



Video #4: EVIDENCE

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Producer: Beth Harrington

Editor: Greg Bond

Executive Producer: Catherine Stimac

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TIME CODE	AUDIO
01:00:45	<p>NARRATOR: PHOTOGRAPHS CAN REVEAL UNSEEN WORLDS – FROM THE TINIEST MICROBE TO THE MOST EXPANSIVE VISTA.</p> <p>AN IMAGE CAN SHOW US OTHERWISE INVISIBLE PROCESSES, PREVIOUSLY UNDISCOVERED LIFE FORMS, OR DRAMATIC CHANGE OVER TIME.</p>
01:01:01	<p>NARRATOR: IN THIS VIDEO, YOU’LL MEET THREE PEOPLE WHO OFFER EVIDENCE OF THE UNKNOWN AND UNSEEN THROUGH PHOTOGRAPHS...</p> <p>... ENVIRONMENTAL PHOTOGRAPHER GARY BRAASCH...</p> <p>...PHOTOMICROGRAPHER DENNIS KUNKEL...</p> <p>...AND SCIENCE TEACHER RIMA GIVOT.</p>
	<p>RIMA GIVOT</p>
01:01:18	<p>RIMA GIVOT: Kind of one of the driving questions for today is what is one factor that controls our muscle growth...</p>
01:01:23	<p>NARRATOR: ONE UNSEEN WORLD THAT PHOTOGRAPHY CAN REVEAL TO US IS LIFE ON A CELLULAR LEVEL.</p>

	<p>TODAY WE'LL VISIT A CLASS IN OREGON WHERE AN EDUCATOR IS USING PHOTOGRAPHS OF MICE CELLS FROM THE ESSENTIAL LENS COLLECTION AS A VISUAL TOOL FOR TEACHING ABOUT GENETIC MODIFICATION AND MUSCLE DEVELOPMENT.</p>
01:01:41	<p>RIMA GIVOT: I'm Rima Givot and I teach science at Sisters High School.</p>
01:01:43	<p>RIMA GIVOT: So today we're gonna be talking about photos and how photos are used in science. And so I wanted to refer to this photo up here.</p>
01:01:50	<p>NARRATOR: RIMA IS SHOWING HER CLASS PHOTOS OF A MOUSE MODIFIED WITH GREEN FLUORESCENT PROTEIN OR GFP, AS WELL AS MICRO PHOTOGRAPHS OF THAT MOUSE'S CELLS.</p> <p>ORDINARILY SCIENTISTS STAIN CELLS IN ORDER TO SEE THEM UNDER A MICROSCOPE. BUT THIS PROCESS KILLS CELLS AND ALTERS THEM.</p> <p>SO THEY'VE LEARNED HOW TO GENETICALLY MODIFY ORGANISMS THEY WANT TO STUDY WITH GFP. IN THIS WAY, THEY CAN OBSERVE CELLS IN THEIR NATURAL, LIVING STATE.</p> <p>THESE MICROGRAPHS OF THE GFP MODIFIED MOUSE CELLS LET THE STUDENTS EXAMINE MUSCLE GROWTH WITHOUT THE AID OF AN ACTUAL MICROSCOPE.</p>
01:02:29	<p>RIMA GIVOT: The photomicrographs, I think, are really important because they gave me a very relevant, quantifiable tool to show the students how to collect data. And so in a situation where we couldn't actually have the authentic cells they were able to use 'em. And actually the pictures amplified what we would have seen in the microscope. And so I think that they're more accurate to do this kind of study than even looking at the live thing.</p>
01:03:00	<p>RIMA GIVOT: These are muscle cells or myotubes from mice. In this particular case, the mouse had myostatin. And in this particular case, the mouse was genetically modified to not have the gene that produces myostatin.</p> <p>So the study that was done was, Well, what if we do have mysotatin and what if we don't? Really, how does myostatin effect cell growth? And that's what we're going to do today is a mock study on using photographs to see just like they do in the lab.</p> <p>So what we're gonna do is look at these two pictures and I have pictures for each of you to use and I'm actually gonna give you guys Sharpies and what I want you to do, you'll be numbering some of the cells that you measure. So we're going to be comparing the two different types of cells.</p>

	<p>So we're going to measure these cells and get some really great scientific data from that.</p>
01:03:57	<p>RIMA GIVOT: Just using the photos and the rulers where would you measure to show maybe growth in the cells and how the cells compare?</p> <p>Yeah, Johanna?</p> <p>FEMALE STUDENT: I also had a question if these are from the same type of muscle cell?</p> <p>RIMA GIVOT: Yes. These are both mouse myotubes. One of the mice had the gene to make myostatin and the other mouse didn't have the gene to make myostatin.</p>
01:04:24	<p>RIMA GIVOT: Photographs are important to science because they give us a record in time and they freeze that moment, as well as helping us see places or things that we wouldn't be able to necessarily see well without them.</p>
01:04:38	<p>NARRATOR: THE STUDENTS WORK TOGETHER TO MEASURE THE MYOTUBES AND GRAPH THEIR RESULTS.</p>
01:04:43	<p>RIMA GIVOT: So like these cells bend and so like if you're going to do this cell you do it this way and not that. OK.</p> <p>And then I wanted to show you, (laughs). So, in your groups, guess which one has myostatin and which one doesn't have myostatin.</p>
01:05:13	<p>RIMA GIVOT: You know I generally try to use as much real specimens as I can. I work to get the students outside as much as I can but in this case photographs were the perfect application because, um, I don't have access to the real thing. Because the students...it's visual, it's colorful and they're doing authentic research with them and I think it's a great application and I would definitely do it again.</p>
	<p>DENNIS KUNKEL</p>
01:05:36	<p>DENNIS KUNKEL: My interest in microscopy started way back when I was a kid. When I was ten years old, my parents bought me a small microscope.</p>

	But this little microscope opened up a whole new world to me.
01:05:49	DENNIS KUNKEL: My name is Dr. Dennis Kunkel and I'm a scientist and a photomicrographer who lives in Hawaii.
01:05:55	DENNIS KUNKEL: I take photos of various types of subjects through different types of microscopes of many things that are in the unseen world around us.
01:06:04	NARRATOR: DENNIS KUNKEL HAS VAST EXPERIENCE ACROSS MANY SCIENTIFIC DISCIPLINES. HE'S WORKED AS A RESEARCHER ON NUMEROUS PROJECTS AND HAS BEEN PUBLISHED IN A NUMBER OF SCIENTIFIC JOURNALS. BUT IN THE LAST DECADE, HE'S DEVOTED HIMSELF COMPLETELY TO THE REALM OF MICROSCOPIC PHOTOGRAPHY. HIS TOOL OF CHOICE IS THE ELECTRON MICROSCOPE, ALLOWING HIM TO EXPLORE MATTER THAT CAN'T BE SEEN WITH THE NAKED EYE.
01:06:29	NARRATOR: DENNIS HAS MADE CONTRIBUTIONS TO THE FIELDS OF BOTANY, MICROBIOLOGY AND NEUROLOGY. AND HAS COLLABORATED WITH FELLOW RESEARCHERS IN DISCIPLINES LIKE ZOOLOGY, AND MATERIAL SCIENCE. HE THRIVES ON THE CONSTANT VARIETY AND NOVELTY OF HIS PROJECTS.
01:06:48	DENNIS KUNKEL: It's amazing to realize you've seen something that nobody else has seen. That's what I really enjoy and I know many of the things that I've seen I've never seen anybody else take a picture of it.
01:07:01	NARRATOR: OFTEN DENNIS' WORK BEGINS WITH COLLECTING SAMPLES FROM THE NATURAL WORLD THAT HE WANTS TO EXAMINE CLOSE UP. WITH EVERYTHING HE SEES, HE IMAGINES THEIR POTENTIAL UNDER AN ELECTRON MICROSCOPE.
01:07:15	DENNIS KUNKEL: Everything I look at, you know, I think right away what it might be on the surface because you know with a scanning electron microscope you're looking at the surface.

	<p>This is a piece of coralline algae on an intertidal rock.</p> <p>Besides just this coralline alga, there's everything else going on it from diatoms to small invertebrates or larva. So it's gonna open up a whole new micro-community.</p>
01:07:39	<p>DENNIS KUNKEL: Hawaii is a place where I have round-the-year chance to get outdoors and there's always something growing or moving around here.</p>
01:07:49	<p>NARRATOR: HAWAII IS ALSO GREAT FOR PROVIDING VOLCANIC SAMPLES FOR EXAMINATION.</p> <p>TODAY DENNIS IS PREPARING TO LOOK AT A PIECE OF RETICULATE LAVA UNDER A SCANNING ELECTRON MICROSCOPE.</p> <p>HE STARTS BY USING A TRADITIONAL LIGHT MICROSCOPE.</p>
01:08:04	<p>DENNIS KUNKEL: I go back at the laboratory, take out the sample and then mount it on a special aluminum stub that is used to place in the microscope.</p> <p>Then the sample that's really adhered to the surface, I'll bring that into the laboratory which has a machine that allows you to coat the sample with a very thin layer of metal, it's a combination of palladium and gold that's placed on the surface to make the surface more conductive so that there's not special electron discharges on the sample and making it harder to image and photograph the sample.</p>
01:08:55	<p>NARRATOR: WITH THAT, DENNIS IS READY TO EXPLORE THE SAMPLE AND MAKE PHOTOS.</p> <p>HE'S LOOKING FOR A CHARACTERISTIC OF THE IMAGE THAT CATCHES THE EYE. MORE OFTEN THAN NOT, IT'S A STRIKING PATTERN.</p>
01:09:05	<p>DENNIS KUNKEL: I go right for the pattern right away to study it and take the photographs right away because I don't know if I'm gonna get back to it or if I'll find it again especially if it's a multi-patterned thing, um, I need to get it to where I see the true visual presentation of it.</p>
01:09:21	<p>NARRATOR: BECAUSE AN ELECTRON MICROSCOPE WILL SHOW AN IMAGE ONLY IN BLACK AND WHITE, DENNIS OFTEN COLORIZES THE ELECTRON IMAGES HE MAKES TO HIGHLIGHT CERTAIN ELEMENTS AND MAKE THEM MORE READILY UNDERSTOOD.</p>

01:09:32	<p>DENNIS KUNKEL: These are photomicrographs of reticulate lava which is a sample that came from the big island of Hawaii.</p> <p>This is a black-and-white photomicrograph taken with the scanning electron microscope of reticulate lava.</p> <p>As you can see from this type of lava, there's structure that has a latticework as well as a lot of holes in it and reticulate lava is formed when molten lava is rapidly—with a lotta bubbles in it, with a lotta gas—there's different kinds of gases—rapidly solidifies. The bubbles are trapped and what is left is this latticework along with all the holes in it.</p> <p>This is a colorized version of the black-and-white original image.</p> <p>And the color is more pleasing to us because we all see in color rather than viewing things in black and white. And in addition to adding color to this image, we can highlight various structural details such as the lattice, the silica lattice. We can also see various hole patterns due to the bubbles as well as down deep within some of the areas where you have repeating patterns and lots of holes.</p>
01:10:41	<p>NARRATOR: BUT DENNIS' PHOTOS AREN'T JUST INTRIGUING PICTURES. THEY OFTEN HELP SCIENTISTS UNCOVER NEW INFORMATION.</p> <p>FOR EXAMPLE, AFTER MAKING MICROGRAPHS OF MOSQUITOS FOR A FLORIDA SCIENTIST, IT WAS REVEALED THAT THERE WERE MECHANISMS AT THE TIP OF THE INSECT'S ANTENNA THAT NO ONE HAD SEEN BEFORE.</p>
01:11:00	<p>DENNIS KUNKLE: And they realize now that this is one of the ways that this mosquito is able to chemically sense his environment and tell where to find an animal to go bite.</p>
01:11:10	<p>NARRATOR: OF COURSE, DENNIS' PHOTOS WERE ALSO TAKEN WITH EDUCATORS IN MIND.</p>
01:11:15	<p>DENNIS KUNKLE: I've always had this goal when I take them to share them with the public especially students who are in classes, and so to inspire teachers you know I've always had my pictures accessible to them via my Web site and then doing special demos or going to schools.</p> <p>Get the kids interested and asking questions. Maybe don't even tell 'em what it is. Start it off and then have them think about other things that look familiar.</p> <p>So using analogy as a way to approach getting discussions going with the kids keep it open. Don't make it scary initially because you know some of these images can be scary. But once they find out kids aren't afraid. You know they think, <i>Well, that's really weird</i> but they're going to really see the inherent beauty of the subject, learn about the subject, in particular, based on the teacher helping them.</p>

01:12:06	<p>DENNIS KUNKEL: There are so many things to be found still on our planet that goes beyond what we see with our normal eye especially microorganisms. Microorganisms are so important to us in our bodies, as well as in the environment that if it weren't for microorganisms there wouldn't be life on this planet.</p>
	<p>GARY BRAASCH</p>
01:12:24	<p>GARY BRAASCH: The word of photographic exploration is quite wide. I mean, the things that people do using micrographs is exploring worlds that we cannot see with our naked eye.</p> <p>But there are many things in the world that are hidden from us because time passes or because different seasons happen when we're not here. So my kind of photography is to give us a place in time and how that place changes over years. That's the kind of change and the kind of detail that landscape photography brings about.</p>
01:12:53	<p>GARY BRAASCH: My name's Gary Braasch. I'm a photojournalist. I specialize in nature subjects, environmental stories and especially lately in climate change, global warming and all that means for the world.</p>
01:13:03	<p>NARRATOR: GARY BRAASCH WAS TRAINED AS JOURNALIST YET HE BEGAN HIS CAREER AS A NATURE PHOTOGRAPHER.</p> <p>BUT IT TOOK JUST ONE DAY FOR THE COURSE OF HIS WORK TO CHANGE DRAMATICALLY.</p> <p>MAY 18, 1980: THE ERUPTION OF MT. ST. HELENS IN WASHINGTON STATE.</p> <p>THE DAY STARTED WITH AN EXCITED PHONE CALL FROM A FRIEND. SOON THE TWO MEN WERE SPEEDING TOWARD THE VOLCANO.</p>
01:13:36	<p>GARY BRAASCH: A friend of mine knew the area enough, had a map of the national forest and we got within 12 miles of the mountain on the south side which was the side that was the safest.</p> <p>We had this unrestricted view of the eruption and it was a most amazing, roiling, giant gray cumulus cloud.</p> <p>And I got pictures that immediately were news pictures.</p>
01:14:00	<p>NARRATOR: GARY'S WORK WAS WIDELY SEEN IN PUBLICATIONS LIKE TIME AND SMITHSONIAN</p>

	MAGAZINE. AND THIS CHANGED THE WAY HE THOUGHT ABOUT HIS PHOTOGRAPHY.
01:14:09	GARY BRAASCH: Because Mt. St. Helens is not only a huge nature event but also news and beautiful and dangerous and just awe-inspiring. I put the journalism back into my photography and I became an environmental photojournalist. And I have been doing that ever since.
01:14:27	NARRATOR: SINCE THAT TIME, GARY HAS RETURNED YEAR AFTER YEAR TO ST. HELENS. AND HE'S DOCUMENTED THE ASTOUNDING RECOVERY OF THE LANDSCAPE WITH A METHOD CALLED "REPEAT PHOTOGRAPHY."
01:14:38	GARY BRAASCH: 'Repeat photography', sometimes called 'time series photography', is going back to the same location and re-photographing it as time goes by. This could be after from a difference between winter and spring, a matter of weeks, it can be through the seasons of a year or in case of Mt. St. Helens and climate change it's usually longer periods of time. And the trick is to make it really useful scientifically and useful as a graphic tool is to get the pictures to line up the right—and be in the right spot.
01:15:11	GARY BRAASCH: So these are photographs from '85 when it was still raw landscape, very few plants around, and-and the erosion down in the valley was very raw. And the canyons were deeper and steeper. But the river was still relatively small and now the landscape has changed a lot. So I'm looking at the relationship between points of land erosion, cliffs that are in my photo from 1985 and where the mountain is in relationship to those points to sorta get a straight line and don't want to get myself into that relationship so I have a line between the mountain and that point of land. But that point of land has really eroded away and there's two of 'em down there now and I'm not sure which is which... So there's a lotta changes that make it more difficult to find exactly the right spot to do a repeat. I think here is one and maybe even back there to do one to see if I can get a match.
01:16:06	NARRATOR: GARY'S REPEAT PHOTOS TELL AN INTERESTING STORY OF HOW LIFE HAS RETURNED TO MT. ST HELENS.

01:16:13	<p>GARY BRAASCH: This is all aftermath when we thought there would be nothing coming back.</p> <p>They really at first – the scientists – were saying, “Well, it’s gonna be years and years before this place recovers. Look at the devastation.”</p>
01:16:25	<p>GARY BRAASCH: There’s two prime locations that I photographed in the first few years of Mt. St. Helens where you can see the remnants of the forest that once clothed the hills around Spirit Lake.</p> <p>And so this particular year was a pretty dramatic illustration of the time that’s gone by. And now we’re completely covered with grasses most of the bushes are back and there are lots of tree seedlings in the area.</p>
01:16:51	<p>GARY BRAASCH: So this is the second of the two major shots that I’ve followed through the years and that have been republished a lot.</p> <p>This was for LIFE magazine in 1984 and this one of the very first plants to pop up in the pumice plain.</p> <p>Nowadays it looks more like this.</p>
01:17:11	<p>NARRATOR: GARY IS APPLYING THIS TECHNIQUE TO OTHER WORK, MOST NOTABLY HIS PROJECT “WORLD VIEW OF GLOBAL WARMING.”</p>
01:17:19	<p>GARY BRAASCH: This idea of having a long-term view of a landscape and being able to tie it to what the scientists are finding, that’s actually what I’m doing with “World View of Global Warming”, too. I have repeat shots that I’m doing there and with the information from scientists I’m trying to connect up people to the process that’s happening so they can see the changes that are happening and have some sense of the time scale.</p>
01:17:40	<p>NARRATOR: THESE IMAGES ARE BEING SEEN AND USED BY SCIENTISTS AND OFFICIALS AT THE HIGHEST LEVELS OF GOVERNMENT.</p>
01:17:47	<p>GARY BRAASCH: I know that the people in the White House in the Office of Science and Technology Policy have my pictures and I know they’ve done a lot of slide shows where my pictures are part of their presentation of telling not only people in the legislative branch but also people in their departments and maybe even other countries that climate change is happening and here’s some examples.</p>

01:18:07	<p>NARRATOR: BUT HE ALSO HOPES THAT HIS WORK WILL BE OF USE TO TEACHERS AS THEY EDUCATE THE NEXT GENERATION OF CITIZENS.</p>
01:18:14	<p>GARY BRAASCH: So to tell the story that time can paint in comparison photography is probably the most powerful kind of teaching tool that what I do gives to the teacher.</p>
01:18:25	<p>GARY BRAASCH: Things are changing very rapidly. And so photography brings us that possibility of being able to bring that change to people who were not even born when the process started but can relate to today's landscape and be amazed and learn from what it used to look like.</p>
<p>CREDITS</p>	
<p>PRODUCER Beth Harrington</p> <p>ASSOCIATE PRODUCERS Ashley Michael Karitis Ann Suckow McGarry Carol Sherman Tracey Whitney</p>	
<p>CAMERA Greg Bond Tom Shrider Todd Sonflieth</p> <p>AUDIO Ted Cutler Randy Layton William Ward</p>	
<p>ADVISORY BOARD Makeda Best Brooke N, Bourdélat-Parks Julia Dolan Lisa Espinosa Bruce Larson Susan McWilliams Lesley Meyer Gary Nash</p>	

CONSULTANTS

Gary Braasch
Sandra Childs

ON CAMERA

Gary Braasch
Rima Givot
Dennis Kunkel, Ph.D.
Sisters High School Students

EDITOR

Greg Bond

ONLINE EDITOR

Greg Bond

AUDIO ENGINEER

Steven Vaughn Kray

GRAPHICS & ANIMATION

HUB Collective
Laverne Heiman-Layton
Bradley Marks

NARRATOR

October Moore

THEME MUSIC

Brian Sussman

ADDITIONAL MUSIC

Audio Network

CURRICULUM WRITERS

Bruce Larson
Lauren McClanahan
Tullan Spitz
Chris Tachibana

WEBSITE PRODUCER & DEVELOPER

Heather Young

WEBSITE CONTRIBUTORS

Makeda Best
Bruce Larson
Tullan Spitz
Catherine Stimac
Ann Suckow McGarry

COPY EDITOR

Jennifer Ingraham

CURRICULUM EVALUATORS

RMC Research Corporation

SPECIAL THANKS

Tina Cravalho
Marilyn Dunlap
University of Hawaii
City & County of Honolulu
Honolulu Film Office
Mt. St. Helens National Volcanic Monument
Sisters High School

ARCHIVE

Anticancer, Inc.
Gary Braasch Photography
Tim Flach Photography, Ltd.
Dennis Kunkel Ph.D. / Dennis Kunkel Microscopy, Inc.
Jonathan Slack, Emeritus Professor, University of Bath
Stock Image Provided by Shutterstock.com

PRODUCTION MANAGEMENT

Cheri Arbini
Susan Boyd
Stacy Carroll Coonfield

POST PRODUCTION

Michael Bendixen
Steve Hoyt
Jonathan Newsome
Tom Shrider

PRODUCTION SERVICES

Lisa Miyamoto

LEGAL SERVICES

Rebecca Morris
Kathleen Susco

BUSINESS AFFAIRS

Susan Smith

EXECUTIVE PRODUCER

Catherine Stimac

VICE PRESIDENT OF TELEVISION PRODUCTION

David Davis

EXECUTIVE IN CHARGE OF PRODUCTION

Steven M. Bass

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END