



# EARTHQUAKE

*e-Newsletter about what's movin' and shakin' at the Earth Science Museum*

Earth Science Museum, 3215 W. Bethany Home Rd., Phoenix, AZ 85017  
[www.earthsciencemuseum.org](http://www.earthsciencemuseum.org), [scote@earthsciencemuseum.org](mailto:scote@earthsciencemuseum.org), 602-973-4291

January 2023  
 Volume 12, Issue 1

## ESM OUTREACH UPDATE

Mardy Zimmermann, Outreach Coordinator

### Egg Carton Program through the Years

Year	Cartons	Comments
2012	864	First year ESM at Flagg Show
2013	1048	New record
2014	784	
2015	938	
2016	825	Fewer scouts
2017	736	
2018	550	New ESM banner
2019	308	No scouts, cloudy weather
2020	468	
2021		No Flagg Show due to Covid
2022		Did not setup due to Covid
2023	467	
<b>Total</b>	<b>6988</b>	



ESM Board members Bob Holmes and Mardy Zimmermann along with ESM member Lynne Wheeler helping egg carton participants. S. Coté photo

## 2023 Fluorescent Mineral Display - “The Glow Must Go On!”

By Harvey Jong

Since last year’s open-air, “dark corner” fluorescent display seemed to be well received, the ESM decided to continue with this arrangement for the 2023 Flagg Show. We hoped that the simple layout would make setup easier and provide a more kid-friendly viewing experience. Unfortunately, some unexpected issues made this year’s exhibit a rather challenging undertaking.

The first problem involved one of the ultraviolet (UV) lights for the main viewing cabinet. The longwave bulb would flicker momentarily but would not stay on. I wasn’t able to identify what was causing this malfunction, but I managed to find a replacement unit. It arrived about a week before the show.

The next issue was related to the big, 1250 watt-hour battery used to power the display. This battery was acquired in 2014 with a Staples Foundation grant. Over the years charging the unit has been problematic. After several days of charging, the battery indicated less than 90% capacity. During setup day, a very unpleasant discovery was made after connecting the UV lights to the battery: the charge dropped with zero power output!!



ESM’s Big Goal Zero Yeti Battery (2014-2023)

But following NASA's example of redundant systems, we had a backup battery on hand. This unit, however, has a smaller 1000 watt-hour capacity while having to power four UV lights of the viewing cabinets along with a separate light for the "good to glow" station for checking samples. So, to conserve power, we switched off the lights after each group of visitors.

Free samples for kids represent one of the key attractions of the Flagg Show, so I wanted to add a fluorescent fluorite "freebie" to the mix. Another issue was encountered in printing label stickers for the fluorite specimens. Due to recent software updates, an incompatibility between Photoshop and my printer developed that caused Photoshop to crash. Switching to a different imaging application resulted in a mismatch between the label design and the sheet of stickers. Some trial and error "tweaking" was needed to get the labels to print correctly.

After working around all these obstacles, here is how the exhibit appeared:



**2023 Fluorescent Display - Overall View**



**2023 Fluorescent Display - The "Dark Corner"**

Four UV lights (two 9W Way Too Cool and two 8W UVP lamps) are powered by the small backup battery (in front of the blue box). Two different step stools were available for young visitors to get up close and personal views of the fluorescent minerals.



**2023 Fluorescent Display - Small Viewing Cabinet**

This cabinet featured multi-color fluorescent combinations. It uses a 4W UVP light powered by a separate 187 watt-hour battery.

The minerals for the fluorescent display were selected to highlight two key points:

1. The energy of ultraviolet light is related to its wavelength.



2. Different energies may cause minerals to glow different colors.

The following info graphic, “ABC’s of UV”, was created to emphasize these takeaways.

**ABC's of UV**  
(The long and short of ultraviolet light)

Graphic by Foumart – CC-BY-SA-3.0, via Wikimedia Commons

**What is ultraviolet?**

- Type of electromagnetic radiation
- Moves as either waves or particles (photons)
- Wavelength measured in nanometers (nm)

**Types of ultraviolet**

UVA	UVB	UVC
315-399 nm	280-314 nm	100-279 nm
Longwave: 365 nm	Midwave: 302 nm	Shortwave: 254 nm
3.397 eV	4.105 eV	4.881 eV

**Energy of ultraviolet**

- Energy is related to its wavelength,  $\lambda$

$$E = hc / \lambda$$

where  $h = 4.136 \times 10^{-15}$  eV·seconds (Planck's constant)  
 $c = 2.998 \times 10^8$  meters/second (speed of light)

The fluorescent display started with a cabinet of fluorite specimens.



Viewing Cabinet Featuring Fluorites

Fluorescence was first observed with fluorite and is named after this mineral. So, this seemed like a good starting point for the fluorescent display.

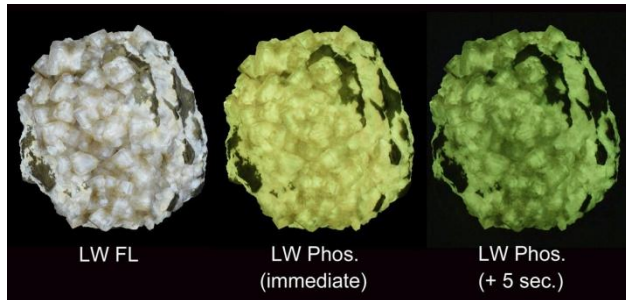


**Fluorites Under Longwave UV**

Fluorite’s common blue-violet longwave UV response is shown in the top row with specimens from Duncan, AZ (left); Donna Anna workings, AZ (middle); and Blanchard Mine, NM (right). Rare-earth elements, such as europium ( $\text{Eu}^{2+}$ ), have been identified as the impurities responsible for this color.

The bottom row provides examples of some unusual colors. The red-fluorescing fluorites (left) are from a recent find from the Ojuela Mine, Mapimi, Mexico. The cause of this rare color is not fully understood but is believed to involve some interaction between europium, oxygen, and samarium impurities.

The fluorite from the Pugh quarry, Ohio (right) exhibits a bright creamy yellow color due to the presence of hydrocarbons. The Pugh quarry fluorites also display the interesting phenomenon of phosphorescence which is the afterglow when a UV light is turned off. The color of this phosphorescence shifts over time as shown in the following image sequence:



### Phosphorescent Color Shift with a Pugh Quarry Fluorite

Chris Clemens photo - CC\_BY\_SA-2.0, via naturesrainbows.com

Some fluorescent gemstones were featured in the next cabinet.



Viewing Cabinet with Fluorescent Gemstones

Gemstones may contain impurities that will produce a fluorescent response.



### Fluorescent Gemstones Under Shortwave UV

The fluorescent gemstones included:

**Amber** (back row, left): This specimen is from Sumatra, Indonesia and fluoresces a sky blue color with both shortwave and longwave UV. It is found in coal seams, so hydrocarbons are likely responsible for the fluorescence.

**Corundum var. ruby** (back row, middle): This ruby is from Mysore, India, and its red fluorescent color is due to the substitution of some aluminum atoms by chromium.

**Common opal** (back row, right): Nevada's Virgin Valley has produced a variety of opals that includes strongly fluorescent common opal. A tiny amount (~1 part per million) of the uranium ion group, uranyl ( $\text{UO}_2^{2+}$ ), may be all that is needed for the bright green color (Götze, Gaft, and Möckel, 2015).

**Hyalite opal** (front row, left): This hyalite opal is a new find from the El Tepetate Mine, San Luis Potosi, Mexico. In addition to the bright green fluorescent response under both shortwave and longwave UV, it also exhibits an unusual faint green color when viewed in shaded daylight conditions. The reasons for this daylight fluorescence are not fully understood, but some factors may include a certain "optimal" concentration of uranyl impurities; the absence of fluorescent inhibitors, such as iron ( $\text{Fe}^{3+}$ ); and the lack of light scattering effects not related to the fluorescence.

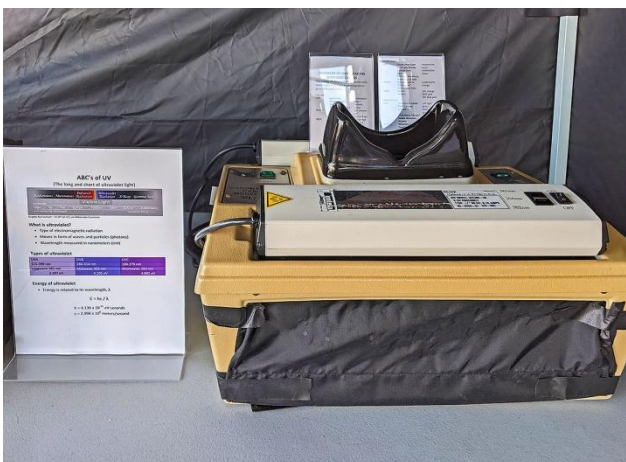




**Hyalite Opal from the El Tapetate Mine Viewed Outside in Indirect Daylight**

**Zircon** (front row, middle & right): The middle specimen is from the Harts Range, Northern Territory, Australia, while the zircon on the right was found in Seiland, Finnmark, Norway. Zircon studies have identified several different sources for its fluorescence, but the golden yellow color has been attributed to crystal lattice defects induced by exposure to natural radioactive materials.

Specimens in the main viewing cabinet demonstrated the effect of different UV wavelengths with fluorescent colors.



**Main Viewing Cabinet**

Some minerals fluoresced only with a certain wavelength; others displayed different colors for each wavelength; and a few glowed the same color but with different intensities.

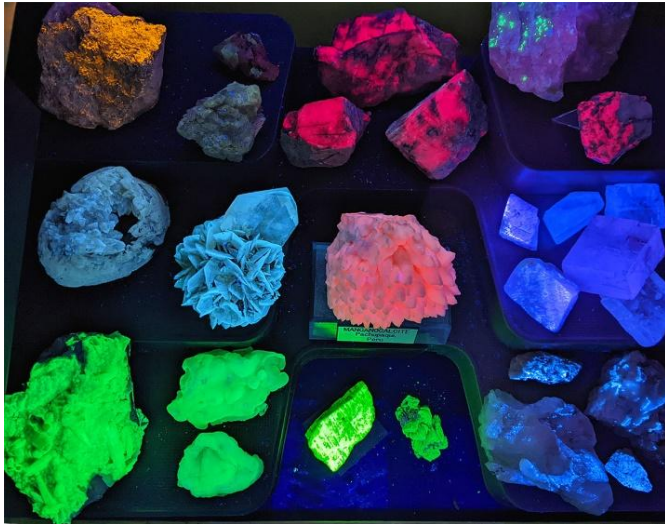


**Main Viewing Cabinet Minerals under Longwave UV**



**Main Viewing Cabinet Minerals under Midwave UV**





### Main Viewing Cabinet Minerals under Shortwave UV

*Top row (left to right):*

**Sphalerite**, Bisbee, Arizona  
**Cerussite**, Mibladen, Morocco  
**Eucryptite**, Midnight Owl Mine, Arizona  
**Hackmanite**, Karnasurt Mtn., Kola Peninsula, Russia  
**Tugtupite**, Greenland

*Middle row (left to right):*

**Calcite** after Clam, Ruck's pit, Florida  
**Gypsum var. Selenite**, Red River floodway, Manitoba, Canada  
**Manganocalcite "Pineapple"**, Pachapaqui, Peru  
**Calcite**, Mexico

*Bottom row (left to right):*

**Chalcedony Geode**, Potts Canyon, Arizona  
**Chalcedony "Roses"**, Saddle Mountain, Arizona  
**Willemite var. Troostite**, Franklin, New Jersey  
**Autunite**, Daybreak Mine, Washington  
**Scheelite**, Johnson City, Arizona

*Back row (left to right):*

**Calcite, Fluorite, Willemite**, Purple Passion Mine, Arizona  
**Calcite and Willemite Sphere**, Franklin, New Jersey  
**Calcite and Willemite "Santa Hat"**, Franklin, New Jersey

*Front row (left to right):*

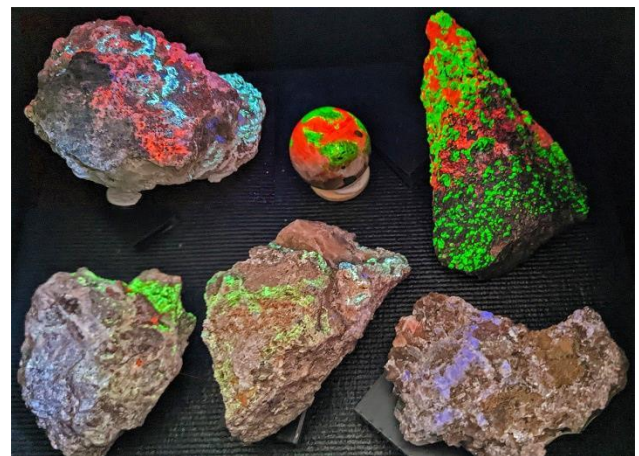
**Calcite and Willemite**, Casa Grande, Arizona  
**Calcite, Fluorite, and Willemite**, Black Rock Mine, Arizona  
**Calcite and Fluorite**, North Geronimo Mine, Arizona

Some fluorescent multi-color combinations were displayed in the last cabinet.



### Viewing Cabinet with Multi-color Combinations

Calcite, fluorite, and willemite often occur together producing a familiar red, blue, and green color combination.



### Multi-color Combination Fluorescent Specimens under Shortwave UV

Overall, a total of 859 visitors viewed the 2023 edition of the fluorescent mineral display, while 594 of the 600 fluorite samples were given away. This attendance represents a respectable increase from last year (505).

Many thanks to Mardy Zimmermann and Shirley Coté for providing some of the specimens for the display and to the following volunteers for their time and effort before, during, and after the Flagg Show: Shirley Coté, Doug Duffy, Debby Ellis, Wally Frlich, Bob Holmes, Tom Osborn, Don Richardson, Lynne Wheeler, and Mardy & Dick Zimmermann.

**References**

Götze, J., M. Gaft, and R. Möckel (2015) Uranium and uranyl luminescence in agate/chalcedony. *Mineralogical Magazine* Vol. 79(4), 983-993.



In other outreach news, on January 26, Terry and Lynne Dyer attended the Chandler Traditional Academy's science fair and there were hundreds of students and parents that got to see their display and ask questions!



The pictures on this page show some of the many displays that Lynne and Terry take to science fairs and classrooms. The exhibits include a quartz family tree, the elements/minerals used in smart phones and

the elements/minerals that are used in the components of a light bulb.



Part of this display is about copper and where copper is found in Arizona.



**How many elements/minerals can you name that are used to build your home or that make up your body?**



**Can you name some of the different igneous rocks? Which ones are intrusive and which are extrusive?**

**Can you name some sedimentary rocks or some metamorphic rocks?**

**And you thought you weren't going to have a test today, didn't you? 😊😊**





## AZ Mining, Mineral & Natural Resources Education Museum Update January 2022

<https://ammnre.arizona.edu/>

Catie Carter Sandoval

cscarter@email.arizona.edu

703.577.6449

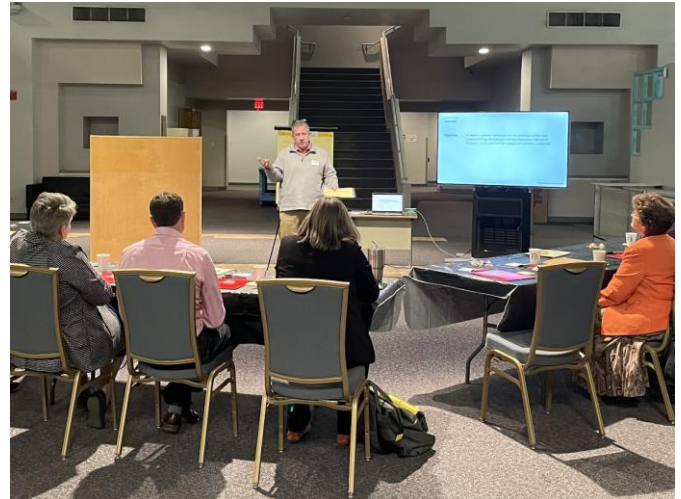
Help support the museum at:

<http://tinyurl.com/SupportMM-NREmuseum>

Happy 2023! This will be a big year for the AMMNRE Museum. University of Arizona administration has been working behind the scenes to develop initial plans for the museum and hire a design-build company that will oversee renovations at the building. We continue our meetings with Representative Gail Griffin (LD-14), who supports the direction of the new museum connecting Arizonans with our natural resources - minerals, water, forests and food - and inspiring the next generation of scientists and engineers.



Museum consultant Mark Walhimer (Museum Planning LLC) and University of Arizona administrators Dr. Elliott Cheu and Sabrina Vazquez outside the Arizona House of Representatives after a meeting with Rep. Gail Griffin.



Planning session at the museum

In other news, we recently picked up a donation of 4 flats of beautiful Brazilian amethyst from Dick and Mardy Zimmermann,



to be used for retail sales and also in educational activities. Mardy spent several weeks cleaning and sorting the amethyst and hand-picked some specimens for our gift shop inventory. The Zimmermanns also donated some Hexagonaria coral fossils from the Payson area, which we will use for our egg carton outreach in February.

Stay tuned for more news about our progress as we begin the design-build process. We also look forward to the upcoming Tucson Gem and Mineral Show and will share photos of our case in next month's update. Thank you for your continued support!





## Arizona Rocks 116

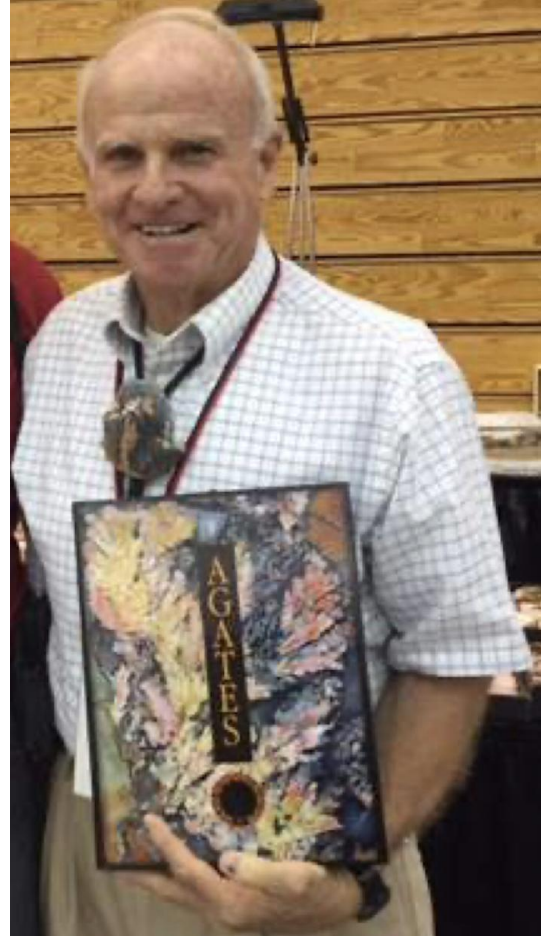
Text and photos by Ray Grant

The fabulous Tucson Gem and Mineral Show is coming again. The main show is February 9 to 12 at the Tucson Convention Center. The show theme this year is “Silica - Agates and Opals and Quartz, Oh My!” As usual, there will be lots of exhibits and dealers and a symposium on Saturday, February 11 about agates and quartz. For information on the symposium program go to <https://www.friendsofmineralogy.org> and check symposia. The show admission costs \$12 plus a \$1 ticket tax for adults, but the symposium on the upper level is free. A show flyer with a \$3 discount coupon is available at:

[https://www.tgms.org/s/Pages-from-168425-TGMS\\_2023-Flyer\\_ALL.pdf](https://www.tgms.org/s/Pages-from-168425-TGMS_2023-Flyer_ALL.pdf)

Arizona has produced some exceptional agates. Pat McMahan has published a book *Agates, the Pat McMahan Collection* with 58 pages of photographs of Arizona agates and many more photographs of agates from all over the world. There has never been such complete coverage of Arizona agate localities and most collectors have no idea that Arizona has such spectacular agates; I didn't until I got his book. Go to Pat's website: [agateswithinclusions.com](http://agateswithinclusions.com) to see many agate photos and see how to purchase the book which costs \$129.95. It is worth the price.

If you get to the Tucson Show, I think you will see some fabulous quartz specimens this year.



Pat McMahan

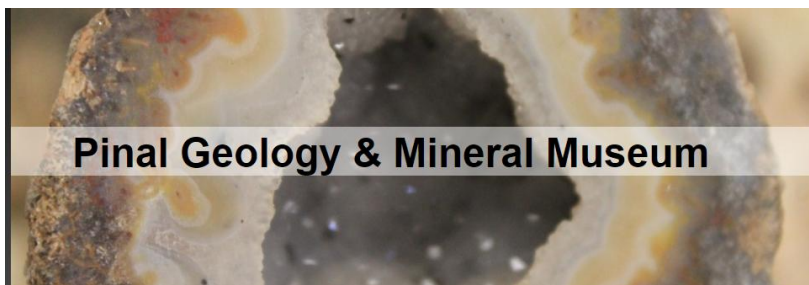


Examples of some agates in Pat McMahan book

Photo above by S. Coté

Photo left and top by Ray Grant





## Pinal Museum and Society News

351 N. Arizona Blvd., Coolidge, AZ

Pinal Geology and Mineral Society meeting

**February 15, 2023**

[www.pinalgeologymuseum.org](http://www.pinalgeologymuseum.org)

Ray Grant [ray@pinalgeologymuseum.org](mailto:ray@pinalgeologymuseum.org)

The Museum is open from 11 to 4,

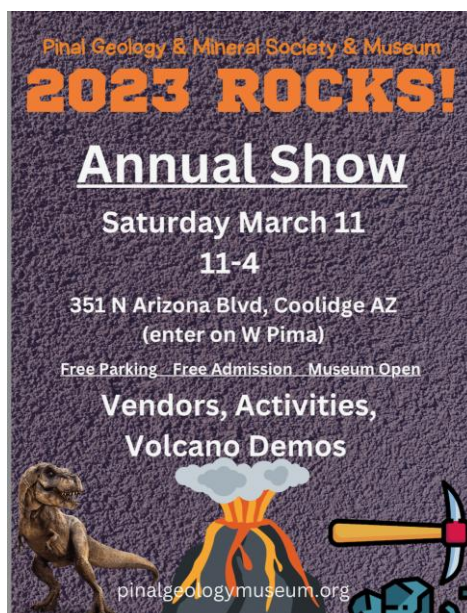
**Wednesday through Saturday**

Masks are now optional at the Museum. Please bring your own mask if you wish to wear one. We will have some masks on hand at the Museum, but cannot guarantee to provide them.

We've been holding in-person meetings since September, with a wide range of speakers. Meetings are the third Wednesday at 7pm, doors open at 6:30.

We're also hosting special days at the museum, running member-only field trips, and have greatly expanded our newsletter.

On Saturday, March 11, our annual show returns. Vendor information can be gotten from Richard Sichling, or email [info@pinalgeologymuseum.org](mailto:info@pinalgeologymuseum.org). Richard will be representing us at the Flag show in Mesa.







## PRESS RELEASE

A DAY AT THE ALFIE: ALFIE NORVILLE GEM AND MINERAL MUSEUM  
LAUNCHES EVENT DURING TUCSON GEM SHOW SEASON

### **A Day at the Alfie**

**Saturday February 4th 9:30am-10pm**

Spend the day listening to expert guest speaker presentations, networking with industry professionals, and enjoying the newest exhibit installations in our galleries!

Food and beverage will be included at each portion of the day.

Purchase tickets for each separate event or an all-day pass!

#### **9:30am-2:45pm Brunch Presentations**

10am Wim Vertriest, Gemological Institute of America  
Mozambique Field Exposition  
Mozambican Rubies: News from the Field

11am Bruce Bridges, Bridges Tsavorite  
The Discovery and Faceting  
of The Lion of Merelani Tsavorite

12pm David Smith, Faceters Paradise  
The United States Faceters Guild

1pm Les Presmyk, Chairman, Flagg Mineral Foundation  
Underground Collecting:  
Adventures in Arizona and Mexico

2pm Aaron Palke, Gemological Institute of America  
Sapphires from Montana:  
Gemology, Geology, and History

#### **3-6:45pm Afternoon Presentations**

3pm Jeff Morrison, Havey Quarry  
Mining the Havey Tourmaline Quarry

4pm Robert Weldon, Gemological Institute  
of America  
Peter Rainier and the Chivor Mine  
Colombian Emeralds in 1920s

5pm Jesse Fisher  
Fluorite from the Weardale Region,  
Northern England

6pm Justin Prim, Faceting Apprentice  
Early History of American Gem Cutting &  
Early History of Mixed Drinks

QR Code to book tickets  
or Search "A Day at the  
Alfie" on Eventbrite for  
Tickets





## SHOW HOURS

**Thursday, February 9 - 10:00 am to 6:00 pm**

**Friday, February 10 - 10:00 am to 6:00 pm**

**Saturday, February 11 - 10:00 am to 6:00 pm**

**Sunday, February 12 - 10:00 am to 4:00 pm**

**Tickets are \$12.00 with a \$1.00 TCC ticket tax**

**Children 14 and under are free with a paying adult**

***OPEN TO THE PUBLIC!! COME JOIN THE FUN!!***

**At the Tucson Convention Center - 260 S. Church Avenue**



# 2023 DAISY MOUNTAIN GEM & MINERAL SHOW



**KIDS CORNER**  
Events & Games

**VENDORS**  
Jewelry, Gems,  
Minerals, Fossils,  
Beads, Geodes  
and More

**Saturday, March 11th**  
9am – 5pm  
**Sunday, March 12th**  
10am – 4pm

**ANTHEM SCHOOL**  
41020 N. Freedom Way  
Anthem, AZ 85086

**Adults \$3, Seniors & Students \$2**  
**Kids 12 & under Free**

**RAFFLES & DOOR PRIZES**

**FLUORESCENT DISPLAY**

**FACETING**

**“DR. ROCK”**  
Identify your Favorite Rock



Sponsored by:  
DAISY MOUNTAIN ROCK AND MINERAL CLUB  
DMRMC.COM

For more information contact: Claudia Marek (623)640-8290

Email: [cmarek2@cox.net](mailto:cmarek2@cox.net)



### Apache Junction Rock & Gem Club

Meetings are on the 2<sup>nd</sup> Thursday  
Next Meeting: February 9, 2023, 6:30 pm

[www.ajrockclub.com](http://www.ajrockclub.com)

@ Club Lapidary Shop

2151 W. Superstition Blvd., Apache Jct.



### Daisy Mountain Rock & Mineral Club

Meetings are on the 1<sup>st</sup> Tuesday  
(unless a Holiday then 2<sup>nd</sup> Tuesday)  
Next Meeting: February 7, 2023, 6:30 p.m.

**Please go to their website for more info**

[www.dmrnc.com](http://www.dmrnc.com)

@ Anthem Civic Building

3701 W. Anthem Way, Anthem, AZ



### Maricopa Lapidary Society, Inc

Meetings are on the 1<sup>st</sup> Monday  
(unless a Holiday then 2<sup>nd</sup> Monday)  
Next Meeting: February 6, 2023, 7:00 pm

[www.maricopalapidarysociety.com](http://www.maricopalapidarysociety.com)

@ North Mountain Visitor Center  
12950 N. 7<sup>th</sup> St., Phoenix



### Mineralogical Society of Arizona

Meetings are on the 3<sup>rd</sup> Thursday  
(Except December)  
Next Meeting: February 16, 2023, 5:00 pm

**Please go to their website for more information**

[www.msaaaz.org](http://www.msaaaz.org)

@ Franciscan Renewal Center  
Room: Padre Serra

5802 E. Lincoln Dr., Scottsdale



### Pinal Geology & Mineral Society

Meetings are on the 3<sup>rd</sup> Wednesday  
Next Meeting: February 15, 2023, 7:00 pm

**In person meeting**

[www.pinalgeologymuseum.org](http://www.pinalgeologymuseum.org)

@ Artisan Village

351 N. Arizona Blvd., Coolidge



### West Valley Rock & Mineral Club

Meetings are on the 2<sup>nd</sup> Tuesday  
Next Meeting: February 14, 2023, 6:30 pm

[www.westvalleyrockandmineralclub.com](http://www.westvalleyrockandmineralclub.com)

@ Buckeye Community Veterans Service  
Center

402 E. Narramore Avenue, Buckeye, AZ



### Gila County Gem & Mineral Society

Meetings are on the 1<sup>st</sup> Thursday  
(unless a Holiday then the next Thursday)  
Next Meeting: February 2, 2023, 6:30 pm

[www.gilagem.org](http://www.gilagem.org)

Club Building

413 Live Oak St, Miami, AZ



### Wickenburg Gem & Mineral Society

Meetings are on the 2<sup>nd</sup> Friday  
(February & December on the 1<sup>st</sup> Friday)  
Next Meeting: February 10, 2023, 7:00 pm

[www.wickenburggms.org](http://www.wickenburggms.org)

@ Coffinger Park Banquet Room  
175 E. Swilling St., Wickenburg



**ESM's Meeting Notice**

ESM's next meeting will be at North Mountain Visitor Center, 12950 N. 7<sup>th</sup> St., Phoenix, on Tuesday, TBA 2023, at 6:30 p.m.

**BECOME A MEMBER!**  
Join the Earth Science Museum's



**IS IT TIME TO RENEW YOUR MEMBERSHIP?**  
Please renew today! 😊😊😊

----- cut here -----  
**ESM Earth Science Investigation  
 Team Membership Form**  
 \_\_\_\_\_ New Member      \_\_\_\_\_ Renewal

Membership levels:

\_\_\_\_\_ ESI Family \$20

\_\_\_\_\_ ESI Individual \$10

Membership benefits:

- ◆ Monthly e-newsletter *Earthquake*
- ◆ Official team membership card
- ◆ Knowledge that your contribution is making a difference in earth science education.

**MANY THANKS TO OUR MAJOR DONORS!**

- AZ Leaverite Rock & Gem Society
- Flagg Mineral Foundation  
[www.flaggmineralfoundation.org](http://www.flaggmineralfoundation.org)
- Friends of the AZ Mining & Mineral Museum
- Maricopa Lapidary Society  
<http://maricopalapidarysociety.com/>
- Mineralogical Society of AZ  
[www.msaz.org](http://www.msaz.org)
- Payson Rimstones Rock Club
- Sossaman Middle School
- White Mountain Gem & Mineral Club  
[www.whitemountain-azrockclub.org](http://www.whitemountain-azrockclub.org)
- Wickenburg Gem & Mineral Society  
<http://www.wickenburggms.org>  
[www.facebook.com/pages/Wickenburg-Gem-and-Mineral-Society/111216602326438](https://www.facebook.com/pages/Wickenburg-Gem-and-Mineral-Society/111216602326438)
- West Valley Rock and Mineral Club  
<http://www.westvalleyrockandmineralclub.com/>
- Staples Foundation  
[www.staplesfoundation.org](http://www.staplesfoundation.org)
- Anita Aiston
- Peter & Judy Ambelang
- Stan & Susan Celestian
- Russ Hart
- Will & Carol McDonald
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- Janet Stoeppelmann
- Dennis & Georgia Zeutenhorst

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**Earth Science Museum**  
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**Phone:**  
 602-973-4291

**Editor E-Mail:**  
 scote@earthsciencemuseum.org

**Mission**  
 Our Mission is to excite and inspire all generations about earth sciences through educational outreach.

**Vision**  
 We envision a community where students and the general public have curiosity about, passion for, and understanding of the underlying principles of earth sciences.

For more information about the ESM, how to become a member or how to arrange for a school visit or Community function, go to: [www.earthsciencemuseum.org](http://www.earthsciencemuseum.org).

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*We're on the Web!*

*Visit us at:*

[www.earthsciencemuseum.org](http://www.earthsciencemuseum.org)

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**NOTICE:**  
 ESM's next meeting will be at North Mountain Visitor Center, 12950 N 7<sup>th</sup> St, Phoenix, on Tuesday, TBA 2023, at 6:30 p.m.

**THANK YOU FOR YOUR CONTINUING INTEREST & SUPPORT!!!**

**EARTH SCIENCE MUSEUM  
 NON-PROFIT BOARD OF DIRECTORS**

Harvey Jong	President
Mardy Zimmermann	VP Outreach
Shirley Coté	Secretary/ Treasurer

Cindy Buckner, Doug Duffy, Ray Grant,  
 Bob Holmes, Chris Whitney-Smith

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