SAN JOSE MUSEUM OF ART

SOWING CREATIVITY S.T.E.A.M. PROGRAM

Science and Art Curriculum

INVESTIGATING PERCEPTION

Teacher Packet

SAN JOSE MUSEUM OF ART

The San Jose Museum of Art celebrates new ideas, stimulates creativity, and inspires connection with every visit. Welcoming and thought-provoking, the Museum rejects stuffiness and delights visitors with its surprising and playful perspective on art and the artists of our time. The San Jose Museum of Art is the largest provider of arts education in Santa Clara County. The quality of its exhibitions, the extent of its educational programs, the expertise of its staff, and the depth of its ties in the local arts community uniquely qualify the museum to deliver the ambitious Sowing Creativity program.

www.sanjosemuseumofart.org

See what you think

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CONTACT

Manager, Youth Programs

Alysia Caryl

acaryl@sjmusart.org

408.271.6846

Teachers,

This packet is intended to familiarize you with Sowing Creativity so you can make the most out of the program for you and your students. In addition to basic information, the packet includes a letter to parents that can be printed and distributed directly, or adapted to fit into your own parent newsletter. It also includes a detailed curriculum outline so you can plan ahead and connect the sessions to your classroom content. Lastly, it offers a number of resources for related activities before, during, and after the program.

We look forward to working with you!

Education Department, San Jose Museum of Art

SOWING CREATIVITY

Sowing Creativity is an integrated visual arts residency program developed by the San Jose Museum of Art to address the new California Common Core State Standards and to meet the urgent need to promote creativity across disciplines. The premise behind the program is that well-honed visual thinking abilities contribute powerfully to the teaching and learning of specific cross-disciplinary concepts. Sowing Creativity brings elementary school classroom teachers together with teaching artists from SJMA and science instructors from the Youth Science Institute (YSI) to promote student creativity and success.

CURRICULUM: INVESTIGATING PERCEPTION

If you change the way you look at things, the things you look at change.

The premise behind the Sowing Creativity curriculum is that well-honed visual thinking abilities can contribute powerfully to the teaching and learning of specific cross-disciplinary concepts. An investigation of *perception*, defined as "a thought, belief, or opinion, often held by many people based on experience," encourages students to explore the both seen and unseen. A rich sequence of hands-on art making lessons and inquiry-based discussions of contemporary art help students to understand the shared art and science concepts of perception, perspective, optics, light, and color theory.

The integrated curriculum, developed collaboratively by SJMA's teaching artists and YSI's science instructors, leads students to ask and answer two essential questions: How can I look at the world different ways? What is the science behind looking and seeing?

EDUCATIONAL FRAMEWORKS & STANDARDS

Sowing Creativity is rooted in a number of educational frameworks. Following the national shift to **Common Core** standards, the program promotes an integrated approach to big-picture questions at the intersection of science and art. The curriculum aligns itself with the **California Visual Arts Standards** and the newly implemented **Next Generation Science Standards**. It is informed by the research-based initiative to add the arts into the nationally dominant science, technology, engineering, and math (STEM) curriculum. The shift from STEM to **STEAM** fosters true innovation founded in the belief that, by developing students' abilities to use knowledge across contexts, the arts can play a vital role in promoting the four C's of the **Partnership for 21st Century Learning** skills**:** creativity, critical thinking, collaboration, and communication. The program has also adopted the **Studio Habits of Mind** framework for teaching and learning in the visual arts as developed by the Harvard Graduate School of Education's Project Zero.

PROGRAM DELIVERABLES

- **Pre-program meeting**

A required meeting with participating classroom teachers, the principal, and SJMA educators is held at each school before beginning the Sowing Creativity program. These meetings are a platform to collaborate, communicate, and work out any necessary logistics.

- **Eight hands-on artmaking sessions in the classroom**

SJMA teaching artists lead a weekly, hour-long artmaking session in each participating classroom. Over the course of eight weeks, students will complete up to four projects and participate in a range of processes that may include drawing, painting, printmaking, photography, and sculpture. All art materials, including a sketchbook/scientific journal for every student, are provided with the program.

- **A hands-on science lesson in the classroom**

In coordination with the teaching artist, a teaching scientist from the Youth Science Institute will lead an hour-long complementary science lesson in each participating classroom during the course of the 10-week program.

- **A field trip to the San Jose Museum of Art**

The Two-Part Art field trip to the museum encourages students to experience art as both viewers and makers. Each student participates in a one-hour, inquiry-based tour of selected artworks that relate to their classroom art and science lessons, followed or preceded by a corresponding one-hour hands-on art workshop.

- **Teachers' packet**

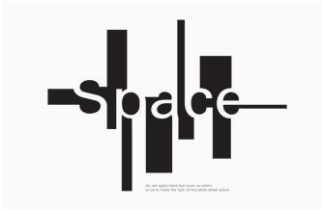
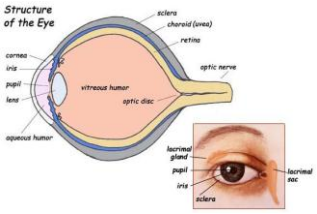
An informational packet is offered to all participating teachers in an effort to help develop classroom connections to the Sowing Creativity program. The teacher resource guides offer optional pre- and post- program activities as well as grade-appropriate suggestions for related books, videos, websites, and other local resources.

- **Teacher membership to museum**

Each participating classroom teacher and school principal receives a one-year Individual Membership to the San Jose Museum of Art. Benefits of the membership include free admission card for yourself and one guest, invitations to exhibition receptions and members-only events, discounted tickets for programs and lectures, SJMA e-News subscription and e-updates, and 10% discount in the SJMA Store and Café Too!

- **Post-program assessment**

In addition to formative and summative student assessments throughout the program, participating teachers will be directed to an online survey to provide feedback at the end of the Sowing Creativity. Each school also has the option to schedule a post-program meeting to discuss the successes of the program along with potential areas of improvement for the following year.

PROJECT	 **EYE-PAD JOURNALS**	 **MATTER OF FACT**	 **YSI: SCIENCE OF SIGHT**
SESSION, TIME	**Session 1, 1 hour**	**Session 2 & 3, 2 hour**	**Session 4, 1 hour**
PROBLEM/ ACTIVITY STATEMENT	Each student receives a new "eye-pad" which serves as their sketchbook and scientific journal for exploration throughout the entire program. As an introductory activity, they learn about blind contour and gesture sketching from observation, then will touch, observe, sketch, and take notes about their environment.	Individually, students will brainstorm a list of different sentences comprised of random, interesting facts (or opinions) that they know. Students choose one sentence to use in their artwork. The layout of their text is planned with graphite pencil and finalized with crayon. Students will identify the positive and negative shapes.	In this classroom lesson, led by a science instructor from the Youth Science Institute, students participate small hands-on activities that encourage a deepening in their understanding of the optic and neurological science behind seeing. They build a simple model eye, view and discuss simple optical illusion, and create a light refractive spectroscope tool.
GOALS	Students will: Make observations about objects and people in their environment. Understand how artists and scientists use journals as a tool. Create drawings from life.	Students will: Identify positive and negative shapes. Use a variety of art tools. Learn about wax and water resist. Create an abstract artwork using text and color. Understand that the human eye occasionally has difficulty processing what it sees.	Students will: Build a model demonstrating the construction of a human eye, learn that what they see may not always be the "truth," understand how light is refracted.
CROSS-DISCIPLINARY CONNECTIONS	Scientific journaling, language arts, journaling	Penmanship, Drafting, Calligraphy, Social Science: Psychology	Biology, adaptation, light waves, color theory
PROCESSES	Sketching, journaling	Brainstorming, Collaborating, Sketching, Drawing, Painting	3-D model building
SKILLS	This lesson places an emphasis on observation and documentation as part of the creative process.	This lesson defines in simple terms positive and negative spaces in an artwork and prepares the students for future lessons. Students are also introduced to the styles of visual art known as optical art and abstract art.	Collaborative discussion, critical thinking, 3-d construction
CONCEPTS	Sketchbook, journaling, scientific illustration, gesture, blind contour, organic lines, and patterns.	Patterns; Scale, Proportion, & Quantity	Pupil, iris, cornea, optic nerve, focus, light, refraction, optical illusion, spectroscope
STUDIO HABITS OF MIND	Develop Craft, Observe, Stretch and Explore	Develop Craft, Envision, Express, Reflect, Stretch & Explore	Stretch and Explore, Observe, Reflect
NGSS SCIENCE & ENGINEERING PRACTICES	Asking questions, Carrying out investigations, Obtaining, Evaluating, and Communicating Information	Analyzing and Interpreting Data; Obtaining, Evaluating, and Communicating Information	Asking questions, Carrying out investigations, Obtaining, evaluating, and communicating information
OPTIONAL CLASSROOM EXTENSIONS	Students should be encouraged to continue to use their journals throughout the day and across subjects.	Students may want to research calligraphy or make observations and record the behaviors of light and shadow in their daily life.	Using the spectroscopes in and out of class produced with different objects

			
SJMA FIELD TRIP	**OUT OF THE BOX**	**DEPTH PERCEPTION**	**REFLECTIONS AND SHADOWS**
Session 5, 2 hour	Sessions 3 & 4, 2 hours	**Sessions 8 & 9, 2 hours**	Session 10,1 hour
The Sowing Creativity Two-Part Art field trip includes a one-hour tour of the galleries with a member of the museum's gallery teaching staff. Students share their ideas about the artwork that they see in inquiry-based, open ended group discussions. The second hour consists of a hands-on artmaking activity in which students create their own simple animation device called a decotrope. .	Each student creates their own pinhole camera or camera obscura, a simple optical device that allows viewers to see the world upside down. They discuss a brief history of the camera obscura and learn the basic mechanics of how it works. After creating the devices, they experiment with looking at the world from a different perspective.	In this session student will be introduced with the concept of depth perception. We will explore how our eyes are able to see far into the distance and up close and why we are able to determine how far object are in perspective to ourselves. Student will be asked to create a scene using 3 layers. The background, the middle ground and the fore ground will create a depth painting.	In this lesson the students will observe and experiment with light and shadows using reflections from the sun. They will create color shadows and use the scientific method to discover and explore the negative and positive space created with the reflections.
Students will: Experience art as makers, viewers, and active community members, engage with contemporary art through close looking, critical thinking, and collaborative discussion	Students will: Learn that light travels in a straight path; Understand the basics of photographic optics; Transform an observational drawing into an imaginary illustration.	Students will: Learn how artists use layers to create depth in a work of art; Learn artistic terms such as foreground and background as they create their own layering effects; Will be able to describe their painting using artistic terms.	Students will: Explore light shadows , Students will learn about reflection and color shadows, Students will apply the scientific method to their art exploration
Variable based on current exhibitions and art work visited	Technology, optics, photography, historical inventions, light	Depth perception	Reflections, shadows, light, vision and optics, perception
Optical illusions, Sequential storytelling, Technology, Illustration, and Animation	3-dimensional construction	Sketching, drawing, paint markers, transparency sheets	Transformation of everyday objects such as mirrors using simple pigmentation
Looking closely, critical thinking, collaborative discussion	Sequential 3-d construction, fine motor skills, investigation	Layering paintings, deconstructing, looking closely, 3-d construction	Collaborative discussion, critical thinking, using the scientific method
Museum, gallery, translucent, perspective, illusion, reflection and other terms based on current exhibitions and art work visited	Camera obscura, aperture, lens, perception	Depth, visual perception, distance, layers, foreground, middle ground and background	Reflection, color shadows, negative and positive space, color, light bending, translucent opaque
Understand Arts Community, Express, Reflect	- Develop Craft - Engage and persist - Reflect	Stretch and explore, express, envision, understanding arts and community, reflect	Stretch and explore, express, envision, understanding arts and community, reflect
Asking questions, Carrying out investigations, Engaging in arguments from evidence	- Carrying out investigations - Asking questions - Constructing explanations	Asking questions, Carrying out investigations, Obtaining, evaluating, and communicating information	Asking questions, Carrying out investigations, Constructing explanations, scientific method
Art Walk at your school or go online to sjmusart.org and browse the permanent collection	Take students on a walk with their camera obscuras. Have them reflectively write about their observations upon returning.	View old Animation techniques .	**Use mirrors to create reflections and shadows, video a performance of students describing the experience and what they created.**

Websites:

Brain Games: National Geographic

http://channel.nationalgeographic.com/brain-games/videos/brain-games-seeing-is-believing-preview/

This Emmy-nominated series is designed to mess with the ultimate supercomputer. Host Jason Silva reveals how brains process information. Interactive games and hidden-camera experiments capture hilarious and shocking results, and viewers get real-world takeaways.

NHI- Kid's Page: Illusion Games

http://kids.niehs.nih.gov/games/illusions/lots_of_illusions.htm

What are Illusions? Illusions trick us into perceiving something differently than it actually exists, so what we see does not correspond to physical reality. Hence, the word illusion comes from the Latin word *verbilludere* meaning "to mock." In addition, some illusions show us one thing in a picture, while someone else sees something entirely different in the same picture.

Kids Health: Your Eyes

http://kidshealth.org/kid/htbw/eyes.html

Which part of your body lets you read the back of a cereal box, check out a rainbow, and see a softball heading your way? Which part lets you cry when you're sad and makes tears to protect itself? Which part has muscles that adjust to let you focus on things that are close up or far away? If you guessed the eye, you're right!

Ducksters: Science of Light

http://www.ducksters.com/science/light.php

Help students understand how light is made and answer questions like Why does light go through some things and not others? How Light helps us to survive, what is the speed of light? And what is Refraction?

Videos:

Kids Health: How Your Eyes Work

https://www.youtube.com/watch?v=syaQgmxb5i0

Your eyes see, but how does vision happen? Find out how the eyes and brain work together in this eye video.

Amazing Sidewalk illusions Chalk 3D Street Art

https://www.youtube.com/watch?v=kagKgpDbJco&feature=youtu.be

Painted bridge optical illusion, amazing sidewalk illusion, coffee on the street illusion, crazy cliff sidewalk optical illusion, escalator sidewalk illusion, flying carpet, gone fishing, hole in the ground sidewalk illusion, ice fishing sidewalk optical illusion, sidewalk frog optical illusion, sidewalk river optical illusion, swimming pool sidewalk optical illusion, falling down stairs sidewalk illusion.

Reflection and Refraction of light - Introduction for kids

https://www.youtube.com/watch?v=JRh0CGfX7dQ

The best and the biggest channel for science videos for kids. Light can bounce off when it hits objects and it can bend also while passing through from one medium to another.

Nat Geo Kids Learn About Sound

https://www.youtube.com/watch?v=HblEhc0gses&list=PLQlnTldJs0ZQRzLgW42JXOV_KjtG7TXck

Discover the very best videos about sound YouTube has to offer - brought to you by National Geographic Kids!

SOWING CREATIVITY: INVESTIGATING PERCEPTION STEAM CONNECTIONS

Overview:

Sowing Creativity not only introduces young students to the tools and practices of the visual arts, it provides them with a much-needed vehicle for self-discovery and self-expression. Our goal this year was to connect these life-changing art experiences to the rest of the subjects taught in school. We want our students to think creatively and be expressive all day long!

As the attached analysis clearly shows, we were able to find solid alignments between our seven art experiences and virtually every educational standard the students will encounter: from STEM to English Language Arts. In fact, every project we offer has **six** or more ties to art standards, and **ten** or more ties to science, technology, engineering, math, and language standards. Here are just a few examples:

Science (NGSS): Ask questions about the world, plan investigations.
Technology (ISTE): Explore a variety of 2ia and formats.
Engineering (NGSS): Design solutions, build models.
Common Core Math (CCSS-Math): Persevere in problem-solving, make use of structure, use repeated reasoning.
Common Core English Language Arts (CCSS-ELA): Describe ideas, decode academic words, engage in discussions.

The teachers and children who engage in the Sowing Creativity program with us will not only be inspired artistically, they will develop new skills and new insights that will help them in every facet of their lives long into the future.

NGSS: SCIENCE AND ENGINEERING

The **Next Generation Science Standards** (NGSS) give educators the flexibility to design learning experiences that stimulate students' interests in science and prepare them for college, careers, and citizenship. Science standards that align well with each Sowing Creativity activity are 1lighted below:

Sowing Creativity Alignment to Standard: 2 (strong) 1 (strongest)

	Eye Pad	Matter of Fact	YSI Visit	Field Trip	Pin Cam.	Depth Per.	Reflect
SEP: SCIENCE AND ENGINEERING PRACTICES							
1. Ask questions and define problems	1			2	2	2	2
2. Use drawings and Models		1	1	2	1		
3. Plan and carry out investigations	1		2	2		2	1
4. Analyze data					2	1	
5. Use math and computational thinking	2				1		
6. Construct explanations/design solutions		1				1	2
7. Argue from evidence			1	2		1	
8. Obtain, evaluate, and communicate info.	2	1	1	1			2
DCI: DISCIPLINARY CORE IDEAS							
ETS: Develop and test possible solutions	2	2	2	2	2	2	1
CCC: CROSS-CUTTING CONCEPTS							
1. See patterns	2	1		1	1	2	2
2. Explore cause and effect	2	2	2	1	2	2	1
3. Notices scale, proportion and quantity	2	2		1		1	
4. Define systems and system Models					1		2
5. Explore energy and matter			2		2		1
6. Consider structure and function			1			2	2
7. Notice stability and change	1						2

TECHNOLOGY

The **International Society for Technology in Education** (ISTE) standards promote technological advancement and proactive measures on the part of the teacher to encourage and foster involvement in the digital age. The ultimate goal is to get students prepared, at all stages, for a career in a global economy. On a school-wide level, the plan is to create digital learning spaces and teaching Models that are appropriate for the time and reflect recent developments in technology.

	Eye Pad	Matter of Fact	YSI Visit	Field Trip	Pin Cam.	Depth Per.	Reflect
1. Creativity and innovation							
1a. Generate new ideas or products	2	1		2	2	2	1
1b. Express ideas through original works	2	2		2	2	2	2
1c. Use Models and simulations			1		1	2	2
2. Communication and collaboration							
2a. Interact, collaborate, and publish	2	2		1			2
2b. Use a variety of 2ia and formats	2	2	2			2	1
3. Research and information fluency							
3a. Plan strategies	1	2		2	2	1	2
4. Critical thinking, problem solving, and decision making							
4a. Define problems and questions	2	2	1	2	2	2	2
4b. Manage projects	2	2			2	2	2
4c. Collect and analyze data	1	2			2	2	2
4d. Explore alternative solutions	2	1				1	2
5. Digital citizenship							
5c. Take responsibility for learning	2	2		1		2	2
6. Technology concepts							
6a. Understand and use technology	2			2	1		

COMMON CORE - MATH PRACTICES

The **Common Core State Standards** (CCSS) in Mathematics are built on the best of 1-quality math standards from states across the country. The math standards provide clarity and specificity.

	Eye Pad	Matter of Fact	YSI Visit	Field Trip	Pin Cam.	Depth Per.	Reflect
MATHEMATICAL PRACTICES							
1. Make sense of problems and persevere in solving them.	1	2	1	2	2	2	2
2. Reason abstractly and quantitatively.					1		1
3. Construct and critique arguments.	2	2	2	1		2	
4. Model with mathematics.						1	
5. Use appropriate tools strategically.	2	2	2	2	2	2	2
6. Attend to precision.	2	2	2	2	1	2	1
7. Look for and make use of structure.	2	1	1	1	2	1	2
8. Use repeated reasoning.	1	1	2	2	2	2	2

COMMON CORE - ENGLISH LANGUAGE ARTS

The **Common Core ELA** standards challenge students to read stories and literature, as well as more complex texts that provide facts and background knowledge in areas such as science and social studies. Students will be asked questions that push them to refer back to what they've read. This stresses critical-thinking, problem-solving, and analytical skills.

	Eye Pad	Matter of Fact	YSI Visit	Field Trip	Pin Cam.	Depth Per.	Reflect
RL: Reading: Literature							
Describe characters in a story	2	2		2		1	
Explain how illustrations contribute to text	2	1		2		2	
RI: Reading: Informational Text							
Ask and answer questions.	2	2	1	2	2	1	2
Describe science ideas and procedures.	1	2	2	2	1	1	2
Determine the meaning of academic words.	2	2	1	2	1	2	1
Use information gained from illustrations.	2	2		2		2	1
W: Writing							
Provide reasons that support opinions.	2	1	2	1	2	2	2
Recall information from experiences.	2	2	2	2	2	2	1
SL: Speaking & Listening							
Engage in collaborative discussions.	2	2	1	1	2	2	2
Explain ideas.	1	2	2	1	2	2	2
Tell a story or recount an experience.	2	1	2	2	2	2	2
L: Language							
Use knowledge of language when writing, speaking, reading, or listening.	1	2	2	2	1	2	2

VISUAL ARTS

The Visual and Performing Arts (VAPA) standards cultivate essential skills, such as problem solving, creative thinking, effective planning, time management, teamwork, effective communication, and an understanding of technology.

	Eye Pad	Matter of Fact	YSI Visit	Field Trip	Pin Cam.	Depth Per.	Reflect
1.0 ARTISTIC EXPRESSION							
1.2 Use tints and shades.	2	1					
1.3 Create the illusion of space.	2	2	1			1	1
1.4 Compare works of art		2		1		2	
1.5 Describe works of art.	2	2		1	2	2	2
2.0 CREATIVE EXPRESSION							
2.1 Explore ideas in a sketchbook.	1	2	1	2	2	1	2
2.4 Create art based daily life	2	1			1	2	1
2.6 Create art emphasizing movement	2	1		2		1	1
3.0 HISTORY AND CULTURE							
3.4 Observe art in a museum				1			
3.5 Research and write about a work of art from your culture	1	2		1	2	2	
4.0 CULTURE AND VALUING							
4.1 Use the vocabulary of art	1	2		2		2	2
5.0 LIFE CONNECTIONS							
5.3 Look at art and predict what might happen next.	2	2		2		1	
5.4 Describe how artists (e.g., architects, book illustrators, muralists, industrial designers) have affected people's lives.	2	2		2	1	2	

STUDIO HABITS OF MIND

Studio Habits of Mind (SHoM) were developed by Project Zero at Harvard's School of Education. Developing these habits will help students be creative, learn, and express themselves in any subject area.

	Eye Pad	Matter of Fact	YSI Visit	Field Trip	Pin Cam.	Depth Per.	Reflect
1. Develop Craft							
Learn to use art tools and conventions.		1		1	1	2	2
2. Engage & Persist							
Embrace relevant problems. Focus on problems of personal importance.	1	1			2	1	2
3. Envision							
Learn to picture things in your mind. Imagine next steps in making a piece.		2				2	1
4. Express							
Create works that express feelings and ideas	1	2	2		1	2	2
5. Observe							
Observe more closely. See things that otherwise might not be seen.	2	1	1	1	2	1	1
6. Reflect							
Learn to think and talk with others about one's work or process, and learn to judge one's own work and process and the work of others.	1	2			2	2	2
7. Stretch & Explore							
Learn from mistakes. Explore playfully.	2	2			1	1	1
8. Understand (Arts) Community							
Interact with other artists in the community	2			1			

21st CENTURY SKILLS (The 4C's)

The "4C's" are were developed by the **Partnership for 21st Century Skills** (P21) and are widely accepted as the skills which all young people need to master to be successful in the future.

	Eye Pad	Matter of Fact	YSI Visit	Field Trip	Pin Cam.	Depth Per.	Reflect
21st CENTURY SKILLS							
CREATVITY	2	2	2	2	2	1	1
CRITICAL THINKING	2	2	1	1	1		2
COLLABORATION			1	2			
COMMUNICATION	1	1		2	2	2	

SOWING CREATIVITY STEAM CONNECTIONS (rev 6)

Eye Pad Journal

- ✓ Science: Ask questions, notice change, plan investigations
- ✓ Technology: Plan strategies, collect data
- ✓ Engineering: Define problems
- ✓ Math: Persevere in problem-solving, use repeated reasoning
- ✓ Visual Art: Explore ideas in a sketchbook, write about a work of art, use art vocabulary
- ✓ Studio Habits: Focus on problems of personal importance, express feelings and ideas, think about one's work process
- ✓ English: Explain ideas, use knowledge of language, define ideas and procedural steps
- ✓ 4C's: Communication

Matter of Fact Activity

- ✓ Science: Communicate information, see patterns, use drawings
- ✓ Technology: Generate new ideas, explore alternative solutions
- ✓ Engineering: Design solutions
- ✓ Math: Make use of structure, use repeated reasoning
- ✓ Visual Art: Describe rhythm and movement, use tints and shades, create art based on daily activity
- ✓ Studio Habits: Use art tools and conventions, embrace relevant problems, see things that otherwise might not be seen
- ✓ English: Explain how illustrations contribute to text, provide reasons that support opinions, tell a story or recount an experience
- ✓ 4C's: Communication

Youth Science Institute: The Science of Sight Presentation

- ✓ Science: Obtain and evaluate information, structure and function, argue from evidence
- ✓ Technology: Use models, define questions
- ✓ Engineering: Use models
- ✓ Math: Make sense of problems, make use of structure.
- ✓ Visual Art: Explore ideas in a sketchbook, create the illusion of space
- ✓ Studio Habits: Observe more closely
- ✓ English: Ask and answer questions, determine meaning of academic words, engage in discussions
- ✓ 4C's: Critical thinking

San Jose Museum of Art Field Trip

- ✓ Science: Obtain and evaluate information, see patterns, notice scale and proportion
- ✓ Technology: Interact, take responsibility for learning
- ✓ Engineering: Explore cause and effect
- ✓ Math: Construct critiques and arguments, make use of structure
- ✓ Visual Art: Compare and describe works, research artists from your culture, observe art in a museum
- ✓ Studio Habits: Observe more closely, interact with the art community, use art tools and conventions
- ✓ English: Provide reasons that support opinions, engage in discussions, explain ideas
- ✓ 4C's: Critical thinking

Pin Hole Camera Activity

- ✓ Science: Use math, see patterns, define systems
- ✓ Technology: Use models, use technology
- ✓ Engineering: Use models
- ✓ Math: Reason quantitatively, attend to precision
- ✓ Visual Art: Create art based on daily life, describe how photographers affect our lives, explore ideas in a sketchbook
- ✓ Studio Habits: Create works that convey ideas, use art tools and materials, learn from mistakes
- ✓ English: Describe science ideas and procedures, determine meaning of academic words, use knowledge of language
- ✓ 4C's: Critical thinking

Depth Perception Activity

- ✓ Science: Analyze data, notice scale, argue from evidence
- ✓ Technology: Plan strategies, explore alternative solutions
- ✓ Engineering: Define problems
- ✓ Math: Model with mathematics, make use of structure
- ✓ Visual Art: Create the illusion of space, predict what might happen next, create art emphasizing movement
- ✓ Studio Habits: Focus and persevere, observe more closely, learn from mistakes
- ✓ English: Describe characters in a story, describe science ideas and procedures, ask and answer questions
- ✓ 4C's: Creativity

Reflections and Shadows Activity

- ✓ Science: Carry out investigations, explore cause and effect, explore energy and matter
- ✓ Technology: Generate new products, use a variety of formats
- ✓ Engineering: Test possible solutions
- ✓ Math: Reason quantitatively, attend to precision
- ✓ Visual Art: Create art based on daily life, create art emphasizing movement, create the illusion of space
- ✓ Studio Habits: Imagine next steps in making a piece, explore playfully, See things that otherwise not be seen
- ✓ English: Determine meaning of academic words, use information from illustrations, recall information from experiences
- ✓ 4C's: Creativity

BACKGROUND: NGSS PERFORMANCE EXPECTATIONS

The **Next Generation Science Standards** (NGSS) performance expectations detail what students should learn in their science classes throughout elementary, middle, and 1 school. They outline the science skills and knowledge students should be able to demonstrate at each grade level, from kindergarten through 1 school. Expectations increase in complexity at each grade level.

Here are the PE's that most closely align with Sowing Creativity. Note that this list shows Grades 4 and 5 in addition to the target audience (Grade 3).

LIFE SCIENCE

- 3-LS1-1: Develop Models to represent living organisms.
- 3-LS3-1: Plants and animals share similar traits with their parents.
- 4-LS1-2: Observe that energy can be transferred from place to place by light.

EARTH AND SPACE SCIENCE

- 3-ESS2-1: Use data to describe weather conditions and seasons.
- 3-ESS2-1: Describe climates in different regions of the world.
- 5-ESS1-2: Represent patterns showing the changing length and direction of shadows.
- 5-ESS3-1: Describe ways communities use science information to protect the environment.

PHYSICAL SCIENCE

- 3-PS2-1: Show the effect of balanced and unbalanced forces on the motion of an object.
- 3-PS1-2: Show how the current motion of an object can be used to predict future motion.
- 4-PS3-2: Show the effect of balanced and unbalanced forces on the motion of an object.
- 4-PS3-4: Design and test a device that converts energy from one form to another.
- 4-PS4-1: Develop a model of waves to describe patterns.
- 4-PS4-2: Develop a model to describe that light reflecting off an object and entering the eye allows the object to be seen.
- 5-PS1-3: Make observations to identify materials based on their properties.

ENGINEERING DESIGN (All Grades)

- ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- ETS1-2: Generate and compare multiple possible design solutions.
- ETS1-3: Plan and carry out fair tests to improve a model or prototype.
- ETS1-4: Develop a model to generate data

BACKGROUND: NGSS SCIENCE AND ENGINEERING PRACTICES

In third grade, students are discovering the "science and engineering practices." Just like artists, scientists notice patterns and use Models to convey their ideas. Approaching the practices from both angles (art and science) will give the students a robust introduction to the vital skills listed below:

1. **Asking questions and defining problems**
   - Predict reasonable outcomes based on patterns.
   - Define a simple design problem.

2. **Modeling**
   - Build and revise simple Models.
   - Use Models to represent events and design solutions.
   - Develop a model using an analogy, example, or abstract representation.
   - Develop a diagram or physical prototype to convey a proposed object, tool, or process.

3. **Planning and carrying out investigations**
   - Make observations and measurements to explain a phenomenon or test a design.
   - Test two different Models of the same proposed object, tool, or process.

4. **Analyzing data**
   - Collect data and conduct multiple trials of qualitative observations.
   - Represent data in tables and graphs to reveal patterns that indicate relationships.
   - Use data to evaluate and refine design solutions.

5. **Mathematical and computational thinking**
   - Organize simple data sets to reveal patterns that suggest relationships.
   - Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time).
   - Use graphs and charts to compare alternative solutions to an engineering problem.

6. **Constructing explanations and designing solutions**
   - Construct an explanation of observed relationships.

7. **Engaging in argument from evidence**
   - Construct and/or support an argument with evidence, data, and/or a model.
   - Use data to evaluate claims about cause and effect.

8. **Obtaining, evaluating, and communicating**
   - Combine information in written text with that contained in tables, diagrams, and charts.
   - Communicate scientific and/or technical information.

BACKGROUND: NGSS DISCIPLINARY CORE IDEAS

The best fit with the NGSS DCI's is in the design area:

ETS.B: Developing Possible Solutions

- Designs can be conveyed through sketches, drawings, or physical Models.
- Testing a solution involves investigating how well it performs under a range of likely conditions.
- Communicate with peers about proposed solutions is an important part of the design process.
- Shared ideas can lead to improved design.
- Tests are often designed to identify failure points or difficulties.
- Different solutions need to be tested to determine which one best solves the problem.

BACKGROUND: NGSS "Nature of Science"

The NGSS focus on helping children understand "the nature of science." This focus is clearly documented in Appendix H:

- Scientists use tools and technologies to make accurate measurements and observations.
- Scientists use drawings, sketches, and Models as a way to communicate ideas.
- Science theories are based on a body of evidence and many tests.

The Sowing Creativity projects provide students with a simple and effective 2ium to:

- Document questions
- Share interests, ideas and feelings
- Collect drawings, designs and sketches
- Plan projects
- Make measurements and record observations
- Communicate insights

As students become more expressive and perceptive artists, they also become more creative and observant scientists.

BACKROUND: NGSS CROSS-CUTTING CONCEPTS

Crosscutting concepts (CCCs) provide students with intellectual bridges that help connect different content areas of science and engineering. Their purpose is to help students deepen their understanding of the disciplinary core ideas and develop a coherent and scientifically based view of the world. Sowing Creativity connects to all seven CCC's:

1. **Patterns** exist everywhere. For example, in the symmetry of flowers and snowflakes. In grades 3-5, students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.

2. **Cause and effect** is often the next step in science, after a discovery of patterns or events that occur together with regularity. Indeed, the process of design is a good place to help students begin to think in terms of cause and effect, because they must understand the underlying causal relationships in order to devise and explain a design that can achieve a specified objective. In grades 3-5, students identify and test causal relationships to explain change.

3. **Scale, proportion and quantity** are important in both science and engineering. An understanding of scale involves not only understanding systems and processes vary in size, time span, and energy, but also different mechanisms operate at different scales. In grades 3-5, students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.

4. **Systems and system Models** are useful in science and engineering because the world is complex, so it is helpful to construct a simplified model of it. Models can be valuable in predicting a system's behaviors or in diagnosing problems or failures in its functioning. In grades 3-5, students understand that a system is a group of parts that can carry out functions its individual parts cannot. In Sowing Creativity, students investigate Models of the eye system.

5. **Energy and matter** are essential concepts in all disciplines of science and engineering, often in connection with systems. In grades 3-5, students learn matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes and recognizing the total weight of substances does not change.

6. **Structure and function** are complementary properties. The functioning of natural and built systems alike depends on the shapes and relationships of certain key parts as well as on the properties of the materials from which they are made. In grades 3-5, students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions.

7. **Stability and change** - When looking at a living organism over the course of an hour or a day, it may maintain stability; over longer periods, the organism grows, ages, and eventually dies. In grades 3-5, students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.