

# Connecting the Disciplines Through Collaborative Problem Solving: Interdisciplinary Design

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## Abstract

We teach at a JK-12 Independent Progressive day school. Founded in 1901 with an emphasis on learning by doing, the school allows teachers to design learning environments that encourage independent thinking, problem solving, and cooperative practice.

The seventh grade team of teachers is particularly adept at interdisciplinary work, frequently altering the master schedule to allow for longer working blocks, collaboration across disciplines, and attention to student engagement in heterogeneous classes of 11-13 year-olds. Teachers keep the tenets of Maker Empowerment at the forefront of individual class projects, and they have aligned elements of their curriculum for the past five years to facilitate a continuing, interdisciplinary design project focused on environmental or societal challenges.

Giving students real problems to solve and allowing them time to collaborate on solutions has had its rewards. Working on a genuine problem with a diverse team of classmates is both fun and challenging for students (and teachers). Asking the right questions about sustainability and accessibility at school has allowed our students to empathize, innovate, collaborate, design, tinker, build, present, and implement their solutions.

## Keywords

design; tinkering; maker empowerment; interdisciplinary project; middle school;

## Where we work

A JK-12 Independent Progressive day school. Teachers are encouraged to design learning environments that build independent thinking, problem solving, and cooperative practice. The seventh grade team of teachers is particularly adept at interdisciplinary work, frequently altering the master schedule to allow for longer working blocks, collaboration across disciplines, and attention to student engagement in heterogeneous classes of 11-13 year-olds. Teachers keep the tenets of Maker Empowerment at the forefront of individual class projects, and they have aligned elements of their curriculum for the past five years to facilitate a continuing, interdisciplinary design project focused on a central, guiding question.

## What We Do

For the past four years, teams of student designers and makers have focused on providing innovative solutions to human centered problems at our school. In these first years the team asked students to look to where we can improve our efforts of sustainability, accessibility, and the use of space within our campus. Student teams had to balance the competing needs of different groups of users and stakeholders. They made models and plans, and they presented those plans to panels of people who use spaces regularly or who are affected by the problem. From the start of the year, the seventh graders engage in tinkering, making, and design thinking as they consider solving problems. The seventh grade team works to provide experiences and skills in all disciplines so when students reach project week they have tools to build a successful design team.



**Image 1: Students design and build an Obstacle Course for the school's fall fair. Some materials used are paper, cardboard, PVC pipe, duct tape, and lumber.**

An early dose of design and collaboration success happens in October as each year they continue to reimagine our activity at the school's fall festival, County Fair. They model and plan elements of an obstacle course designed for students in preschool to 6th grade based on data gathered and feedback received from the previous year's iteration of the course. Students also practice human-centered design by imagining the wide array of "users" who will be attempting the obstacle course, considering, in particular different ages and ability levels. They design, model, and prototype new activities in response to the success and disasters of previous courses. County Fair itself is always a morning of prototype testing and on-the-go design modification as students keep the Obstacle Course up and running despite design difficulties and the wear and tear that comes from the enthusiastic response of the participants.

Even before mid-October students are making and tinkering. Students are challenged to create a tool that they wished they had on their class trip camping in Michigan; they study adaptations of organisms and biomimicry to design a product that utilizes adaptation to solve a human centered problem; and they use the 3D printing, laser cutting, and low fidelity materials (clay, cardboard, LEGOs) to model architecture through history. Work across the disciplines continues to give students opportunities to code, use CAD programs, design, make, work in teams, and consider the impact of their work on the world.



**Image 2: Ellie and Caroline collaborate on their tool design.**

One week in March the seventh grade team blends all core content areas to provide uninterrupted time for teams to work on their project. For the last four years the team has provided a guiding question or focus for student work during project week. We have looked at recycling, general sustainability, use of space, and accessibility. The focus has been framed as a question: How might we improve the success of our recycling program? How might we make different or improved use of the common spaces? How might we make the school more accessible for people with visible or invisible accessibility challenges? We have learned from our work on this project that we can trust the students and ourselves, and this year we are asking students to devise their own question and look for a project that is interesting to them. The parameters we propose for them are that they look for topics that they think are interesting, solvable, human-centered, and connected to the school in some way. In addition, we want their project to have some kind of social good or benefit.

We are committed to the project and to the time and energy that it deserves. We enjoy the collaboration between students and adults as we all learn together. Teachers act as coaches and co-learners in this project. The project is firmly mission-based for our school, and it fosters student leadership in a global, democratic community as well as building genuine empathy. Student designers always present their final projects and proposals in authentic ways, which have included in front of panels of stakeholders, to the Director of Operations and for the

Building Committee of the Board. We like seeing students challenge themselves and try new things. There is a high level of interest and excitement about the work all year long, and the project breaks down the artificial walls of the curriculum and class schedule structure.

This project takes time, but the team is committed to it, and we are in the midst of our fifth iteration of the project.

### What does a year look like?

The team meets in the summer to sketch out the project theme and a basic calendar. As experienced teachers, we make an early decision for the timing of project week based on the ebb and flow of the curriculum and the pressures of the year. The rest of the project dates are more flexible. Our classes are 45-50 minutes long, and block classes are 90-100 minutes. Our target for project week is a full week in March.

**Table 1: Sequence of Design Challenges and Class Time Used**

<b>DATE</b>	<b>LESSON</b>
9/18-9/19 Block (History)	Tool Design Challenge <ul style="list-style-type: none"> <li>• Intro Design Thinking (DT) and the project</li> <li>• Go through DT process with focus on interviewing and ideating</li> </ul>
9/20 (English)	Data Analysis of Obstacle Course <ul style="list-style-type: none"> <li>• Using feedback from the previous year (photos &amp; surveys), students decide which obstacles to keep, tweak, or trash</li> </ul>
9/24-9/25 Block (Math)	Ideating Obstacle Course challenges: <ul style="list-style-type: none"> <li>• Day one: DT process, develop new obstacles and two tweaks.</li> <li>• Day two: students watch Explain Everything videos of proposed obstacles, and sticky vote on the options. Narrow down choices. Groups form.</li> </ul>
9/27 (first fifteen minutes of tutorial)	Vote on Obstacles: <ul style="list-style-type: none"> <li>• Students see final options, use google form to select 2 new ones and 1 tweak.</li> </ul>
10/2 and 10/3 Block (English)	Build New Designs and Iterate on Existing Obstacles <ul style="list-style-type: none"> <li>• Sections on Tuesday started the obstacles; Wednesday sections finished building</li> </ul>
10/4 Tutorial	<ul style="list-style-type: none"> <li>• Final touches and tweaks to obstacles</li> </ul>
10/9 - 11/2 (Science)	Biomimicry Design project <ul style="list-style-type: none"> <li>• Defining problems and developing "How might we.." questions</li> <li>• Looking to nature for inspiration.</li> </ul>
12/13 (History)	Case Studies of Existing Designs for Social Good <ul style="list-style-type: none"> <li>• Look back at what students have done so far and preview of project week</li> <li>• Show case-study videos &amp; jigsaw case studies.</li> </ul>
1/28 (Math)	<ul style="list-style-type: none"> <li>• Measuring space and drawing to scale</li> </ul>
1/29 and 1/30 Block (Spanish)	Locker Redesign challenge - <ul style="list-style-type: none"> <li>• How might we improve the locker bays? Full DT process</li> </ul>
2/6 (English)	<ul style="list-style-type: none"> <li>• Identify stakeholders in Locker Redesign &amp; propose persuasion strategies</li> </ul>
3/12 (English)	<ul style="list-style-type: none"> <li>• Designer from IDEO speaks with students</li> </ul>
Week of 3/18 (all classes)	<ul style="list-style-type: none"> <li>• Project Week</li> </ul>
As needed	<ul style="list-style-type: none"> <li>• Prepare presentations for designs moving forward</li> </ul>

We take one full week in March and suspend all regular classes. Students still attend PE and fine and performing arts classes during the week. Students work in teams of three and four. Students take on roles as needed throughout the week. All students on the team are part of the final presentations. The week includes time to develop questions, pitch projects, design, prototype, test, modify designs based on feedback, and present to community stakeholders.

## What Happened

Students discovered the power of their ideas and designs. The school implemented some of their designs for recycling bins and scrap paper collection. The Upper School dean is using the designs and plans that the current freshman created when they were in seventh grade for improved use of common space, and students have been able to present to administration and the Building Committee of the Board. This experience of defending their ideas and answering questions was exciting, and students have been empowered by both positive feedback and implementation of their plans and designs. Beyond unleashing their creativity and energy, nothing is more important than getting students (and us, their teachers) to work as a team. They (and we) have learned the skills of compromise and working toward a common goal. The project allows students who tend to succeed in school to have a space to struggle, and it allows students who may not thrive in a traditional classroom a chance to take a leadership role on a team. The work deepens our relationships with students and with each other as teachers.



**Image 3: Seventh graders present to the Director of Operations and a panel of teachers**

With the fifth iteration this year, we have turned the reins of control over to the students. We trust that they will be able to identify a project that they would like to work on as well as find a team to work with. We know that there will be new challenges for us as coaches, and we are excited to take this up.

## Broader Value

The artificial silos of the content-area driven schedule gives students the mistaken impression that the use of English ends at the door of the classroom, biology only exists in the lab, mathematics is only problem solving and history and social issues are something that can only be studied. This interdisciplinary project makes the barriers between content areas disappear as students use skills developed in their classes on a project of their choice. We have seen students develop proficiency in both creating things, through computer design and production of handcrafted items, and in being resourceful and collaborative as they define and solve problems. They look at each other in more complex and thoughtful ways, and they see their teachers as partners in their efforts. Students become experts and designers, with deep proficiencies in content areas and in the application of their knowledge.

## Relevance to Theme

Students have engaged in this interdisciplinary project with the most excitement and enthusiasm when they care about an issue and could see a genuine social benefit to the work. When we based our work on accessibility, students became attuned to the needs of people who have physical and/or cognitive challenges at school. When we looked at energy use and sustainable practices, students recognized how their behaviors impact both the school and the world around them. A project like this empowers students to solve problems related to the environment, to see how people are marginalized in spaces that should feel welcoming, and to bring people together to create social change. We can design trust, we can create pathways to equity, and we can recycle all the cardboard ever delivered to school into amazing things.

## Bios

Kate Tabor teaches English at Francis W. Parker School. She is currently co-chair of the English Department. Kate has served as Seventh Grade Team leader and well as past project leader for the Interdisciplinary Design Project. She is a reader, writer, and maker.

Adam Colestock is a STEAM integration teacher at Francis W. Parker School. He introduces computer science to grades 4-8 by co-teaching units that integrate programming into the curriculum. He also co-designs and facilitates immersive projects that develop students' experience in design and engineering, including a STEAM week for 5th graders and an interdisciplinary design week for 7th graders.

Anthony Shaker teaches History at Francis W. Parker School. He is currently co-chair of the History Department. Anthony is the current and past project leader for the Interdisciplinary Design Project.

Adam and Kate will be part of the Educator Roundtable.