Teaching Content and Creativity Through Student-Generated Media Projects

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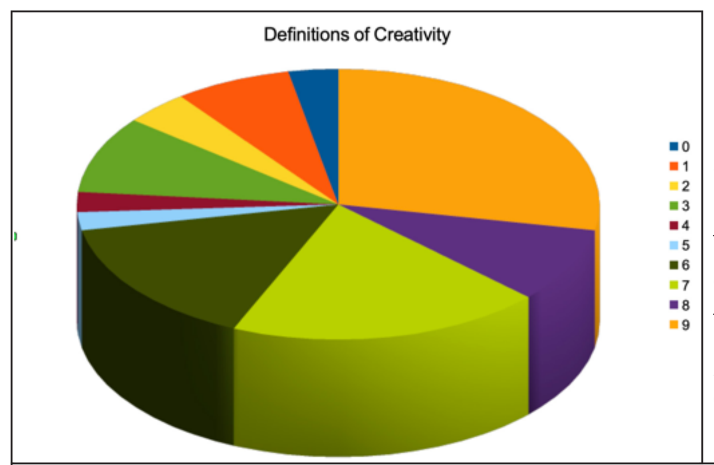
Abstract:

Having students create their own educational media can be an effective method for teaching subject content. As student teams create videos, posters, infographics, animations or other media about a subject, they acquire desired content knowledge while learning marketable skills. Previous studies have assumed that digital native students will already know media creation skills, yet this is an unwarranted assumption. Such studies have not been based on theoretical frameworks or sound pedagogy (Reyna and Meier, 2018). This poster uses an action research case study approach to examine various types of student-created media, how media design skills can be scaffolded through preliminary projects, and their overall effectiveness at teaching science concepts. Implications for future research and a model of students as content creators and innovators are presented.

The Need for Creativity:

Our society depends on innovation and creativity to provide economic growth and to solve the challenging problems we face (Cropley, 2019). If climate change, overpopulation, resource depletion, pollution, and other current crises are to be resolved, it will require innovative ideas and a scientifically literate populace. Personal success depends upon creative problem-solving at all levels (Kaufman & Beghetto, 2009). Yet creativity and innovation are not systematically taught or supported in our education systems. "It's left to the luck of the draw who becomes creative: there's no concerted effort to nurture the creativity of all children" (Bronson & Merryman, 2010).

With its focus on getting the "right" answers and meeting rigid standards-based tests, most education discourages and even actively stamps out divergent thinking (Kim, n.d.). When we insist that all students demonstrate their knowledge of content in the same way through the same exercises, assignments, worksheets, and tests, we are organizing for efficiency but not effectiveness. We try to turn students into carbon-copy factory models of some hypothetical average, ignoring their differences and unique abilities (Rose, 2018). This process kills innovative thinking. Instead of promoting and teaching creativity, schools are actively stifling it (Robinson & Aronica, 2015). It would be better to base schools on principles of effectiveness and mastery learning, not efficiency, and to actively teach students how to be creative problem-solvers, resilient learners, and successful innovators. This poster suggests a method for doing so that incorporates creativity and constructivist theory, project-based learning pedagogy, and mastery assessment strategies.



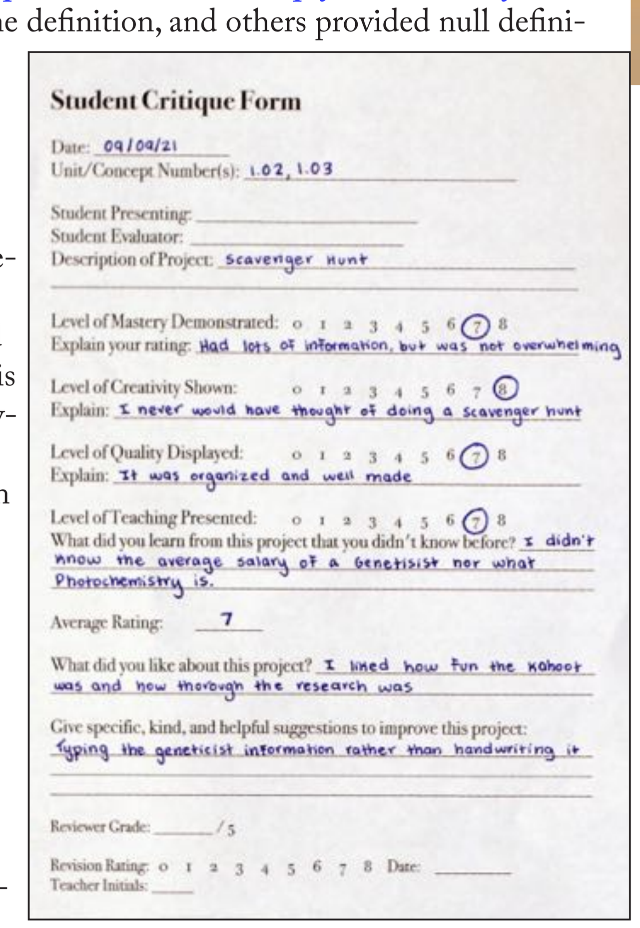
Totals	%		Definitions of Creativity:
23	3.07%	0	Undefinable
54	7.22%	1	Innate trait, talent, drive, passion
30	4.01%	2	Cognitive or mental skills
69	9.22%	3	Mode of thought; imagination, visualization, flow
18	2.41%	4	Rational problem-solving process
16	2.14%	5	Insight, inspiration, "Ah hah!" moment
115	15.37%	6	Ideation, brainstorming, unique ideas, synthesis
146	19.52%	7	Thinking outside the box, open-mindedness, divergence
67	8.96%	8	Completing a socially valuable or aesthetic product
210	28.07%	9	Self-expression, artistic expression, fun, outlet for feelings
748	100.00%		
			Note: Some students' definitions fit into multiple categories
548			and were given multiple tallies.

Definitions of Creativity:

To teach creativity to students we must first understand its meaning. Definitions of creativity have differed widely, starting with the classical concept of creativity as an innate need or voice, called the ***daimon***, a drive that pushes one to fulfill a personal destiny, excellence, or ***arete*** (Kirkpatrick, 2019). Other definitions include creativity as a moment of insight that comes after long reflection and study (Topolinski & Reber, 2010), a fixed personality trait similar to intelligence, a set of cognitive processes or skills that can be trained such as visualization or imagination, including creative flow (Csikszentmihalyi, 2014), or a step-wise process of rational problem-solving that can be implemented. Recent definitions state that there are multiple types and levels of creativity (Kaufman & Beghetto, 2009) including everyday creativity used to solve immediate personal problems, professional-level creativity where someone is recognized inside their own field, and Big C creativity that is acknowledged worldwide.

As an initial assignment in an undergraduate course at Cal State Northridge, Dr. Donna Hardy asked her students to provide a personal definition of creativity. Over a ten year period, she recorded 548 students' definitions at: *http://www.csun.edu/~vcpsy00b/creativity/survey.htm*. Some students provided more than one definition, and others provided null definitions by stating that creativity was undefinable. Altogether, 748 definitions were encoded into nine categories and provided the statistics seen above. Definitions 6 and 7 are similar enough that they can be grouped together, and if so, constitute the largest group of students, who define creativity as ideation: coming up with new and unique ideas, thinking outside the box, and developing divergent solutions to problems. This agrees well with a common definition of creativity: developing new ideas that have social value (Robinson & Aronica, 2015) or "the production of effective novelty" (Cropley, 2019, p. 1).

The second largest category in Dr. Hardy's student definitions is not often recognized in official definitions of creativity: an outlet for feelings and an avenue for self-expression, fun, and artistry. It implies that by improving students' ability to express themselves, we can enhance their creativity. For example, teaching students how to use media design software provides additional outlets for creative expression and can lead to better communication skills, content learning, and job opportunities.



Student Critique Form

Date: 09/09/21

Unit/Concept Number(s): 1.02, 1.03

Student Presenting:

Student Evaluator:

Description of Project: Scavenger Hunt

Level of Mastery Demonstrated: 0 1 2 3 4 5 6 7 8 9

Explain your rating:

Level of Creativity Shown: 0 1 2 3 4 5 6 7 8 9

Explain:

Level of Quality Displayed: 0 1 2 3 4 5 6 7 8 9

Explain:

Level of Teaching Presence: 0 1 2 3 4 5 6 7 8 9

What did you learn from this project that you didn't know before?

Average Rating: 7

What did you like about this project?

Give specific, kind, and helpful suggestions to improve this project:

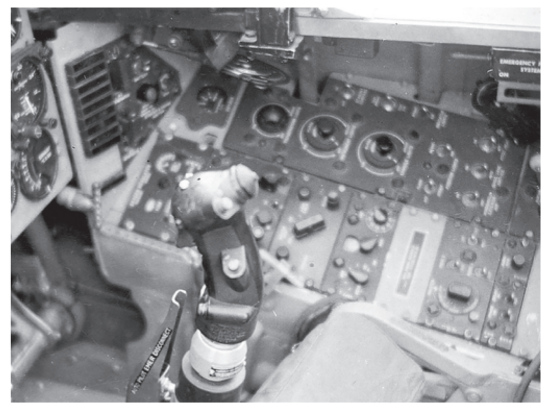
Reviewer Grade: ___/5

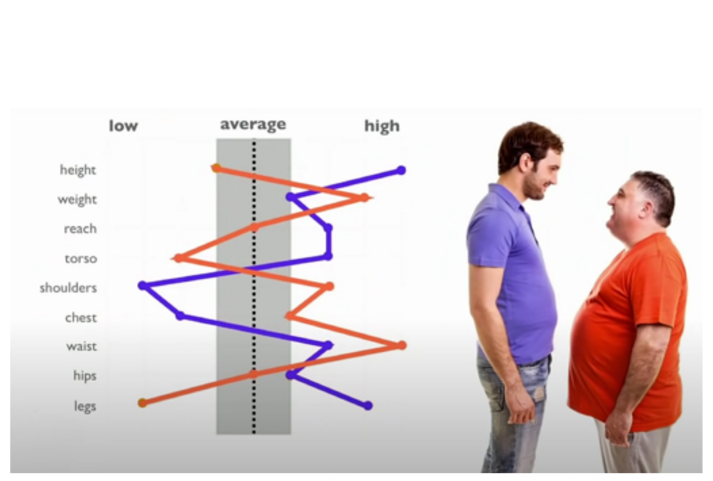
Revision Rating: 0 1 2 3 4 5 6 7 8 9 Date:

Teacher Initials:

Student Engagement Through Project-based Learning:

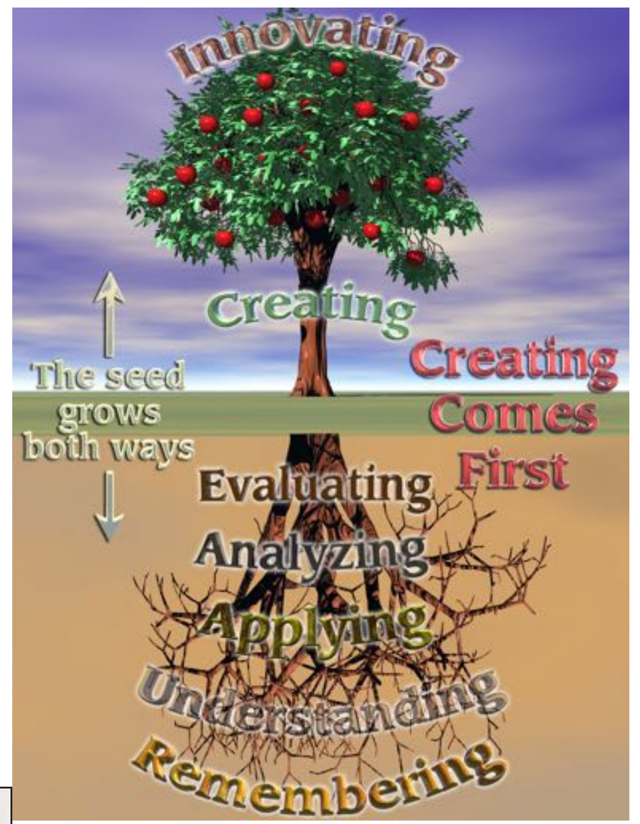
Many of the problems associated with student motivation can be traced to their lack of engagement with learning (Schlechty, 2002). One solution is to engage students actively and creatively with their learning through student-directed projects. According to PBLWorks (formerly the Buck Institute for Education), there are seven characteristics of "Gold Standard" project-based learning (2021). There must be: (1) an authentic, driving, meaningful question to engage student motivation; (2) the opportunity for significant student voice and choice in how to demonstrate their mastery of the topic; (3) student-centered sustained inquiry through asking and answering questions and collecting data from primary sources; (4) frequent formative assessment and feedback on the course of their progress; (5) continuing chances for revision and improvement; (6) a publicly presented product of excellent quality; and (7) deep reflection on the learning process by students.





The Jaggedness Principle:

Todd Rose (2016) uses an example of why student-directed project-based learning works. In the late 1940s and early 1950s, the Air Force was experiencing too many accidents with its fighter jets. Too many good pilots were crashing good planes. The problems came down to the design of the pilots' seat and cockpit. To decide on the dimensions for the seats, over 4000 pilots were measured according to ten parameters including height, reach, torso size, shoulder width, leg length, etc. These measurements were averaged and the seat and cockpit designed to fit those averages. As it turned out, the jets did not actually fit anyone, as there was no pilot who fit the average on all ten dimensions. Finally, after millions of dollars were spent on the problem, a simple solution was found: make the seat adjustable. In education we force students to fit into a bell-shaped curve of averages and "age appropriate" learning materials when all students are extraordinary in various ways; they are all exceptional, but their exceptionalities are jaggedly distributed. Instead of teaching to the average, we should make education adjustable and teach to the needs of all students. Project-based learning does just that; by allowing students voice and choice in the types of projects they create and how they will demonstrate mastery of concepts, we provide engaging, meaningful learning experiences that adjust to the needs of all students.



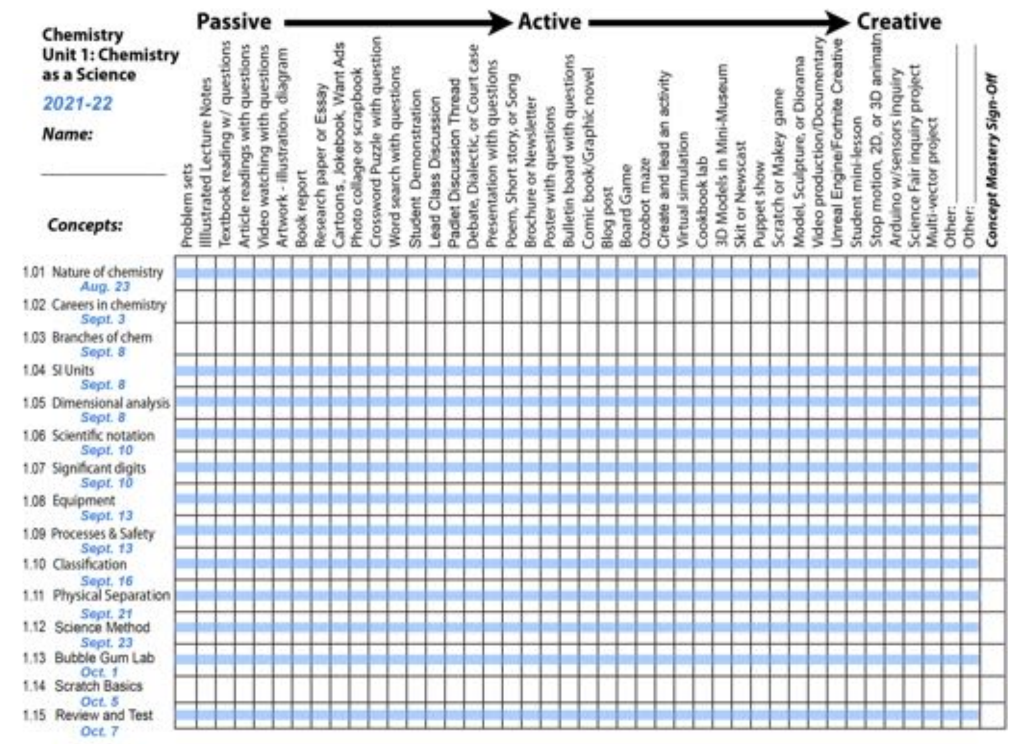
Student Mastery Through Creativity: Inverting Bloom's Taxonomy:

To ensure deeper learning, mastery or competency-based grading systems require students to continue beyond the shallow level of facts and reach higher-order thinking skills according to Bloom's Taxonomy. If the ultimate goal of learning is to move beyond the base level of facts and knowledge into analysis and synthesis and eventually to creativity at the top of the pyramid, then we are doing an abysmal job. Students rarely climb beyond the base and almost never reach creativity. They only reach creativity in spite of education, not because of it.

Instead, we need to invert the taxonomy and start with creativity as illustrated at left. If we use the metaphor of creativity as an apple seed, then starting with the requirement for creativity plants the seed, which germinates into an engaging student-created project. As students work to complete their projects, they will grow down the roots they need to find, understand, analyze, and synthesize the facts behind the driving question. Instead of a teacher or textbook supplying the facts, the teacher becomes a guide or facilitator of the learning process, guiding the students to direct their own learning, which will grow into the fruit of innovation. Education therefore becomes nurturing.

Critique:

To assess the level of concept mastery, student creativity, project quality, and ability of students as teachers a process of formative assessment and revision must be instituted. As it becomes a time challenge for one teacher to provide detailed formative assessments of all student projects, students must learn to provide their own peer project evaluations through a process called critique as developed by Ron Berger (2017). Using feedback forms, students will use the three rules of critique (be kind, specific, and helpful) to provide feedback and suggestions to presenting students. If students wish to revise their projects, they can use the suggestions to improve, then re-demonstrate their learning to the teacher as many times as needed until they reach a desired final grade.



Grade Matrix for Chemistry:

To help students decide between various types of creative projects and to know which concepts they will be responsible for and which will be done as class activities, this unit grade matrix was developed. On the back side are study questions related to the unit concepts. Types of projects become more active and creative as the list moves right.

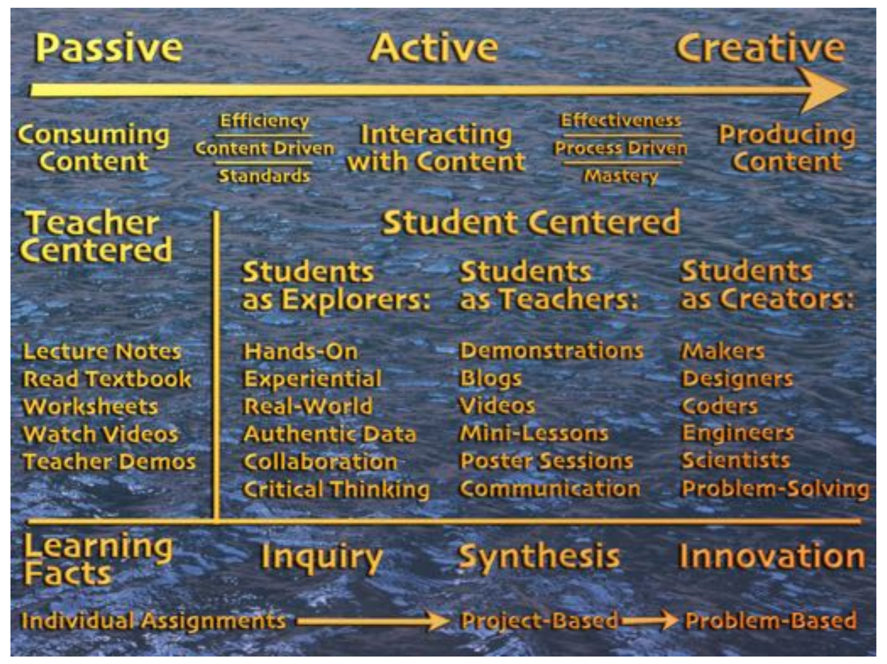
Exemplary Student Projects:

"Cell Yeah!" Musical:

For a unit on cell processes and organelles, three students decided to pass all of the unit requirements by creating an original musical theater production. They wrote ten original songs, a script, created programs and posters, and performed their musical for two biology classes during our study hall period. It might not have been Tony Award-winning material, but it certainly demonstrated mastery of cell parts and processes.

Stop-Motion Nuclear Chain Reactions:

Chemistry students used an iPAD camera and a PVC frame to photograph individual images for a nuclear fission chain reaction of Uranium-235 using beads and paper labels. My biology students created stop-motion animations of cell mitosis using various types of candy.



A Model of Students as Creators:

Education should help students learn how to be creative innovators who are makers, designers, coders, engineers, and scientists. They should become resilient problem-solvers who produce their own scientific content, with the school focus on effectiveness, mastery, and the educational process instead of efficiency, content, and standards.

Cell Cakes with Organelle Frosting:

Two students baked cakes, one round and one square, then decorated them to look like animal and plant cells using colored frosting. They added small label flags for each organelle, then took photos of the cakes and created a poster with information on the function of each organelle.

Quantum Joke Books and Comic Strips:

An AP Chemistry student created a book of jokes and cartoons about quantum mechanics and atomic theory. One of her jokes was: "A neutron walks into a bar. She asks the bartender, 'How much for a drink?' The bartender says, 'For you, there's no charge." Ba-dum-bump. Other students use StoryBoardThat to create comic strips and draw trading cards of physics careers, including Dr. Schrödinger D. Katt, quantum physicist.

Working Models of Hands, Lungs, and Arms:

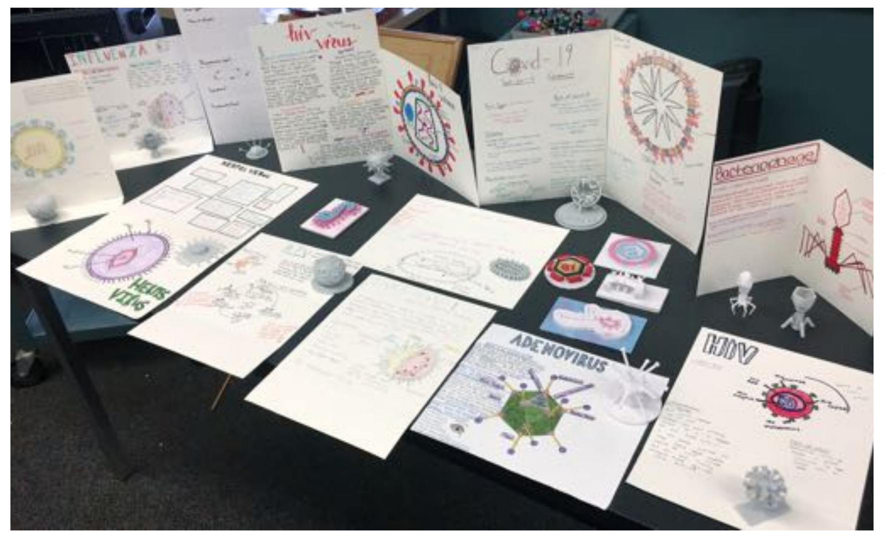
In biology, small groups of students competed to build the best working model of a human hand. Their hands had to be dextrous enough to pick up a small water bottle lid, spell out a word in American Sign Language, and strong enough to pick up a full cup of water. The hand pictured here won because of its large and powerful opposable thumb. Other models included the circulatory system, arms, and lungs.

Mendeleev's Maze of Madness Scratch Games:

Chemistry students chose an element of the periodic table, researched its properties, and built a game for Mendeleev's Maze of Madness, where a castle in the shape of a periodic table must be navigated to reach the top level, moving between the elements room by room. To exit the calcium room, players must win the quiz game "Heal 'dem bones" where a broken bone gradually mends as the player correctly answers questions about calcium. To exit the copper room, players must correctly type the names of three randomly chosen copper compounds into a formula slot machine.

Rube Goldberg Devices:

Physics students learned classical mechanics by building Rube Goldberg devices to press down the plunger of a hand sanitizer bottle. Each device had to use eight or more steps and six types of simple machines.



Viral Mini Museum:

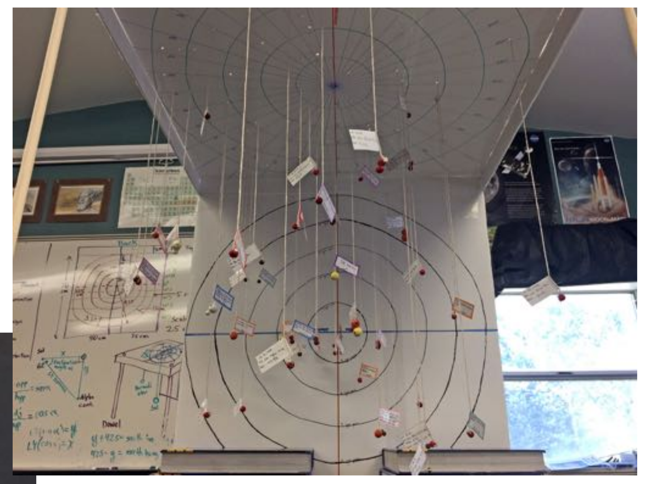
Biology students designed and printed a 3D model of a virus and drew a display backdrop on the infection vectors, life cycle, symptoms, and parts of the virus.

Hay Bale Maze:

Biology students walked peers through a maze made out of hay bales to teach them about osmophilic bacteria.

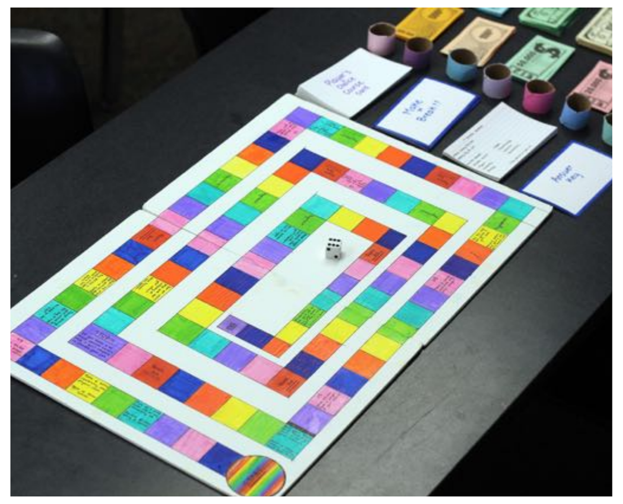
Spray-Painted Exoplanet Art:

Astrophysics students created illustrations for our *Ad Astra Per Educare* student magazine by following YouTube tutorials to make spray painted art of exoplanets. Other students wrote the feature articles, sidebars, and biographies which were critiqued by their peers and went through three drafts.



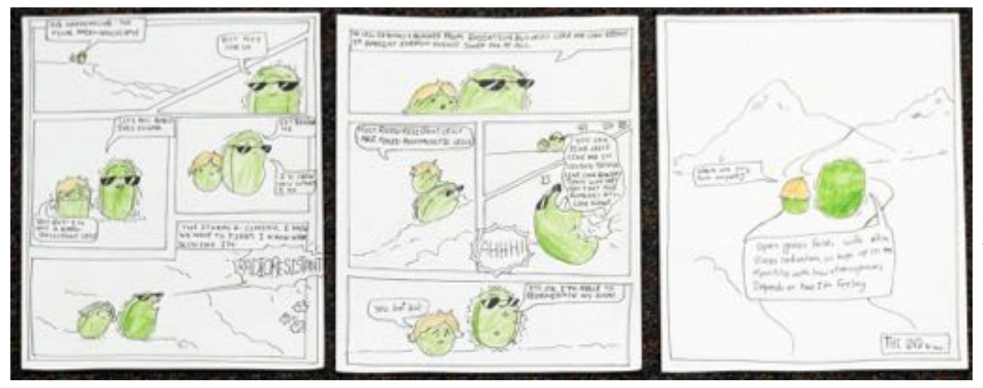
3D Model of the Nearby Stars:

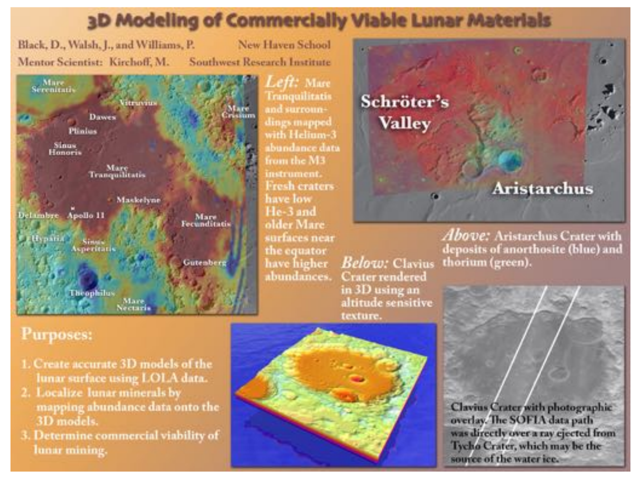
Astrophysics students built this model of the star systems near us out to 15 light years. The stars are hung according to accurate right ascension, declination, and distance using trigonometry functions.



Board Games:

Examples of student-created board games include: Cellular Pursuit (top left), Acid Dash tug-of-war (middle left), and Chemistry Career Game-of-Life (lower left)





ExMASS Poster:

Physics students participated in the Exploring the Moon and Asteroids with Secondary Students program through the NASA Lunar Science Institute. They combined accurate 3D data of the Moon and maps of mineral locations to determine the viability of lunar commercial mining.

Comic Strips:

Students created hand drawn and digitally created comic strips and pop-up story books, such as this comic strip about radiotolerant extremophiles.

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