The Fourth R

The Fourth R is a design-based curriculum for 6th–8th grade students that teaches ecological awareness and problem solving by building an understanding of, identifying problems in, and creating solutions for the human-made systems of waste and waste management.

Written by Sandy Speicher and Corynne McCleary
March 2005
Most of us are familiar with Reduce, Reuse, and Recycle: the three “Rs” which constitute the current framework both for dealing with waste and for teaching waste management. Although these are all important behavioral approaches to the issue of waste, an improvement method with arguably the greatest potential is missing. This curriculum introduces and teaches a fourth “R”: Redesign.
Overview

The Fourth R in a nutshell

The curriculum

The Fourth R aims to teach 2 modes of understanding:
– awareness of human-made and natural systems
– confidence in the ability to create solutions

The topic we have chosen for exploring these modes of thinking is the system of waste and waste management. The same framework can be suitably applied to many other human-made systems, such as energy or water or transportation. We have chosen to focus on waste because it seemed most relevant to the daily lives of middle school students.

This curriculum is intended to be taught by at least 2 facilitators, one of which should be a designer to ensure industry knowledge and experience is available to the students. We encourage the designer to partner with a science teacher to be sure specific knowledge around ecology is available to the students as well.

The site

This curriculum was designed for Girls’ Middle School in Mountain View, CA. Girls’ Middle School values project-based learning and non-traditional educational opportunities. They work with students to grow and value their voices, develop empathy, and set and reach their personal goals.

Girls’ Middle School has a week-long session in the middle of each semester where volunteers are asked to develop and teach programs. It is a chance for the girls to engage in topics not typically covered in their classrooms.

While the curriculum was designed specifically for Girls’ Middle School, it’s framework can be adapted for other sites. Most obviously, it will be important to find a field trip site that is local to the students’ community. The curriculum process is scalable for shorter or longer time frames, but would need significant modification if it was going to be implemented within the regular schedule of a classroom day.
The ideas behind The Fourth R

Intent

The foundation of this curriculum lies in the idea that learning to perceive and reflect upon social, political, and economic systems while learning to take action and create solutions, produces cultural transformation. This is based in the philosophies of Paulo Freire, who uses the term “praxis” to describe this notion. It is through education that one develops a critical consciousness that informs lifelong participation.

What it is, and what it is not

The decision to base this curriculum in the process of design thinking, as opposed to typical classroom-style learning, offers students a process with which to become more aware of their surroundings, identify problems, and create solutions that they see fit. This requires an understanding of criteria for successful solutions. Through the nature of inquiry into these criteria, students gain fact- and science-based knowledge, among other topics, to help them form both their understanding and solutions.

The Fourth R is not a typical program in ecological literacy. It is not a “science” program in that it is not centered around biological, chemical, or physical facts or relationships. Instead, it is centered around understanding human behaviors, inventions, and relationships, which, in turn, incorporate notions of science and other domains of study. Through this frame, students learn about themselves in relation to their community in relation to the world. This is the very notion of the term “ecological”. We are all part of a system within systems. And we both affect and create those systems.
Overview

Ideas behind, continued

Organizing principles

Realizing the concept of praxis requires distinctive styles of teaching and of learning. With action and reflection as foundational concepts, our curriculum is organized through teaching methods and activities that deeply align with Progressive and Constructivist learning theories. Major concepts include:

**Learning happens through personal relevance**

Students engage with problems that they believe relate to their experiences beyond the classroom. Although the broad issue of waste and waste management is posed to students, through their research they develop more specific problems for which they then can create solutions. Explorations of the problems are community-based to further enhance relevance to students’ lives, as John Dewey maintained. We believe this degree of authenticity promotes sustained understanding.

**Learning happens through inquiry**

Inquiry arises out of a personal connection to a subject matter where understanding is not resolved. When students are faced with challenges where the solution is not immediately obvious or structured for them, they experience what John Dewey called disequilibrium. The process of inquiry begins with noticing, observing, and exploring, and requires students to seek information they do not already know. Through this disequilibrium, students construct their own understandings and interpretations that are relevant to their lives.

**Learning happens through engaging creative and imaginative thinking**

Creating a future that does not yet exist requires imagination and dedication. Children are naturally curious and creative, and when this side of them is engaged, not only is the experience more personally relevant, but new discoveries become possible. This is not just play, as Elliot Eisner points out, it is a cognitive act that can be developed.

**Learning happens through idea development with others**

We are always learning through the interaction of our ideas with others. Even when reading a textbook alone, we are in dialogue with the thoughts of the authors of that book. The ideas and inspirations of others help us develop our own ideas – they show us new ways to see, interpret, and respond. And when we articulate our own thoughts and discuss them with others, we learn in the process. This curriculum is designed to build not only individual understanding, but collective knowledge as well.

**Learning happens through structured facilitation**

The role of the teacher is not necessarily to “teach” in the typical definition of imparting or instructing. Our belief is that teachers are facilitators, or more appropriately, scaffolders. Teachers provide students a context and support their learning process. Eleanor Duckworth terms this the “fostering of wonderful ideas.” In order to present relevant challenges, teachers should be aware of each student’s community and personal experiences. They structure the learning process in dialog with the students, and assess where modifications need to be made in order to better facilitate learning.

For more on the ideas and theories guiding this curriculum, see:

The ideas learned through The Fourth R

The Fourth R is based on the following understandings we believe should endure:

1. **I live in a system**
   - **Choices:** selection from an array of options. This necessitates recognizing the current choices we are making, knowledge of available alternatives, and the ability to comparatively evaluate those alternatives. Every action, including inaction, is a choice.
   - **Environment:** the totality of our living surroundings. This includes both natural and human made. Our environment has been a place supportive of human life, but isn't implicitly so. While the space is large, it is also finite.

2. **I can create**
   - **Affect:** influence, effect change within. Within our ecosystem of daily life, everything is interconnected. People influence what is produced.
   - **Believe:** perception of what is good and true. This necessitates a search for truth, self-awareness and self-reflection.
   - **Make real to create:** includes identification (seeing an issue), investigation (a deeper, critical, engagement with what the student encounters in the world) and manifestation (bringing the ideas to a shared space).
   - **I have the ability:** confidence in one’s self and capacity to participate.

“**The choices I and others make affect our environment, lives, and the lives of generations ahead**”

“**I can make positive change in the world**”

“**I have the ability to make real the things I believe**”
### Learning Goals

In order to gain the enduring understandings outlined previously, students will need to know and do the following:

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<thead>
<tr>
<th>Goal</th>
<th>Description</th>
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<tbody>
<tr>
<td>Goal 1</td>
<td>Seek out information needed in order to solve a problem</td>
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<td>Goal 2</td>
<td>Identify and frame problems</td>
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<td>Goal 3</td>
<td>Generate, produce, and refine ideas</td>
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<td>Goal 4</td>
<td>Predict outcomes, incorporate feedback and evaluate effectiveness</td>
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<td>Goal 5</td>
<td>Communicate ideas effectively</td>
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<td>Goal 6</td>
<td>Work collaboratively</td>
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<td>Goal 7</td>
<td>Understand the nature of systems</td>
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<td>Goal 8</td>
<td>Understand the design process</td>
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*“When children are engaged in the process of designing – a product, a building, a city plan, or any object – they are learning to identify needs, frame problems, work collaboratively, explore and appreciate solutions, weigh alternatives, and communicate their ideas verbally, graphically, and in three dimensions.”*  
Quoted from Davis, et al.  
Design as a Catalyst for Learning
Overview

In order to know whether the learning goals have been attained, we will need to watch for indications in both the students’ development. Additionally, we think it is important to assess the success of the curriculum overall, and have built in measures to achieve this.

Learning indicators

Student Assessment Measures
Evidence that students are reaching learning goals and progressing in the enduring understandings.

Inspiration Book notes and entries
The Inspiration Book is the place where they student captures notes and questions. It contains account of observations, feelings, successes, failures, problem and solution ideas, and self-evaluation.

Class discussion, participation
Since a mode of inquiry is fundamental to this curriculum, class discussions, individual questions asked, and different perspectives considered are some of the best measures, although difficult to quantify, of student learning.

Solution
Students will work in teams to generate a new solution around the general problem of waste and waste management in their community. The solutions should be thoughtful, relevant, and creative.

Presentation to expert/user
The presentation is the students’ opportunity to share their ideas and develop skills of communication.

Implementation Plan
Students will predict the effect of their design idea on the system in which they live, and envision how to actualize their proposed solution.

Curriculum Assessment Measures
Tools for assessing the effectiveness of the curriculum as an authentic learning experience.

Pre-and post-Inspiration Book entries
Throughout this curriculum, students should experience a shift or adjustment in their conception of waste. Have thoughts about waste changed from the beginning of the curriculum to the end? Do the changes in the entries reflect new understandings of self and environment? What could the curriculum offer to improve upon this?

Trash Flow Diagram
An important goal is to enable students to gain a greater understanding of the system in which they live, and their own participation in that system. The Trash Flow Diagram represents the class’s collective perception of waste systems, and shifts in that perspective. Has the diagram evolved throughout the curriculum? Was the diagram modified as new knowledge about waste was gained through the activities? Do the changes in the diagram reflect new collective understandings of systems and relationships? What could the curriculum offer to improve upon this?

Transfer
Ideas and understandings gained in this curriculum are designed to be transferable to other situations. This transfer will be explored directly in the final activity, “Extension”. Are students able to identify other opportunities, other than waste, for applying the design approach to create change? Do students have a heightened understanding of their ability to create positive change in the world around them? What could the curriculum offer to improve upon this?
The main project authenticates the learning goals in many ways, including:
- In order to complete the project, each student will need to recognize the current situation of waste in his or her community as well as the causal agents leading to that current situation.
- The project necessitates recognizing future effects of current conditions and practices, as well as alternative choices that can be made.
- Students will gain empowerment and confidence to create by conceptualizing “best solutions” to achieve their goals.
- In addition to recognizing how they can change their personal actions, this project will require the students to think in community terms, and how to potentially influence other peoples’ actions.

The activities in The Fourth R build toward one main project:

Design a solution that improves upon the current situation of waste in your community. You will present that solution to an expert in the field, and users of the system.

A series of activities build toward and support the main project. They are classified into three categories: Understand, Generate, and Implement. Listed below are the topics covered in the activities throughout the process.

**Understand**

1. Impact of waste
2. Own behaviors and habits
3. Other people’s behaviors and habits
4. Systems invented
5. Natural systems
6. Possibilities

**Generate**

1. Problems
2. Ideas for Solutions
3. Manifestation of solution

**Implement**

1. Refine
2. Plan
3. Extend
During the course of the curriculum, we will employ different types of activities.

### Types of activities

#### Mini-lecture

While still engaging the class in discussion, the mini-lecture format is used to convey specific information that the students likely do not already know.

Activities of this type typically frame the hands-on activities to provide students an informational context for their inquiry.

#### Discussion

Facilitated by the teacher, the discussion format will be used to engage students in class dialogue. The discussions should be guided by the students’ ideas and questions.

#### Hands-on

Hands-on activities are used for engaging the students in work either by themselves or in small groups. These activities are the foundation of the curriculum, as students will learn through defining problems, creating their ideas and generating solutions.

#### Field trip

Going out into the community and exploring real-life situations is important for the authenticity of the project, and the personal connections to the subject matter. A field trip engages students individually and collectively.

#### Review

The review format is similar to a presentation, although it is not an end in itself. Reviews are designed to both allow the students to articulate their ideas, and also to gather feedback that will help refine those ideas.
### Overview

#### How it all fits together

An overview of how the activities relate to the goals and assessment measures.

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<th>ACTIVITY</th>
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<th>G1</th>
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### Overview

#### Understand

- **Day 1 / People**
  - **Activity 1.1** What is design?
  - **Activity 1.2** Talkin’ trash
  - **Activity 1.3** Interview & observe

- **Day 2 / Systems**
  - **Activity 2.1** Recap of Day 1
  - **Activity 2.2** Trip to Palo Alto Landfill, Compost, and Recycling Facility

- **Day 3 / Ideas**
  - **Activity 3.1** Journal reflection
  - **Activity 3.2** Brainstorm problems
  - **Activity 3.3** Lenses
  - **Activity 3.4** Brainstorm solutions

- **Day 4 / Prototypes**
  - **Activity 4.1** Class review
  - **Activity 4.2** Plan presentation

- **Day 5 / Evaluate, Plan**
  - **Activity 5.1** Ideas we’ve created
  - **Activity 5.2** Why assess & refine?
  - **Activity 5.3** Refine prototype and presentation
  - **Activity 5.4** Implementation plan
  - **Activity 5.5** Extension

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#### Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity 1.1</th>
<th>Activity 2.1</th>
<th>Activity 3.1</th>
<th>Activity 4.1</th>
<th>Activity 5.1</th>
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<tr>
<td>8:00AM</td>
<td>What is design?</td>
<td>Recap of Day 1</td>
<td>Journal reflection</td>
<td>Class review</td>
<td>Ideas we’ve created</td>
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<tr>
<td>9:00AM</td>
<td>Talkin’ trash</td>
<td>Trip to Palo Alto Landfill, Compost, and Recycling Facility</td>
<td>Brainstorm problems</td>
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<td>10:00AM</td>
<td>Interview &amp; observe</td>
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<td>3:00PM</td>
<td>Recap understandings</td>
<td>Research possibilities</td>
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**Homework:**
- Interview family, photograph trash

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**Collect and weigh waste from lunch**
Activities
Activities

Day 1 / Activity 1.1
What is Design

Objectives
Through this mini-lecture on design, students will begin to develop a personal understanding of the meaning of design, and develop an awareness that everything around them (except nature) has been designed by humans. This activity will also show them the process they are about to experience, and help set their expectations for the week.

Description
Discuss design. Ask the students if they can identify things that have been designed. Prompts include: things in the classroom, that they use everyday, that they encounter on their way to school, etc.

Explain that everything around us, except nature, has been designed by humans. Expand the conversation into more conceptual/system designs, such as the school day, road systems, amusement parks, etc. Capture the list of designs that have been discussed. We recommend writing the ideas on large sheets of paper, so that they can stay in the room throughout the course.

Watch the design process in action. After a list of items and systems has been generated, show the IDEO video.

Discuss the video. Ask students about their impressions. Prompts include: Do you think the final product was good? Is it better than what exists right now? Would you use it? Why or why not? What surprised you about the process? What new ideas does this video inspire?

Ask students to explain the process IDEO designers went through when re-designing the shopping cart. Prompt for both activities (observation, interviews, brainstorming, etc) and values (working collaboratively, understanding users, encouraging wild ideas, postpone judgement, etc.). Capture the discussion and draw the design process: Understand, Generate, Implement.

Learning indicators
Class discussion: Are students able to explain the design process? Do students demonstrate an understanding of the importance of considering others while designing new solutions?

Approximate time
1 hour

Materials
Large pads of paper to capture notes and keep in learning space for the remainder of the course

IDEO Nightline video

Notes to teachers
Beginning with design is an intentional decision: the conversation around design frames both the content and the experience the student will have. It shows them what they will be doing over the next few days... work that is not typical in a classroom setting.
Day 1 / Activity 1.2
Talkin’ trash

Objectives
Students develop an understanding of main problem they will be creating design solutions for: waste. They will also develop an understanding of why waste is a problem, and how the problems of waste and waste management relate to their lives.

Description
Initial perceptions. Ask students to write in Inspiration Books what they think of waste and what they know of waste management systems.

Discuss the problem at hand. Introduce the topic of waste and waste management. Discuss understanding of what that means.

Diagram. Ask students to draw in their Inspiration Books a diagram of where they fit in the trash flow process. We will call this the “Trash Flow Diagram.” Ask students to share their drawings with one other person. Then, ask for a volunteer to draw the diagram in front of the class. Ask for input on that diagram. The diagram does not need to be perfected, the idea is to capture the current understanding of trash items in relation to themselves. For an example, see the sidebar to the left. We will revisit the diagram later in the week. Keep this diagram visible throughout the week so students can see how their understandings are changing.

Calculating footprint. The average citizen generates 4 pounds of garbage a day. Using this figure, ask students to calculate the amount of waste they generate in a year, and that their families generate in a year. Total the amount of waste generated by the families of everyone in the class.

NOTE: ask for a “Trash Queen” volunteer to be responsible for collecting waste after lunch and weigh it. This will be used in a discussion on Day 2.

Predictions. Ask students to reflect in their Inspiration Books on what implications the amount of waste generated may have on the future in general, and for their futures specifically.

Inspiration Book questions
Initial perceptions: What comes to mind when you hear the terms waste and waste management?

Learning indicators
Class discussion: Are students engaged in the topic of waste? Are they able to conceptualize scale? Future implications?
Day 1 / Activity 1.3
Interview and Observe

Objectives
Students will develop an understanding of peoples’ habits and behaviors around trash. These habits and behaviors are an essential aspect of the problem, and reveal issues and opportunities. Students will also learn a transferable practice of gathering qualitative evidence.

Description
Explain activity. Students will interview and observe people in their context and capture details about how their interviewees deal with waste and waste management. Ask students why they think this would be a valuable exercise. Remind them of the IDEO video watched earlier. Discuss strategies for interviewing. Explain how to ask non-leading questions, and how to capture the information with cameras and notes. In the Inspiration Book, direct students to suggested questions and techniques for interviewing. Give the student tips on observing. Explain that it is important to look at the larger context, what’s in the interviewee’s trash, what the course of their day is like, etc. Encourage students to not only photograph and list what is in the trash can, but to take representative items that will help them explain their stories to the class. (For instance, if an individual uses disposable coffee cups every day, take one out of the trash as an example.)

Develop questions. Ask students to form groups of 2-3. These groups do not have to stay the same during the Generate phase of the project.

Send ’em out. Assign interviewees to each group, and send them out to conduct interviews/observations.

Homework
The homework for Day 1 is to conduct this activity at home. Students should interview and observe the habits around waste and waste management in their families. They should choose one family member to interview.

Learning indicators
Inspiration Book: Are students capturing information about the users they are observing? Is it objective, or are they passing judgment? What kinds of questions are they asking in the interviews?

Explain the goals for the next activity, Storytelling, so the students know how the information will be re-presented.
Activity 1.4
Tell stories

Objectives
Students reflect upon their observations and tell each other what they learned in order to build deeper collective knowledge. In this process, students will multiple perspectives on same topic.

Description

**Preparation.** Ask students to prepare an explanation of their observation. The goal is to tell a story of the person they interacted with. This should include one or two photographs that demonstrate their use of waste systems, a list of the items in their trash can, and a description of their habits and behaviors around trash. These should be written on a large piece of paper so they can be hung up and shared. They should not recount their interview, but should interpret the results. This will take time for the students to prepare, and the teachers should informally discuss techniques with students as they work.

**Storytelling.** Ask each group to present their stories for the class together. Visual materials should be hung in a shared space in order to collect the stories of different people together.

Learning indicators
Class discussion: Are students connecting the interviewees’ behaviors to his or her waste creation?

Note: Watch for reference to the stories during the Generate phase. These stories contextualize the user experience. During the Generate phase, it may help to refer back to the user stories. “How would NAME feel about that?”

Approximate time
30 minutes / prepare
45 minutes / storytelling

Materials
Prints of digital photos
Large pads of paper
Day 2 / Activity 2.1
Recap of Day 1

Objectives
Students will reflect upon their learning from Day 1.

Description
Tell stories of homework. Students should begin the discussion by telling stories of what they found in their homes. Frame the storytelling by asking students to explain who they interviewed and what they found. Ask the students to share any photographs they were able to take.

Revisit diagram. Point out the shared Trash Flow Diagram that was created in Day 1. Ask students if this is complete. If not, ask students to create a new diagram that is more complete. Again, we will be revisiting this diagram later, so do not require students to perfect this.

Discuss class lunch. Ask the student who was responsible for weighing the waste collected after lunch on Day 1 to report the data. Ask someone else to project this to the number of students in the school over a school year. Discuss the implications of their findings. Ask students how they feel about their findings, and where they think this waste goes.

Learning indicators
Inspiration Books: Did students do thorough observations at home? Interviews?

Class discussion: Do students make use of the information that they gathered over the previous day? Are they beginning to identify trends and patterns? Are they connecting the issue of waste to peoples’ choices and actions?

Curriculum assessment
Trash Flow Diagram: Are students creating a more complex and systemic view of trash?
Day 2 / Activity 2.2

Field Trip: Palo Alto Landfill, Compost and Recycling Facility

Objectives
Students will gain an understanding of what happens with waste after it leaves their hand. This activity introduces them to the systems for dealing with waste in their community, and demonstrates the concept of the large-scale volumes previously discussed.

Description
Generate questions. Ask students what they expect to see at the facility. Also, as a class, generate a list of questions they would like to know in order to develop a more complete understanding of the systems of waste management. Suggestions for questions include: How much waste gets generated in Palo Alto? How long does it take for waste to decay? Why do different things decay at different rates? Tell students to write these questions down in their Inspiration Book.

Tour. After getting to the facility, the tour guide will walk the students through. Remind students to record observations, take notes of facts, and write down other questions or ideas that come up during the tour. Be sure to bring cameras to allow students to take pictures.

Debrief. When back in the classroom, ask the students what they learned during the tour. Ask them to be specific: provide at least three new facts about waste they learned on the trip.

Learning indicators
Inspiration Book: Have they developed unique and grounded pre-field trip questions? Have they captured new observations, facts, questions, and ideas throughout the field trip? During the post-field trip discussion, have they taken note of what they and others learned?

Class Discussion: What questions are being asked during the field trip? What new information, knowledge, or ideas are they beginning to demonstrate through their questions?

Materials
Inspiration Book
Digital cameras

Notes to teachers
This activity is essential in the learning process and requires advanced planning. Contact the Palo Alto Landfill, Compost and Recycling Facility early to ensure the activity can take place on Day 2. Arrange for a question and answer session with the tour guide. Transportation will also need to be arranged. Be sure to follow school policy, including permission slips.
Approximate time
45 minutes

Materials
Inspiration Book

Notes to teachers
The educator must have some knowledge concerning relationships within ecosystems, and one organism’s waste becoming another organism’s food. If you do not have this knowledge, we encourage you to do some research in advance so the conversation is more specific with the students.

Objectives
Students will develop an understanding of the interconnectedness of systems and nature’s model of dealing with waste.

Description
Introduction to the concept. Begin by asking students what they know about ecosystems. Guide a brief discussion on what ecosystems are, work toward a class definition, and then (if needed) provide a working definition of ecosystems. From the topics brought up by the students, discuss the interconnectedness of ecosystems using concrete examples. Briefly touch upon concepts of cause and effect in such a system (both linear and web-like). Examples to consider may be the classroom as an ecosystem, or the human body as an ecosystem.

Discuss waste within ecosystems. Explain the way nature considers waste. One animal’s waste is another animal’s food. Encourage students to wrestle with the concept of waste serving as food by providing them with specific examples.

Consider again how humans handle waste. Ask the class to reflect back on the ways humans handle waste in light of the discussion of natural ecosystems. Encourage students to generate questions and pose questions to the class here. Allow time for students to reflect on this in their Inspiration Books.

Inspiration Book questions
What do you think about the idea that in nature, waste=food?

What do you think about how humans consider waste in relation to the way natural ecosystems function?

Learning indicators
Inspiration Book: Notice students’ reactions. Is waste=food a new way for them to see waste and nature? Are they comparing the way that nature deals with waste with the way that humans manage waste?

Class Discussion: Are students applying knowledge of cause and effect to discuss relationships within ecosystems? Is a collective definition of an ecosystem evolving as more students contribute? Are students generating new connections and asking new questions about human systems?
Day 2 / Activity 2.4
Research possibilities

Objectives
Students will be exposed to innovative approaches to waste, and will develop an understanding of redesign possibilities. This activity will require students to explore and understand examples of design. They will then communicate what they learn to the rest of the class.

Description
*Distribute articles.* Ask students to break into groups of two. (These do not have to be the same groups they work in later). Give two pre-selected articles in the same category to each group, and ask both students to read both articles. Give list of questions to keep in mind when reading the articles, and ask students to take notes in their Inspiration Books while reading. Have both students discuss the articles together.

*Share with class.* Bring the class back together and ask each group to present major learning from each article.

Inspiration Book questions
What is interesting about this new material, product or service?

How is it different than what existed before?

How could you use this material, product, or service in your community?

Learning indicators
Inspiration Books: Look for useful notes from students’ exploration of their design example.

Class Discussion: Listen for understanding of the design examples, evident as students explain the articles in their own words to the rest of the class. Do they understand the design solution? Are they able to make a compelling case for its effectiveness or ineffectiveness?

Approximate time
1.5 hours

Materials
Articles
Inspiration Book

Notes to teachers
Gather readings that inspire new ideas and possibilities for design solutions. See appendix 1 for suggestions.
Activities

**Day 2 / Activity 2.5**

**Recap understandings from Day 2**

**Objectives**
Students will reflect on their learning over Day 1 and Day 2. Students will also begin to identify problems that they see, and think more critically about how an object relates to its environment over the time.

**Description**
*Reflect.* Ask students to list the activities that they’ve been through thus far. Capture this on a large piece of paper so that it can stay in the room during the week. Allow them to flip through their Inspiration Books to jog their memories, and remind them about any steps they may have forgotten.

*Revisit diagram.* Point out the shared Trash Flow Diagram that was re-created earlier in the day. Ask students if this is complete in light of the new information from Day 2. If not, ask students to create a new diagram that is more complete. Again, we will be revisiting this diagram later, so do not require students to perfect this.

Ask students to reflect upon the solutions they read about in the last activity. Ask them to draw in their Inspiration Books the Trash Flow Diagram that the class has evolved and to plot the solutions they read about in the last activity on the diagram. Ask them to explain what specific problem and point in the process of trash flow the solution is addressing. Discuss these as a class.

**Learning indicators**
*Inspiration Books:* Is the reasoning from groups’ definition of the problem and the solution that they see in their design examples well established?

*Class Discussion:* Are students solidifying their problem-definition and problem-identification skills? Are they incorporating facts and observations from previous activities?

*Curriculum assessment*
*Trash Flow Diagram:* Are students creating a more complex and systemic view of waste?

**Approximate time**
1 hour

**Materials**
Large pads of paper
Inspiration Books
Day 3 / Activity 3.1
Journal reflection

Objectives
Students will begin to consider problems in the systems of waste and waste management by thinking about a tangible object from their observations.

Description
Inspiration Book exercise. Ask the students to chose a specific object they discovered as waste in the past 2 days. In their Inspiration Books, students should write a minimum one-page entry about that object’s journey in human-made systems and nature’s ecosystem. List problems and opportunities along this journey.

Remind students to use the Trash Flow Diagram for reference and inspiration.

Inspiration Book questions
Consider the life-span of an object. How much time does it take to create? How much time does it spend being used? How much time does it spend as waste before it becomes something useful again (if it is able to become useful again)? Where does it spend most of its time? In it’s journey, how does it affect its surroundings?

Learning indicators
Inspiration Books: Are students able to imagine the journey of an object from cradle to grave? Are students thorough in their analysis of the journey? Are students using information gained in the past 2 days in their stories?
Day 3 / Activity 3.2
Brainstorm problems

Objectives
Students will identify problems they see in the systems of waste and waste management.

Description
Frame the brainstorm. Before beginning the class brainstorm, remind students of framework for effective brainstorms:
– Defer judgement. No idea is a bad idea in a brainstorm.
– Encourage wild ideas. They often inspire great solutions.
– Build on the ideas of others.
– Stay focused on the topic.
– One conversation at a time.
– Be visual. A picture will make the idea easier to remember.
– Go for quantity.

The topic for this brainstorm is problems with the systems of waste and waste management.

During the brainstorm Allow students to lead this without too much intervention. Remind students to capture their own ideas and post in a shared space. If idea production slows down, provide a prompt, such as “consider the 5 senses” or “think about space, tools, roles, processes”. There will likely be both problems and solutions generated, this is ok. However, if the ideas become too solution-focused, ask questions to bring the brainstorm back to generating problems.

After the brainstorm The brainstorm should last no more than 30-45 minutes or the ideas may get too far off-topic. When all of the ideas have been posted on a board or wall in the front of the room, ask students to begin to sort through the ideas. Which is their personal favorite? Which do they think will have the most impact? Which is the wackiest? Which is the most easily implementable? Which would excite the users they interviewed the most?

Learning indicators
Class discussion: Are students identifying problems? Are they communicating clearly? Are they enjoying themselves?
Activities

Day 3 / Activity 3.3

Lenses

Objectives
Students will gain an understanding of different ways to look at a problem in order to find solutions.

Description

Discuss Industries
As a class, ask students to describe their experience with the brainstorm, and how they imagine translating those problems into solutions. Discuss that there are different ways to look at every problem, and that you can use different filters, or lenses, to see in a new way.

Explain that there are different industries of design that students can think within: Product design, Fashion design, Interior design, Graphic/Visual design, Marketing, Architecture, Urban Planning, Civil engineering, Computer Science, etc.

Ask the students to pick one example from the problem brainstorm and brainstorm solutions from within different industries.

Discuss social systems
Explain to students that there are other ways to consider both problems and solutions, such as various social systems (economic, political, environmental, religious, etc). Ask them to brainstorm the same problem in these different ways.

Ask students to take notes in their Inspiration Books.

Learning indicators
Class discussion: Are students able to use different lenses to generate solution ideas?

Approximate time
30 minutes

Materials
Inspiration Books

Notes to teachers
Educator must be knowledgeable about different types of design.
Brainstorm solutions

Objectives
Students will generate solutions for problems they see in the systems of waste and waste management.

Description
Frame the brainstorm. Ask students to form 2 teams. It may be best to randomly assign groups so that friends do not become too distracted by each other.

Before beginning the smaller group brainstorms, remind students of framework for effective brainstorms:
– Defer judgement. No idea is a bad idea in a brainstorm.
– Encourage wild ideas. They often inspire great solutions.
– Build on the ideas of others.
– Stay focused on the topic.
– One conversation at a time.
– Be visual. A picture will make the idea easier to remember.
– Go for quantity.

Ask each group to pick 3 problems from the earlier brainstorm. They will then brainstorm solutions for those problems.

During the brainstorm Allow students to lead this without too much intervention. Remind students to capture their own ideas and post in a shared space. If idea production slows down, provide a prompt, such as “consider the Five senses” or “think about space, tools, roles, processes”.

After the brainstorm The brainstorm should last no more than 30-45 minutes or the ideas may get too far off-topic. When all of the ideas have been posted on a board or wall in the front of the room, ask students to begin to sort through the solution ideas. Which is their personal favorite? Which do they think will have the most impact? Which is the wackiest? Which is the most easily implementable? Which would excite the users they interviewed the most?

At the end of the brainstorm, allow for time for the students to capture their favorite ideas in their Inspiration Books. Ask them to explain why they like the idea.

Learning indicators
Class discussion: Are students identifying solutions? Are they communicating clearly? Are they enjoying themselves?
Activities

Day 3 / Activity 3.5
Prototype

Approximate time
~4 hours total

Materials
Craft supplies such as:
- Construction paper
- Play-doh or clay
- Pipe cleaners
- Scissors
- Glue
- Magazines
- Markers
- Polaroid cameras
- Post-it notes
- Toys
- Straws
- Paper clips
- Rubber bands
- Feathers
- etc...

Notes to teachers
You will likely need to gather these materials in advance. Be creative in tracking down prototype materials. Ask students to bring in newspapers or magazines. See if a local design firm or art supply store will donate the materials.

Objectives
Students will create a manifestation of their ideas to share with others.

Description
How to begin Ask students to break into prototype teams of 2-3 students. Each group should select one or two ideas from the previous brainstorm activity that they think will have a big impact on the problem they’ve chosen to solve. Remind them that the goal for the prototypes is not to perfect them, but to capture the idea in a way that others can understand it.

Tips Prototypes do not necessarily need to be objects. Remind students that they can create a new tool, process, space, role, campaign... Whatever works best to illustrate their idea. The prototype might be a skit that acts out how a product inspires a new behavior, or a storyboard that shows how a new process unfolds. Students can take pictures of themselves acting out a scenario, then turn those pictures into a campaign or a report. Also remind students to think as thoroughly as possible about their ideas. For example, if the idea involves new waste-collecting behaviors, students may decide to also design a new uniform for the worker and new transportation vehicles. Students can also role play a situation as a prototype. Encourage students to be creative in their representation.

Learning indicators
Solution: Does the idea address the specific problem they’ve identified? Is the idea creative? Have they considered alternatives? Does the prototype clearly represent their idea?
Day 4 / Activity 4.1
Class review

Objectives
Students will present their work to the class in order to gather feedback on the effectiveness of their designs.

Description
Frame the review Before beginning the class review, explain to the students that this is their chance to get feedback from their peers. Remind them of respectful behaviors:

- Allow presenters to finish explaining their work before talking.
- Explain aspects you like about their idea, and aspects that they can continue to develop. Be specific.
- Respect other people’s ideas. Being mean doesn’t help anyone.

Ask the students to spend a few minutes writing down what they would like to say and what questions they have for the class about their own design idea.

During the review Support each group and encourage the class to share their responses and ask questions. Encourage the students to take notes in their Inspiration Books about other people’s work and new ideas it may inspire for them.

After the review Ask the students to write down the feedback they received and reflect upon what they would like to incorporate into their solution. Allow students to mingle, and discuss their ideas further with other groups.

Learning indicators
Presentation: How thoroughly do they describe their idea? Do they include the specific problem they are looking to solve? Do they include reasons they see the solution as successful? Do they tie this back to the initial research (interviews, site tour, articles)?
Day 4 / Activity 4.2
Plan presentation

Objectives
Students will plan how to present their ideas for review.

Description
**Frame the exercise** Explain to students the importance of communicating their ideas clearly for the presentation. Ask students to brainstorm the kind of things they would talk about in their presentations.

If needed, prompt with:
– The problem we’re addressing
– The criteria for a successful solution
– The solution idea
– Who its designed for
– How they would use/encounter the solution

Ask students to generate a plan for their presentations.

Approximate time
1 hour

Materials
Inspiration Books
### Activities

#### Day 4 / Activity 4.3

**Expert, user review**

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<table>
<thead>
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<th>Approximate time</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials</td>
<td>Photocopied review form generated by students</td>
</tr>
<tr>
<td></td>
<td>Inspiration Books</td>
</tr>
</tbody>
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**Notes to teachers**

This activity requires advance planning. It would be best to invite back the users the students interviewed and observed on Day 1, and also the expert that gave students the tour on Day 2. This way, the reviewers relate most to the context for the solutions that were generated. We also encourage using this review as an opportunity to celebrate. Following the review with a party will demonstrate the importance of the activity they just went through.

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**Objectives**

Students will present their work to the people they interviewed and an expert in the field in order to gather feedback on the effectiveness of their designs.

**Description**

**Frame the review**

Before beginning the class review, explain to the students that this is their chance to gather feedback from experts. Remind them of respectful behaviors:

- Allow presenters to finish explaining their work before talking.
- Explain aspects you like about their idea, and aspects that they can continue to develop. Be specific.
- Respect other people’s ideas. Being mean doesn’t help anyone.

Ask the students to spend a few minutes writing down what they would like to say and what questions they have for the experts. They will then generate a review form for what they feel is the criteria for their project. If possible, make copies of these forms to give to the users and experts during the review.

**During the review**

Support each group and encourage the students to ask direct questions to the users and experts, allowing them to respond without the students defending their work. Encourage the students to take notes in their Inspiration Books about other people’s work and ideas it may inspire for them.

**After the review**

Ask the students to write down the feedback they got and reflect upon what they would like to incorporate into their solution. Allow students to mingle, and discuss their ideas further with everyone. Celebrate the accomplishment of getting to this phase of the process.

**Learning indicators**

Presentation: How thoroughly do they describe their idea? Do they include the specific problem they are looking to solve? Do they include reasons they see the solution as successful? Do they tie this back to the initial research (interviews, site tour, articles)? Has their presentation improved since the class review?
Day 5 / Activity 5.1
Ideas we’ve created

Objectives
Students will consider their solutions as part of a system.

Description
Revisit diagram. Point out the shared Trash Flow Diagram that was re-created earlier in the day. Ask students if this is complete based on their thoughts from Days 3 and 4. If not, ask students to create a new diagram that is more complete.

Ask students to reflect upon the solutions they are generating. Ask them to draw in their Inspiration Books the diagram that the class has evolved and to plot the solutions they have been creating on the diagram. Ask them to explain what specific problem and point in the process of Trash Flow the solution is addressing. Discuss these as a class once the student has done this in their Inspiration Books.

Ask the students to individually reflect upon what is working well about their solution ideas, and what might be missing for their idea to more thoroughly address the system concerns.

Learning indicators
Inspiration Books: Are students able to see where their ideas fit into the overall system?

Class discussion: Are students able to see how their ideas fit collectively into the overall system?

Curriculum assessment
Trash Flow Diagram: Are students creating a more complex and systemic view of waste?

Materials
Inspiration Books
Large pads of paper
Markers

Approximate time
45 minutes
Day 5 / Activity 5.2
Why assess and refine?

Objectives
Students will gain an understanding of the importance of gathering and incorporating feedback in order to create more relevant solutions.

Inspiration Book questions
How do you feel today about the feedback you received in the review yesterday?

What ideas will you incorporate in your revised prototype? Explain why.

What ideas will you leave out of your revised prototype? Explain why.

Description
Reflection exercise Ask students to spend approximately 10 minutes writing in their Inspiration Books their current thoughts about the feedback they got on their solutions from the users and expert the previous day.

Begin the discussion Ask students to consider the current systems of waste management. Discuss them as a process of design, and as systems that have been created. Ask about their effectiveness, and the importance of knowing their effectiveness.

Ask students to now think about the solutions they are creating. While they may be proud of their ideas, will other people actually use them? Why does it matter if other people do or don’t use them? Explain that since we are designing these solutions for people, that it is important to know whether people will actually use and like them. Remind students of the IDEO video from Day 1. Ask if they remember that once they created their design, they took it to a supermarket to see what people thought. With the feedback they were given, they could go back and refine their idea to make it more useful and effective.

Discuss the importance of understanding what other people think when you’re creating solutions for them, that our ideas are not just for us alone.
Day 5 / Activity 5.3
Refine prototype and presentation

**Objectives**
Students will reconsider the effectiveness of their solutions and make appropriate modifications.

**Description**
*Frame the activity* Ask students to spend time refining their prototypes and/or presentations based on the feedback. Speak with each group individually to get a sense of how they’re valuing the feedback they received, and challenge them to make their solution the best it can be.

**Learning indicators**
Solution: Does the idea address the specific problem they’ve identified? Is the idea creative? Have they considered alternatives? Does the prototype clearly represent their idea? Have they successfully incorporated feedback? Have they considered what they need to know or learn in order to make the idea real?

Presentation: Have they articulated their ideas more clearly?
Day 5 / Activity 5.4
Implementation Plan

Objectives
Students will consider what it will take to make their idea real in the world – including what they know already and what they will need to know in the future. This is aimed at not only producing a more effective design solution, but inspiring a mode of relevant inquiry for learning other subject areas in the future.

Description
Frame the activity
Ask students to explain their thoughts on the importance of creating a plan for implementation.

Give students a framework help them begin. Ask them to capture notes in their Inspiration Books, and then to type up the reports to turn in.

Suggested framework:
– Explanation of the solution
– Why it is important/problem(s) addressed
– How the student imagines making the idea real
– What the student needs to learn in order to make the idea real and why. (For instance, a student may choose to invent a new compostable fabric and in order to make this possible, they will need to learn chemistry, textile manufacturing, etc)

Learning indicators
Implementation plan: Does the implementation plan take into account various system influences, such as time, resources, and human behaviors? Have students considered what they need to know or learn in order to make the idea real?

Approximate time
2.5 hours

Materials
Inspiration books
Computer and printer
Day 5 / Activity 5.5

Extension

Approximate time
45 minutes

Materials
Inspiration Books
Large pads of paper

Objectives
Students will consider the process of design and their understanding of systems and then transfer the concepts to other problems.

Description

Reflection exercise. Ask students to write an entry in their Inspiration Books about what they think of around the terms waste and waste management. Next, ask them to write about what they feel they have learned. Give them about 15 minutes to do this.

Transfer exercise. Ask students to think about a problem other than waste that they would be interested in solving. Ask them to write how they would go about solving that problem.

Discuss. As a class, ask for volunteers to talk about what they learned about design and waste. Capture the ideas of large pieces of paper for all to see. Acknowledge the accomplishment this endeavor was.

Ask a few students to share the problems, other than waste, that they would be interested in solving. Ask the class how they would go about solving this.

Learning indicators
Inspiration Books: Is the student able to articulate the design process? Does the student demonstrate an awareness of increased systemic thinking? Is the student able to transfer the concepts to other problems? Are they able to generate ideas for new solutions quickly?

Class discussion: Are the students able to articulate the design process? Issues of ecological awareness? Are they able to transfer the concepts to other problems? Are they able to generate ideas for new solutions quickly?

Curriculum assessment
Transfer: Are students able to identify other opportunities, other than waste, for applying the design approach to create change? Do students have a heightened understanding of their ability to create positive change in the world around them? What could the curriculum offer to improve upon this?

Post-entry (reflection exercise): Have students’ statements on waste and waste management changed since the initial entry? How? What could the curriculum offer to improve upon this?
01 / Facts about waste

**United States**

The United States produces more waste per person than any other country in the world.

The average citizen generates 3 to 5 pounds of garbage a day. Over the course of a year, that amounts to 1,400 pounds per person.

Americans produce 154 million tons of garbage every year. That is enough to fill the New Orleans Superdome, top to bottom, twice a day, 365 days per year. Disposing of that waste cost about $4 billion in 1978. In many cities, expenditures for waste management were second only to those for education.

Each year, Americans throw away approximately 60 billion cans, 28 billion bottles, 4 million tons of plastic, 10 million tons of yard waste, 40 million tons of paper, 100 million tires, and 3 million cars.

Typically, solid waste contains about 42 percent paper, 23 percent yard and food wastes, 10 percent metals, 9 percent glass, 7 percent plastic, and 9 percent other materials.

Although more than half of our solid waste could be recycled, we are currently recycling only about 10 percent. Denmark recycles an impressive 60 percent of its waste.

The single largest component of what people throw away is paper. The average American uses 580 pounds of paper a year, the highest rate of consumption in the world. Making that paper requires somewhere between three and six trees, each weighing close to 500 pounds.

**Bay Area**

On average, each Bay Area resident generated almost two pounds of garbage per day in 1999, while the average employee generated almost eight pounds per day. Marin residents had the dubious distinction of generating the most garbage per day – almost three pounds – while employees in Sonoma County generated the most garbage per day – more than 12 pounds.

During the period 1995 to 1998, the average daily amount of garbage generated increased for both residents and employees.

According to data for the period 1995 to 1998 (the last year for which complete data are available), most Bay Area counties are well on their way to meeting the state-mandated goal of diverting 50 percent of their garbage from landfills. This includes Solano, which, until 1998, had by far the lowest diversion rate in this period.

With the exception of San Mateo and Sonoma, all Bay Area counties diverted at least 40 percent of their total trash in 1998. Three counties – Napa, Solano, and Marin – cleared the 50 percent mark that year. Marin has the highest diversion rate, and San Mateo the lowest.

According to government comparisons, the Bay Area has the second highest rate of per-person garbage production among the state’s regions.
### Materials

- Inspiration Books (you can either make these, purchase sketch books, or ask the students to get a notebook just for this week)
- IDEO Nightline video
- Large pads of paper
- Post-it notes (lots!)
- Markers
- Craft supplies for prototypes
- Computer, printer, internet access
- Digital or Polaroid cameras
- Calculator
- Scale

### Articles

In researching articles to distribute, consider the following categories: materials, products, manufacturing, processes, design solutions, reduce/reuse/recycle solutions, services, processes

For example, materials:

“A new corn-based plastic disappears into the dirt”
http://www.csmonitor.com/2003/0904/p12s02-sten.html

For example, design solutions:

Nike’s new environmental shoe design
http://www.nike.com/nikebiz/nikeconsidered/context.jhtml

For example, reduce/reuse/recycle solutions:

SAN FRANCISCO, 17-cent fee on shopping bags
http://www.nike.com/nikebiz/nikeconsidered/context.jhtml
We would like to thank the following people for helping with the development of this curriculum:

Denise Clark Pope, Stanford University
Marjorie Bullitt Bequette, Stanford University
Django Paris, Stanford University
Debbie Piccoli, Girls’ Middle School
Marjorie Lucks, Girls’ Middle School

and the Curriculum Construction class (208b), Winter 2005, Stanford University School of Education