Inquiring Finds

At what temperature does a rock begin to melt? How does the world really look when seen through rose-colored glasses? Is it true that it'll last longer if you take a picture? What's the most ridiculously complex way to turn on a DVD player? And does nothing truly last forever? At their core, science and art are built upon sets of questions and problems, and a search for answers and solutions. Inquiring Finds, a set of five focused exhibitions, investigates the science behind the concepts and creation of works of art.

Inquiring Finds is part four in a series of academically aligned exhibitions created by museum educators with curatorial support and input from school teachers and university professors. These exhibitions are designed to serve as a valuable interdisciplinary resource for the students and teachers of Hawai'i.

Potter Alchemy: The chemistry of ceramic glazes

Ceramic glazes are made up of three ingredients: silica (the glass former—gives glazes durability and a glass-like quality), flux (the melting agent), and alumina (the refractory—keeps the glaze stable at high temperatures). Mixed with water and applied to the surface of an object, it is heated or fired in a kiln to the point in which the glaze melts and permanently adheres to its substrate, or clay.

By changing the ratios of these three ingredients, one can affect the way a glaze looks and feels. If a glaze formula or recipe has a high amount of alumina, it tends to have a matte finish. High amounts of flux will usually yield a glaze that is runny. Some ingredients can cause a glaze to be bubbly, while others will promote cracks and fissures in the surface. Adding metal oxides can affect the colors of a glaze; so can the presence (or absence) of oxygen in the atmosphere while the ceramic pieces are being fired.

For centuries, ceramists and potters have experimented with materials and techniques. They have developed a deep understanding of how different substances react to one another under specific conditions to create a wide variety of glassy surfaces on their wares. On view here are ceramic vessels—by Peter Voulkos, Toshiko Takaezu, Rose Cabat, Catharine Hiersoux, David Kuraoka, and others—that exhibit a number of popular glaze types.

Celadon

Na2O .085
K2O .09 Al2O3 .35 SiO2 3.00
CaO .65
MgO .10
ZnO .075

+ 2% FeO2

Celadon glazes are categorized by a light, transparent color that ranges from gray to subtle greens and blues. Surface textures can be shiny and waxy, or satin matte. The color of this glaze is derived from very small amounts of iron oxide-only about 1-4% of the total glaze make up. Alkaline earths in the glaze, particularly calcium, have a blanching effect, which promote the Celadon's soft, delicate color. For the distinctive blue and green shades to develop properly, the glaze must be fired in an oxygen-poor atmosphere-a process referred to as reduction firing. An oxygen rich kiln environment would yield a beige or yellow glaze, which is often considered unattractive or unsuccessful. Celadon glazes with a milky, unctuous quality known as "opalescence" is the result of tiny bubbles created by the presence of phosphorus. This glaze has origins in Han Dynasty China where it spread to Southeast Asia, Korea, and

Japan. Regional differences in color and surface quality are likely due to material availability and personal taste.

Salt

Salt glazed pottery is distinguishable by its orange peel-like texture. Developed in the 13th century, salt glaze is created by the introduction of a water and salt solution (H2O + NaCl) into the kiln during firing. When the kiln temperature reaches between 2000 to 2200 F, the solution is inserted into the kiln, where a chemical reaction occurs…

$2NaCl + 2H_2O \rightarrow 2HCl + Na_2O$

The salt and water instantly vaporize in the extreme heat. Hydrochloric gas escapes the kiln in a plume of fog and the sodium oxide created in the reaction adheres to all surfaces in the kiln-including the ceramic wares, where another chemical reaction occurs…

$Na_2O + SiO_2 + Al_2O_3(SiO_2)_2 \rightarrow (Na_2O)_x Al_2O_3(SiO_2)_y$

The sodium oxide reacts with the silica and alumina in the ceramic bodies to form a glaze. If iron is present in the clay, the resulting glaze will be orange to brown in color. Porcelain, which is nearly void of metal oxides, will yield an almost completely clear glaze when salt-fired. Metal oxides such as cobalt oxide or chrome oxide can be applied to the surface of ceramic pieces prior to firing to vary the colorations of the salt-fired orange peel.

Ash

K2O	**.10**	**Al2O3**	**.19**	**SiO2**	**.50**
CaO	**.85**				
Mn	**.03**				
P	**.02**				

Observing how ash created glassy surfaces on wares in wood-fired kilns, ceramists and potters then experimented with wood ash as a naturally occurring glaze. Ashes from a fire pit is collected, screened to remove large chunks of charcoal, washed, and dried. Water is added to the ash, creating a slurry that can be brushed or sprayed onto the surface of a ceramic ware. Great care must be taken by the ceramist when applying ash to the ware's surface; too thick of an application can result in the glaze running completely off a pot during the firing. The liquid and runny nature of ash comes from a chemical composition that is low in alumina and high in calcium and potassium.

Ash of different species of tree can yield a plethora of effects: soft woods such as pine and fir tend to be low in alumina and are thus more fluid, and hardwoods like oak and willow contain high levels of phosphorus which can produce opalescence. Ash is sometimes added to other glazes to give them a "runny" effect, as seen in the works by Daven Hee.

Wood Firing

Simply put, the history of ceramics begins with wood firing. The basic process was unearthed at the bottom of fire pits where clay had become hardened and vitreous (glass-like) after being exposed to high levels of heat. Discovering this phenomenon, cultures around the world experimented with heating earthly materials to transform them into functional and decorative wares. Modifications and improvements were made to the fire pits by enclosing them in hillsides, or building insulated structures to retain heat and increase temperatures. Wood fire kiln design reached its pinnacle in China, Korea, and Japan during the 2nd to 4th century. A number of ancient kiln sites are still active, producing ceramic wares to this day. Wood firing kilns consist of three main components: a fire box where wood is burned, an adjoining firing chamber where the ceramic ware is placed, and a flue where heat can escape and create a crucial draft. Wood kilns are often built on inclines to aid in creating the draft, which allows for an even distribution of heat throughout the firing chamber. Firing these kilns can take up to a couple of weeks and reach temperatures of up to 2500F. Ash created by the burning wood becomes airborne, travelling throughout the firebox and firing chamber, and depositing onto the kiln walls and contents. At such high temperatures, the ash fluxes (or melts) and becomes glassy. This firing process can create wares with blushes in subtle, earthy colors and serendipitous markings.

Today, gas fueled kilns are much more common as they are more efficient in both energy consumption and time. The atmosphere in a gas-fueled kiln is far less volatile as it is void of flying ash. Gas kiln firing results in a more predictable and consistent surface quality. The differences between wood and gas fired wares can be seen here in Untitled Stack by Peter Voulkos, and a traditional Tamba ware from Japan.

Copper Red

Na_2O	.4	Al_2O_3	.35	SiO_2	3.79
				B_2O_3	.19
CaO	.6				

+ .2% CuO
+ 1% SnO_2

Legend has it that the first copper red glaze was created in China during the Song Dynasty. While unloading finished wares out if his kiln, a potter found a piece that was covered with a bright red glaze. Astounded by his discovery, he showed it to the emperor, who in return, ordered the potter to produce one thousand pots with this auspicious colored glaze. Distraught with the seemingly impossible task, the potter tried and tried, but failed to reproduce the one-of-a-kind glaze and was ultimately driven to madness. During his final attempt to recreate the glaze, he jumped into the fiery kiln and killed himself. His assistants continued to fire off the kiln to pay homage to their master, and when the firing was done and the kiln cooled, they discovered a firing chamber filled with brilliant red glazes. Who really knows if this actually happened, but the story speaks to the notorious difficulty in achieving a red color from copper.

Also known as Oxblood or Sang de Boeuf, copper red glazes are prized for their deep red color. The color is the result of copper carbonate fired in a heavily reduced (oxygen poor) kiln atmosphere. The glaze is low in alumina, which gives it the tendency to be runny. Copper reds are notoriously persnickety in that the glaze application and firing atmosphere need to be within narrowly specific parameters for the red color to develop. An overly thin application of the glaze, or an oxygen rich atmosphere during firing will result in a colorless and clear finish, as seen in the lower region of the piece by Catharine Hiersoux.

Crystalline Structures

Although glazes are typically amorphous, (lacking in crystalline structure) crystals do form under certain circumstances. Crystals can form in a glaze as it cools from a liquid to a solid state, a transition known as devitrification. Glazes that crystallize during devitrification are high in silica, low in alumina, and often include zinc or titanium. Many glazes that have matte surfaces are due to devitrification.

Glazes oversaturated with an oxide (such as iron oxide or manganese dioxide) can also form crystals. The Chinese vase displayed here is an example of this type of glaze, exhibiting a matte, opaque surface covered in minute crystalline structures.

Through experimentation, ceramists have even devised glaze recipes that promote large flowery crystals derived from zinc oxide. For these types of crystals to form and grow, ceramists develop long and elaborate cooling schedules, some of which require temperatures in the kiln to remain constant for many hours.

It'll Last Longer: Image Capture, Then and Now

The "Dark Chamber", or Camera Obscura consists of a completely dark box or room with a hole on one side. Light reflecting off of objects passes through the hole, and lands on the opposing interior wall. The projected result is an inverted image of the environment outside the Camera Obscura. This optical device can be traced back to Aristotle and Euclid in the 4th century BCE, and was used extensively by artists and draftsmen as a drawing aid and a way to accurately recreate images. By the 17th century, experiments with the camera obscura, and light sensitive materials were being made, which led to the development of photography, marked by Louis Daugerre's Daugerrotype (the first photograph) in 1837.

Since Daugerre's invention, Artists have been using light and photosensitive materials to capture images and create art. Displayed here are a variety of techniques in which images are captured onto a flat substrate. Some are employ traditional techniques like the use of a pinhole camera, while others incorporate the unexpected use of chemicals, electricity, and algae growth to construct and capture images. Featuring works by Christopher Bucklow, Walter Chappell, Barbara Ess, David Nyzio,Susan Rankaitis, and Gary Schneider

Walter Chappell
Fern, 1974
silver gelatin print, ed. 34/100
Gift of The Contemporary Museum, Honolulu, 2011, and Gift of Sharon and Thurston Twigg-Smith
TCM.2002.50.3

Fern is part of a series of works called Metaflora where Chappell used Kirilian photography to capture the images. The camera-less technique (named after its inventor, Semyon Kirilian) involves running an electrical current through an object, which is placed onto a photosensitive substrate. The electrical field creates the image in the same manner that light would in traditional photographic techniques.

Bruce Conner
Throne Angel, 1975
Gelatin Silver Print Photograph; ed. 8/75
Gift of The Contemporary Museum, Honolulu, 2011, and Gift of Persis Corporation, by exchange
TCM.1993.19

Bruce created Throne Angel by sitting on a stool in between a large sheet of photosensitive paper and a light source. His cast shadow upon the paper acted as a resist, keeping that area from being exposed to light. The process is not unlike a photogram, where objects are placed on a photosensitive sheet, creating an image of highly contrasting sillhouettes.

Barbara Ess
Untitled (Triptych), 1986
Three Monochrome Ektacolor Prints
Gift of The Contemporary Museum, Honolulu, 2011, and Gift of James Jensen
TCM.1997.76.1

Barbara Ess works on a large scale and utilizes simple pinhole cameras to capture her images. Pinhole cameras function on the same principles of a camera obscura and consist of a box or container that is light proof, except for a tiny hole made by a pin. Photosensitive paper is placed in the box, opposite of the hole. The hole is kept covered, and when the picture is ready to be taken, uncovered, allowing light in to expose the paper. The

length at which the paper is exposed is dependent on how much light is needed to capture the image.

David Nyzio
Adventures in Articulation I, 1994
Algae on Paper, Steel
Gift of The Contemporary Museum, Honolulu, 2011, and Purchased with funds derived from gifts of The Honolulu Advertiser COllection at Persis Corporation, by exchange.
TCM.1996.5

To capture the image in Adventures in Articulation I, David Nyzio suspended a large negative over a shallow box filled with water and sheets of paper. Instead of using a traditional photosensitive material, he simply allowed algae to grow on the paper. Where areas on the negative were dark, no light reached the paper and no algae grew. Where the negative was open, light passed through and promoted algae growth.

Susan Rankaitis

Passing in Evening, 1985
Unique Toned Gelatin Silver Print
Overall: 69 x 54 7/8 in. (175.3 x 139.4 cm)
Gift of The Contemporary Museum, Honolulu, 2011, and Purchased with funds derived from a gift of Esther Goodale, by exchange.
TCM.1995.34

Passing in Evening is a semi abstract photomontage of planes taking off and landing at Los Angeles International Airport. In the same manner one can digitally manipulate an image with filters and after effects in Photoshop, Susan Rankaitis does so with the use of multiple negatives, tricks with the enlarger, and photographic chemicals.

Gary Schneider
Robert, 1996
toned gelatin silver print
Gift of The Contemporary Museum, Honolulu, 2011, and Purchased with funds derived from the Honolulu Advertiser Collection at Persis Corporation, by exchange
TCM.2004.2

Some photosensitive materials are also sensitive to heat. Photographer Gary Schneider takes advantage of the phenomenon by having a person place their hand down on a photosensitized sheet. When the sheet is developed, an impression from the heat from the hand is revealed.

Christopher Bucklow
Guest (A.F.) 25,000/solar images, 4:43p.m./1st September, 1993,
Unique Photogram, Cibachrome Print
Gift of The Contemporary Museum, Honolulu, 2011, and Purchased with funds derived from gifts of Helen Eskridge Rodman, by exchange.
(TCM.1996.3)

Christopher Bucklow's Guest (A.F.) 25,000/solar images, 4:43p.m./1st September, 1993 was done using the concept of a pinhole camera. Instead of a single pinhole, Bucklow's rudimentary camera had 25,000 holes oriented in the shape of his friend and fellow photographer Adam Fuss's silhouette.

The camera was set up on his roof and he gradually pulled out the cover, exposing a photosensitive sheet. The head of the silhouette was first to be exposed and thus the longest, resulting in a large white mass. Areas below were exposed later and for a shorter time, resulting in more refined dots.

Fool, Spectrum: Color, Light, and Perception

The galleries at Spalding House are painted white and gray. These "colorless" walls take on subtle shades, tints, and hues depending on the source of light that shines on them. These color shifts are due to wavelengths, frequencies, and how they interfere with one another. White light is made up of a full spectrum of colored light, each color having its own wavelength and frequency. Daylight may have stronger blue and green wavelengths, which will give white and gray walls a cooler, blueish green cast to them. The LED light fixtures in the galleries have stronger yellow and red wavelengths, resulting in warmer tones as it strikes the walls. The differences can be barely noticeable when dealing with white lights and white and gray walls, but what happens when colored lights strike colorful paintings?

On view here are works that rely heavily on the relationship of colors and how they react to one another when in close proximity, and see how different light waves and frequencies can affect the color of colors. Featuring works by Richard Anuszkiewicz and Karl Benjamin, Helen Gilbert, and Anderson O'Mealy

What Moves You: The Mechanics of Kinetic Art

Levers, wheel and axles, pulleys, inclined planes, wedges, and screws are all simple machines. Simple machines are defined as devices with a specific movement or purpose that change the direction or magnitude of a force. They can be seen as elements or components that make up more complex machines like an elevator, or a car, or a kinetic work of art.

Explore the inner workings of sculptures by Alexander Calder, Arthur Ganson, Heinz Mack, George Rickey, Mamoru Sato, and a fully functional Rube Goldberg machine by Ross Mukai, and see how they rely on engineering, principles of physics and the use of simple machines

Come Undone: The Art of Entropy and Decay

Entropy: n, (1) The degradation of matter and energy in the universe to an ultimate state of inert uniformity (2)a process of degradation or running down or a trend to disorder.

Much effort and energy is spent in creating, building cleaning and improving. It is also spent to preserve things in a state of sameness. Left unchecked and at the mercy of the chaotic and random devices of time and the universe, all things eventually come undone, and revert to simpler states. This exhibition presents works of art that in a variety of ways, speak to, and work with the inevitability of entropy and decay. Some artists

celebrate entropy as the happy accident, or depict it in an illustrative and didactic way. Others work in concert and collaboration with the act of decay, creating work that is fleeting and finite. Featuring works by Bruce Connor, Charles Christopher Hill, Ernesto Pujol, and Vipoo Srivilasa

Bruce Conner, American

May the Heart of the Tin Woodsman Be with You, 1981

engraving collage, glue, melted plastic, charred wood

Gift of The Contemporary Museum, Honolulu, 2011, and purchased with funds derived from gifts of Buck Buchwach and the Honolulu Advertiser Collection at Persis Corporation, by exchange, 1996

(TCM.1996.45)

May the Heart of the Tin Woodsman Be with You started off as a collage of cut-up old wood engravings mounted in a frame. The work was in a private collection and unfortunately went through a fire. In the blaze, the acrylic glazing that covered the collage melted and crystalized (that's what you see sagging in the image). Amazingly, the artwork and mat were relatively untouched (acrylic melts at 320 °F and paper burns at 451°F). The unhappy collector showed Connor the damaged work, and upon recognizing it's evocative specialness, the artist agreed to trade him another collage in return for getting this back. Connor put the entire burnt work in another acrylic case and put it back on the market.

Ernesto Pujol

Desert Walk, from Inheriting Salt, 2008

Salt, iron

Gift of Ernesto Pujol in honor of TCM staff who worked with the artist on the exhibition and performance project, 2011

(14387.1)

As a performance artist, Ernesto Pujol works with the ephemerality of moments and episodes. His sculpture Desert Walk also addresses ideas of impermanence. Pujol created the work by placing 50 pounds of pink salt from Utah and 50 pounds of white salt from the Dead Sea in an iron box with the dimensions of the artist's body and walk width, and walked through the salt, leaving behind his footprints in its surface. Over time, the iron has turned to rust, and the salts have crystalized, hardened, and changed color by absorbing iron oxide from the rusty box. The work is constantly changing, and will ultimately reach a point where the iron box will fall a part and rust away.

Charles Christopher Hill

For Connie, 1974

Paper, pigment, thread, dirt, gold leaf

Gift of Constance Lewallen, 1981

(4943.1)

Paper will turn yellow, become brittle, and degrade in acidic conditions. Normally seen as a detriment to a work of art, Charles Christopher Hill makes the reaction a part of his art making process. Hill stitches layers of hand made paper impregnated with pigments and gold and silver leaf, and then buries the work in the ground. After some time has passed, he unearths the piece, which is now distressed, worn, and imbued by dirt and acidity.

Vipoo Srivilasa

Unkown Artist (Japan)

Hand Scroll

Nine Stages of Decomposition of the Heian Period Empress Danrin

Edo period, 18th century

ink and colors on paper

Purchase, Richard Lane Collection, 2003 (2007.3)

Conserved in 2009 with a generous grant from Robert F. Lange Foundation

This scroll documents the death and decay of the Heian period Empress Danrin, wife of Emperor Saga (786-850). The scroll features nine chronological images, showing the various stages of decay, from a living woman to a skeleton and scattered bones.

Known as kusözu (meaning "pictures of the nine aspects") Japanese paintings depicting the decay of a woman's corpse first appeared during the Kamakura period in the 13th century. These were painted in a Buddhist context and were used to contemplate the concept of impermanence.

All nine images will be shown in order over the course of the exhibition, with each image being on view for 3 weeks.