLANTS

Living Systems Machine




EXIT

Fish Tanks

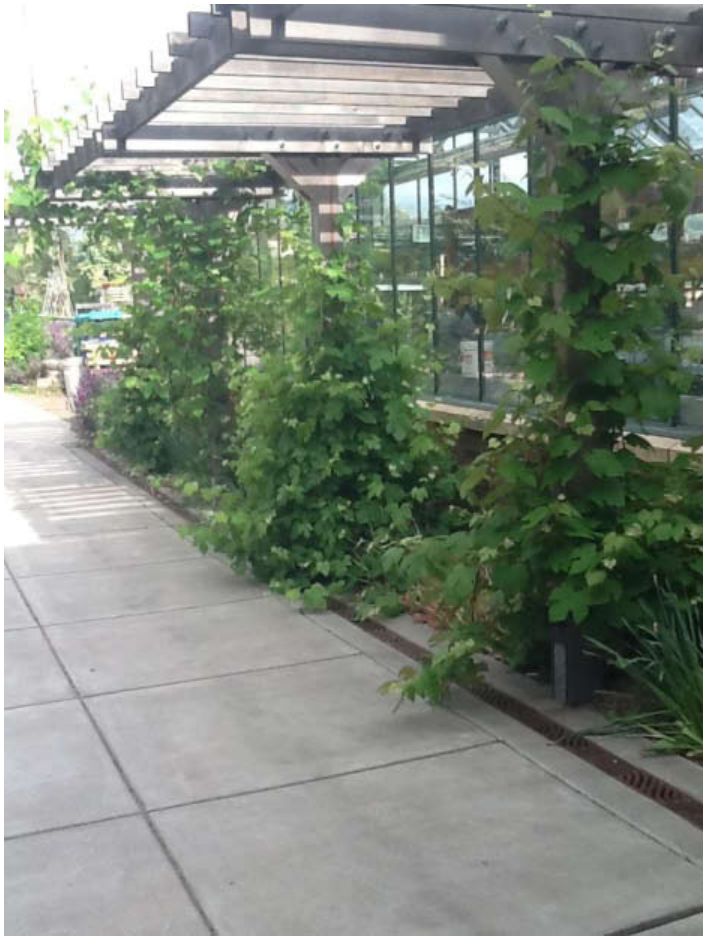

EXIT

Passive Solar House

Cobb Oven Project

Bridge Project

Greenhouse Climate Control



Current Projects

Outdoor Kitchen

Outdoor classroom

Willow tunnel

Climate battery

Fish tanks

Bridge

Plant propagation

Arches

Art + Science

Eco System Design Workshop

Participants

6th Grade
Grace Whitmore
Audrey Becker
Kiki Hosaka
Erin Sutherland
Rose Dillon
Lauren Greenleaf
Brynnan Burns

7th Grade
Elle Smith
Lucy Fine
Julia S
Megan Daley

8th Grade
Victoria Kohner
Morgan Graves

High School
Beth Mixon
Collette Zack
Lucy McLean
Jestena Matsen