Pollen Collection Information and Protocols

Western Hummingbird Partnership (WHP) • Environment for the Americas (EFTA)

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Pollen Identification, Collection, and Pollen Experts

Existing online pollen libraries *(these libraries do not have images of hummingbird plant species of interest).*
Common Southwestern plant species that pollinators prefer.
Pollen experts that may be interested in helping hummingbird banders collecting pollen from birds and other scientists/citizen scientists who are collecting pollen from plants.
(All potential collaborators have been contacted).

Making Mounts of Pollen Grains
http://www.microbehunter.com/making-mounts-of-pollen-grains/
- Mounting techniques (glycerol wet mounts, air mounts, glycerol jelly, non-water based mounting media)
- Reading Material

An Overview of Mounting Media for Microscopy
http://www.microbehunter.com/an-overview-of-mounting-media-for-microscopy/

Pollen Identification- Discover Life Website
http://www.discoverlife.org/mp/20q?guide=Pollen

Pollen Identification Activity- The Virtual Forest Initiative of the Black Rock Forest Consortium
https://blackrock.ccnmtl.columbia.edu/paleoecology/identification

Pollen Identification- University of Arizona Catalog of Internet Pollen and Spore Images
http://www.geo.arizona.edu/palynology/polonweb.html

Pollen Identification- MicrolabNW Phtomicrograph Gallery
Pollen Under the Microscope
http://www.microlabgallery.com/PollenFile.aspx

Pollen Forecast (Perhaps this could help us identify what kind of pollen is floating around where and when?)
https://www.pollen.com/forecast/current/pollen/80305

Pollen Identification-Pollen Image Library
http://www.saps.org.uk/pollen/pollen/index.htm

The Global Pollen Project: a new tool for pollen identification and the dissemination of physical reference collections- a scientific article
http://onlinelibrary.wiley.com/doi/10.1111/2041-210X.12752/abstract
http://onlinelibrary.wiley.com/doi/10.1111/2041-210X.12752/full

Plant Identification- Lady Bird Johnson Wildflower Center
Native Plant Database, Search for native plants by scientific name, common name or family. If you are not sure what you are looking for, try the *Combination Search* or our *Recommended Species* lists.
http://www.wildflower.org/plants/search.php?search_field=penstemon&family=Acanthaceae&newsearch=true&demo=

Pollen Experts

• AASP, The Palynological Society
http://palynology.org
AASP – The Palynological society (AASP-TPS) was founded to promote the science of palynology for and in behalf of the public interest. It is a non-profit organization, to foster the spirit of scientific research among its members and others engaged in this field of science. It also aims to gather information and data on this subject that is disseminated to its members and to the general public. AASP-TPS was established as the "American Association of Stratigraphic Palynologists" following a survey conducted by Herbert Sullivan in spring of 1967. It held its first meeting on December 8, 1967 in Tulsa, Oklahoma.

• Palynology Instruction- List of courses and professors around the world
http://www.geo.arizona.edu/palynology/classes.html

• International Federation of Palynological Societies
http://www.geo.arizona.edu/palynology/ifps.html
The International Federation of Palynological Societies (IFPS) is a federation of regional, national, linguistic, and specialist palynological organizations of the world. Its goals are to advance knowledge in palynology and related subjects by promotion of international cooperationand sponsorship of regular meetings between palynologists of all countries and regions. IFPS publishes the ***WORLD DIRECTORY OF PALYNOLOGISTS*** irregularly, and ***PALYNOS*** Newsletters semiannually.

• University of Florida- Florida Museum
https://www.floridamuseum.ufl.edu/index.php/paleobotany/palynology/about/

• Northern Arizona University
https://nau.edu/research/1000-words/pollen/
The Laboratory of Paleoecology at Northern Arizona University has a state-of-the-art pollen-processing laboratory to identify and count pollen. This laboratory includes five research-grade light microscopes, two binocular microscopes, and a modern pollen reference collection of ca. 2500 specimens. In addition, the facility has all of the field equipment necessary for collecting sediment cores from lakes and wetlands, including coring platforms and coring equipment. Photo: **IDEA Lab**

Hummingbird Flowers- The best 18 plant families for natural nectar
http://www.hummingbirdsociety.org/hummingbird-flowers/
Anisacanthus- desert honeysuckle

Pollen Experts: Individuals to reconnect with.

Scott Anderson: Scott.Anderson@nau.edu
Extremely helpful, open to the idea of collaborating, would like to digitalize his pollen library but predicts it will be very expensive.

Stephen T. Jackson:jackson@uwyo.edu
Jane M. Beiswenger: jmbeis@uwyo.edu

Owen K Davis: odavis@email.arizona.edu
Chad Lambert Yost (polynologist): chadyost@email.arizona.edu (palynologist)
John M Logan (palynologist): jlogan@email.arizona.edu

Vaughn M. Bryant: vbryant@tamu.edu

Capulin Volcano National Monument Pollen Protocol

Zach Cartmell: zach_cartmell@nps.gov
Cassy Hill: Cassy_Hill@nps.gov

Syringes and glycerin jelly used. Omit phenol or any other antiseptic.

It is suggested that before the pollen samples are of immediate use, there must first be a sufficient pollen library (including native and non-native plants of the area).

First collect from flowering plants to begin building a sufficient pollen library.

1) First step to proper pollen identification is proper flower identification.
   Used the syringe with the glycerin gel. With the exposed gel on the syringe, dab the stamen of the flower. The portion of the gel with the sample can then be removed with a sterilized exacto knife and put into a properly labeled container/baggy.
   If the flower has multiple blooms, it is acceptable to remove a bloom and undergo the pollen collection process in the "lab".
   If the plant species is unknown, take a picture of the flower and the full plant in order to identify it later. If there are multiple plants, a species sample can be harvested for ID later.

2) Once pollen samples have been collected, it is time to start heat-fixing the samples on a glass slide. If gel has been cut already proceed to step 4.
3) Place the syringe sideways with the gel laying against the center of the slide and using an exacto knife slice off a few mm of the gel.
4) Using sterile forceps, position the gel where the sample side of the gel is flat down on the slide.
5) If the heat fixing process is postponed, place the cover slip on top of the gel and place the sample in the properly labeled plastic baggy. Set aside in a cool dry place.
6) With distilled water was both the exacto knife and forceps, and dry completely. Change out gloves and repeat the process with other samples.

Heat-fixing the pollen sample
1) Heat a 250 ml beaker of water on a hotplate set to 65-75 degrees Celsius/150-170 degrees Fahrenheit.
2) In order to melt the gel on the slide, place the slide over the top of the beaker.
3) Place the cover slip on top of the gel once it has melted. Be careful not to trap air bubbles.
4) Once the cover slip has been placed and is secure, the sample is ready for observation.
5) Once observed and identified, label the slide with species name, date and time of when sample was obtained.
6) Store the slide in the slide book.

It is advised to heat-fix the sample as soon as possible.

Collecting Pollen Samples from Hummingbirds

1) Take the syringe with the glycerol gel to collect the pollen that is around the bill and the head of the bird. Dab the top, sides and bottom along the full length of the bill. Do not let the sides of the gel or the syringe touch the bill. Dab on the head of the bird only where pollen is possible.
2) Repeat steps 2-6 in from previous protocol as well as the heat fixing pollen process. If pollen was visible on the bird, write the corresponding acronym/label in order to communicate the color and location of the visible pollen on the bird.
3) Set up your hot plate with a beaker of water on it.
4) Cut the gel from the syringe and place it on a clean slide. Place the slide over the beaker the beaker. Leave the gel on until it has melted. Be careful that the gel does not stay on the heat for too long as it can denature the pollen.
5) Once the gel has melted enough, place a cover slip on top and remove the slide from the heat.

Capulin Volcano National Monument staff member collecting pollen from a Black-chinned Hummingbird's bill.

Pollen Collection Used by the Rocky Mountain Biological Observatory

Nicolas Alexandre: nalexandre@berkeley.edu
Irina Chen: chenirina.2014@gmail.com

To sample pollen, we made fuchsin jelly. The pink dye allows many of the pollen surface features to be visible under a microscope. The recipe can be found here: http://tiee.esa.org/vol/v2/experiments/pollinate/pdf/pollinate.pdf. I would like to note that we did not use the phenol or gelatin from the recipe. Once the jelly was cool, we would pinch out a small piece with forceps and dab over the surface of hummingbird bills.

Once you have done your swab, you can put this in an epitube for later. Put the piece of jelly on a microscope slide and hover 4 inches above a bunsen burner fame until it has liquefied SLOWLY. You don't want to melt it too fast or too close or you will denature the pollen. You can then put a slide cover on and get to identifying.

There are a couple of problems with using this method:

1) Many types of pollen are the same shape and are thus unidentifiable. Tricolpate pollen seemed to be the most common variety of pollen. If you make a reference collection of pollen collected from flowers in the field, I'm sure you will be able to find a handful of identifiable pollen by species. We found quite a few species that were diagnostic using this method, plus it is cheap!

2) Don't rely on size of pollen to identify species as there is both variation that exists with respect to size within a species and different pollen grains may have absorbed/lost more water than others.

3) If you want to have a clearer picture of what all of the pollen is, you can do some pollen metabarcoding using the Illumina Miseq. This has finer taxonomic resolution than visual identifications, but not always. Cost is ~$20 / sample without labor, so not cheap, but in many instances better than dealing with a huge mess of pollen slides. You can multiplex 392 samples into a single Illumina run for maybe ~24 total hours of sample prep time. We are going to try this this summer and use tape to collect pollen, then wash the pollen off of the tape using ethanol or buffer.

4) If you decide to use tape, make sure to store in the fridge or freezer.

Gel Preparation of Basic Fuchsin Gelatin and Pollen Slides:
As suggested by Beattie, A. J. 1971. Pan-Pacific Entomologist 47:82.

Ingredients
- distilled water, 175 mL
- glycerin, 150 mL
- gelatin, 50 g
- crystalline basic fuchsin as desired- enough to make solution the color of a fine claret
- crystalline phenol, (Phenol is not used as it can be harmful to the hummingbird).

Steps to make jelly
1) Add gelatin to the distilled water in a beaker and heat until the gelatin dissolves.
2) Add 150mL of glycerin
3) Add phenol (usually skip this step)

4) Add basic fuchsin crystals a few at a time until the solution is the color desired. If it is too light then the pollen will not be stained, but if it is too dark the stain may mask the details of the pollen
5) Filter the solution through glass wool or cheesecloth
6) Pour into sterile containers such as petri plates. If phenol is not used, refrigerate the plates and slides. If not they will only keep about a month.

Preparation of Pollen Slides

1) Keep the prepared slides and the unused jelly out of the sun and in a cool enough place so they do not melt.
2) With a dissecting needle, cute small cubes of the jelly out of the petri plate,
3) Brush the cube of jelly against an anther containing pollen, or on an insect.
4) Place the cube containing the pollen sample on a glass slide
5) Place a cover slip on top of the cube of jelly
6) Gently heat the slide over a candle flame until the jelly melts. Do not overheat.
7) Label the glass slide (date, species sample was collected on).

Pollen Collection Protocol used at the Southeastern Arizona Bird Observatory

Sheri Williamson: sheri@sabo.org

Our protocol uses police fingerprint-lifting tape, an upgrade from the ordinary Scotch tape provided in the Nabhan/ASDM collecting kit. I lay a narrow pre-cut strip lengthwise down the bird's bill and crown, gently smooth it with a finger to ensure good adhesion to the pollen, then lift it starting at the bill end and apply it to a glass microscope slide labeled with the bird's band number and the date. We do this only on birds with visible pollen and will sample the throat and ventral surface of the bill if pollen is evident there. My collecting bias has been in favor of small but diverse samples over quantity and duplication. We have several hundred slides archived from previous seasons, waiting for someone to help us identify the pollens.

We also note on our data sheets the color and location of any visible pollen on all birds, using alpha codes for colors and numbers for location (1 = bill tip, 2 = mid-bill, 3 = bill base, 4a = forecrown, 4b = chin/throat). If we can ever get the pollen colors and locations correlated to specific flowers, it will help us understand the phenology and relative importance of the nectar resources along the San Pedro River.

Moth Pollen Collection by Atwater 2011

A simple technique to sample pollen from moths and its applications to ecological studies by Atwater 2011.
Materials needed:
-Stereo microscope (7-15x magnification)
-hot plate
-probe with fine point
-glycerin gel stained with pigment
-glass microscope slide with cover slips
-small weights
-slide warmer

Glycerin Gel with Stain
1) Add 20 g of gelatin to 70 ml boiling distilled water
2) Once thoroughly mixed, add 60 ml of glycerin and 1.2 g phenol
3) After crystals dissolve, add 22 drops of Safranin-O stain

To scan a moth for pollen, remove from the vial and pin the specimen through the thorax. Scan the specimen for pollen under a stereomicroscope. Extracting pollen from specimen. Heat the glycerin gel on a hot plate at 52 degrees C in a water bath until it has reached liquid form. Place microscope slides on a slide warmer. Locate pollen on the moth. Pour a small portion of the glycerin gel onto the microscope slide. Gently dip the probe tip into the glycerin gel. Once the pollen is adhered to the probe, transfer the pollen from the specimen to the microscope slide into the drop of glycerin gel. Cover the drop with a cover slip, add a small weight on top. Prepare a label for the microscope slide. Allow the slide to rest on the slide warmer long enough to enable the gel to stain the pollen, at least 24 hours. Seal the edge of the coverslip with clear fingernail polish.
Identifying pollen:
Pollen key, Pollen and spores, Kapp et al. 2000 or a pollen identification manual, Allergy pollen keys with images Jelks 2001, and/or matching pollen with pollen sample extracted from a properly identified plant. Creating a pollen library with the plants in the area of study is not only beneficial for identifying pollen found on the moths, but can also be preserved in a local palynology library as a resource for future resources.

Pollen analyses for pollination research, unacetolyzed pollen –Gretchen D. Jones
Collecting pollen internally and externally
For best results use slides that have a thickness of 0.93-1.05mm.
18mm square cover slip easily fits onto a 15X75 mm glass slide so that the slide can be labeled and the covers slip sealed to the slide.
Cover slips should be a 1 or 1.5 with a thickness of between 0.13 to 0.19mm. Thinner cover slips are more fragile and make crack more easily.

Glycerol Jelly Mounting Media for Pollen According to Kisser

Materials	• Glycerin • Unflavored gelatin powder • Distilled water • 250 mL beaker	• 100 mL graduated cylinder • Hot plate w/magnetic stirrer w/stirbar • 1 mL syringes • Red food coloring

Step 1: Gather Equipment

Step 2: Put 10 g of gelatin powder into a 250 mL beaker

Step 3: Add 35 mL of distilled water to the gelatin

Step 4: Add 30 mL of Glycerin

Step 5: Set the beaker on a hotplate and allow the water to warm and dissolve the mixture (About 40 degrees Celsius). Place a stirbar in the mixture to stir.

Step 6: Add enough drops of red food coloring to get the mixture to turn dark red.

Step 7: After the gelatin is completely dissolved (after about 10-15 minutes) remove from the hotplate.

Step 8: Allow mixture to cool slightly.

Step 9: Use the syringes and draw 1 mL of the gelatin mixture into each of them. Do this until there is no mixture left.

Step10: Place the syringes in the refrigerator to solidify.

Helpful tip for making gel:

Use a hot plate if available and set it to the suggested heat of setting of 40 degrees celsius. We improvised and used a single burner. The heat must have been too hot and concentrated and it actually burned our mixture. It smelled terribly and we had to start over again. When we remade the mixture, we hovered the beaker and placed it on the corner vs. the center.

Pollen Collection Using CAVO's Method

Materials	• Scissors • Gel syringes • Ziploc bags • Sharpie • Camera to document flowers

Step 1: Gather Equipment
Make sure to cut the tip of your syringes so that the gel is exposed to the pollen evenly.

Step 2: Dab the stamens of the flower with the gel. Make sure to get is as centered as possible and avoid getting pollen on the edges.

Step 3: Place the syringe with pollen into a labeled baggy. The bag should be labeled with location, date, initials, plant species or description of the plant.

Step 4: If you are unfamiliar with the plant and would like to identify it later, make sure to take pictures of the flower, leaves, and overall shape of the plant.

Helpful tip for collecting pollen: *If you are in a place that allows you to collect the flowers and if there are plenty of blooms on a plant, you could also take the flower, place it in a labeled ziploc bag and collect the pollen in the lab and immediately make pollen slides from them. You may reuse syringes until you are out of gel.*

Creating Pollen Mounts

Materials	• Scissors • Gel syringes • Tweezers • Beaker full of water • Hot plate • Glass slides • Cover slips • Sharpie

Step 1: Gather Equipment

Step 2: Using sterile scissors, cut off as much of the gel that is needed to make a slide mount (only a few millimeters).

Step 3: Using sterile forceps take the piece of gel from the scissors to place on the slide.

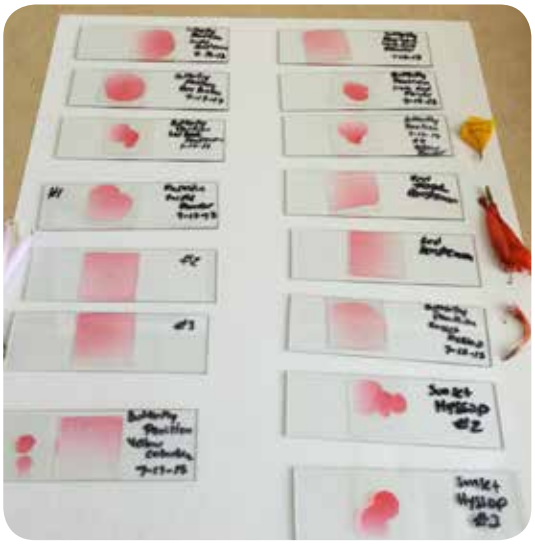
Step 4: Position the gel where the sample side of the gel is flat down on the slide.

Step 5: Have a 250 mL beaker with wtaer being heated on a hotplate to 65 - 75 degrees C or 150 - 170 degrees F. Melt the gel pollen sample taking the slide and suspend it above the hot water.

Step 6: Allow the gel to melt.

Step 7: Once the gel has been melted, remove from the beaker and place a cober slip over the melted sample. Be careful not to trap air bubbles.

Step 8: Once the cover slip has been placed and is secured, the sample is ready for observation. Make sure all slides are labeled correctly and stored away in a cool and safe place.



Helpful tip for making pollen mounts: In order to avoid air bubbles in slides, *try placing the cover slip on one end of the sample and letting it fall on the other end instead of dropping it down evenly or you can slightly press down on the corners of the cover slip for a few seconds to help fix it in place.*

Pollen Observation

Step 1: Use a light microscope to observe your slides.

Step 2: A standard microscope has 3 to 5 objective lenses that range in power. Start with the lens with the least magnification and work your way up. Be careful that the objective lens doesn't touch th slide as it could destroy the specimen

Helpful tip for observing slides:

In order to be successful in your pollen identification, make sure to create proper pollen mounts. Below is a slide with too many air bubbles.

We would like to thank the University of Colorado Museum of Natural History for allowing us to borrow their microscopes and space that helped us greatly in moving forward with this pollen project. A special thanks to Cathy L. Regan and Rebecca Coon.

Aconitum columbianum	Colombian Monkshood
Agastache urticifolia	Nettleleaf Giant Hyssop
Aquilegia caerulea	Colorado Columbine
Aquilegia canadensis	Wild Columbine
Aquilegia formosa	
Arctostaphylos patula	Greenleaf Manzanita
Arctostaphylos uva ursi	Kinnikinnick
Asclepias incarnata	Swamp Milkweed
Asclepias speciosa	Showy Milkweed
Asclepias tuberosa	Milkweed, butterfly weed
Astragalus canadensis	Canadian Milkvetch
Camassia quamash	Small Camas
Campanula rotundifolia	Bluebell Bellflower
Castilleja applegatei	Wavyleaf Indian Paintbrush
Castilleja chromosa	Desert Indian Paintbrush
Castilleja integra	Wholeleaf Indian Paintbrush
Castilleja linariifolia	Wyoming Indian Paintbrush
Castilleja miniata	Giant Red Indian Paintbrush
Castilleja rhexiifolia	Spitleaf Indian Paintbrush
Castilleja scabrida	Barneby's Indian Paintbrush
Chamerion angustifolium	Fireweed
Corydalis caseana	Sierra Fumewort
Delphinium barbeyi	Barbey's Delphinium
Delphinium glaucum	Sierra Larkspur
Delphinium nuttallianum	Nuttall's Larkspur
Delphinium scaposum	Desert Larkspur
Epilobium alpinum	Alpine Willowherb
Epilobium canum sub garrettii	Hummingbird Trumpet
Erythronium grandiflorum	Glacier Lily
Frasera speciosa	Elkweed
Gaultheria shallon	Salal
Geranium viscosissimum	Sticky Geranium
Hydrophyllum capitatum	Ballhead Waterleaf
Ipomopsis aggregata	Scarlet Gilia
Iris missouriensis	Western Blue Flag Iris
Lilium columbianum	Columbian Lily

Lilium michiganense	Michigan Lily
Lilium philadelphicum	Wood Lily
Lithospermum ruderale	Western Stoneweed
Lobelia kalmii	Kalm's Lobelia
Lonicera caerulea	Sweetberry X Honeysuckle
Lonicera involucrata	Honeysuckle
Lonicera involucrata	Twinberry Honeysuckle
Lonicera utahensis	Utah Honeysuckle
Lupinus perennis	Sundial Lupine
Lycium pallidum	Pale Desert-thorn
Mahonia aquifolium	Oregon Grape
Mahonia nervosa	Cascade Barberry
Mahonia repens	Creeping Barberry
Menziesia ferruginea	Rusty Menziesia
Mertensia oblongifolia	Oblongleaf bluebells
Mertensia paniculata	Tall Bluebells
Mimulus cardinalis	Crimson Monkeyflower
Mimulus guttatus	Seep Monkeyflower
Mimulus lewisii	Purple Monkeyflower
Mimulus ringens	Allegany Monkeyflower
Monarda fistulosa	Wild Bergamot
Monardella odoratissima	Coyotemint
Penstemon barbatus	Beardlip Penstemon
Penstemon eatonii	Firecracker Penstemon
Penstemon fruiticosus	Shrubby Penstemon
Penstemon payettensis	Payette Beardtongue
Penstemon procerus	Small-flowered Penstemon
Penstemon rostriflorus	Bridge's Penstemon
Penstemon rydbergii	Rydberg's Penstemon
Penstemon speciosus	Showy Penstemon
Penstemon strictus	Rocky Mountain Penstemon
Penstemon whippleanus	Whipple's Penstemon
Phlox longifloia	Long-leaved Phlox
Phlox multiflora	Rocky Mountain Phlox
Phlox speciosa	Showy Phlox
Phlox spp	Phlox
pomopsis aggregata ssp. formosissima	Scarlet Gilia

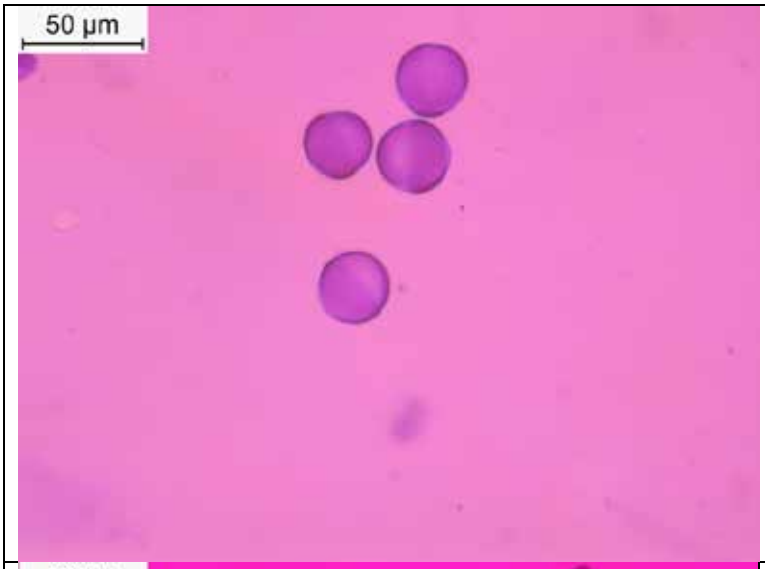
Ribes aureum	Golden Currant
Ribes cereum	Squaw Currant
Ribes inerme	Whitestem Gooseberry
Ribes montigenum	Mountain Gooseberry
Ribes sanguinium	Pink-flowered Currant
Ribes spp	Various Currants
Ribes viscosissimum	Sticky Currant
Robinia neomexicana	New Mexico Locust
Rosa woodsii	Woods' Rose
Rubus parviflorus	Thimbleberry
Rubus spectabilis	Salmonberry
Salvia dorrii	Hairy Sage
Sambucus racemosa	Red Elderberry
Symphoricarpos albus	Common Snowberry
Symphoricarpos occidentalis	
Symphoricarpos rotundifolius	Round-leaved snowberry

Plants from Colorado, Wyoming, South Dakota, Idaho, Montana, and North Dakota

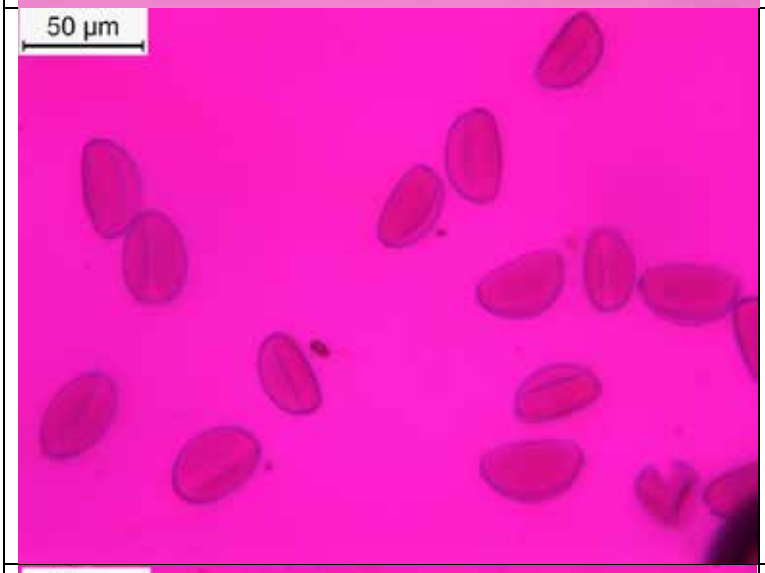
Black-chinned, Ruby-throated, Calliope, Broad-tailed, and Rufous Hummingbirds

Pollen images shared by: Nicolas Alexandre- nalexandre@berkeley.edu
Irina Chen- chenirina.2014@gmail.com

Flower images are the property of the public domain.

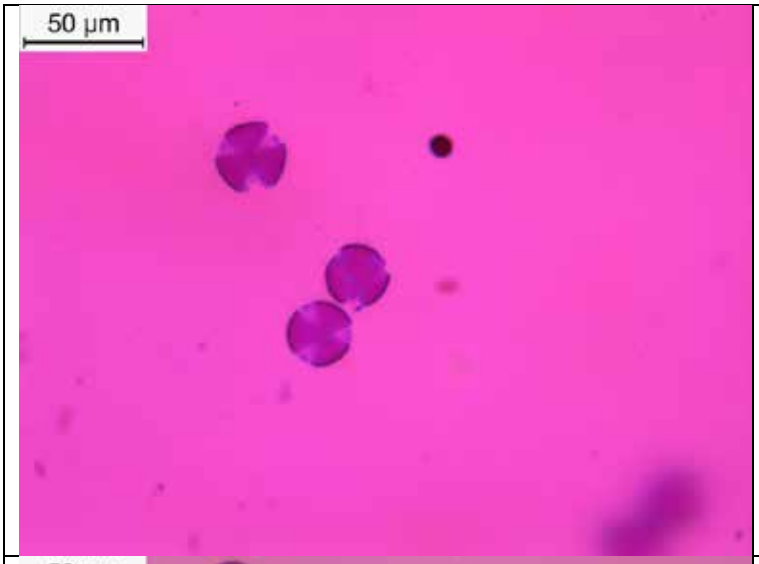


Aconitum columbianum/ Western Monkshood



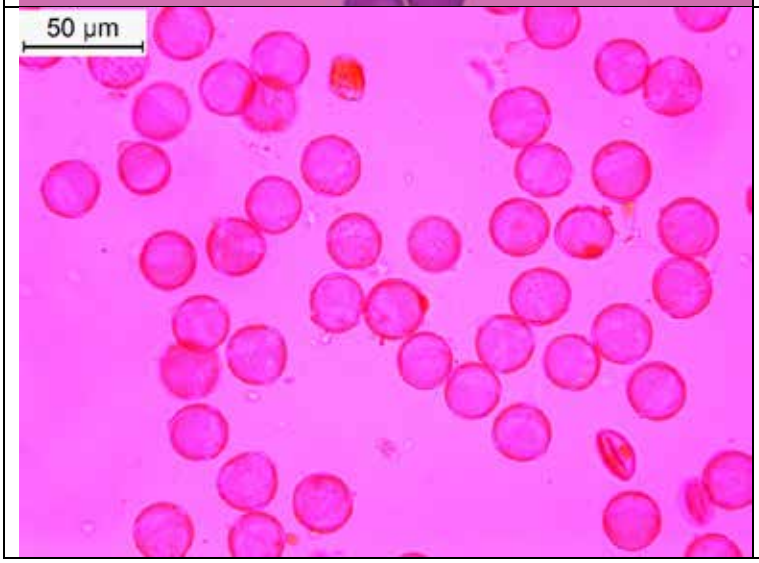
Allium geyeri/ Geyer's Onion

Apocynum cannabinum/ Indian Hemp

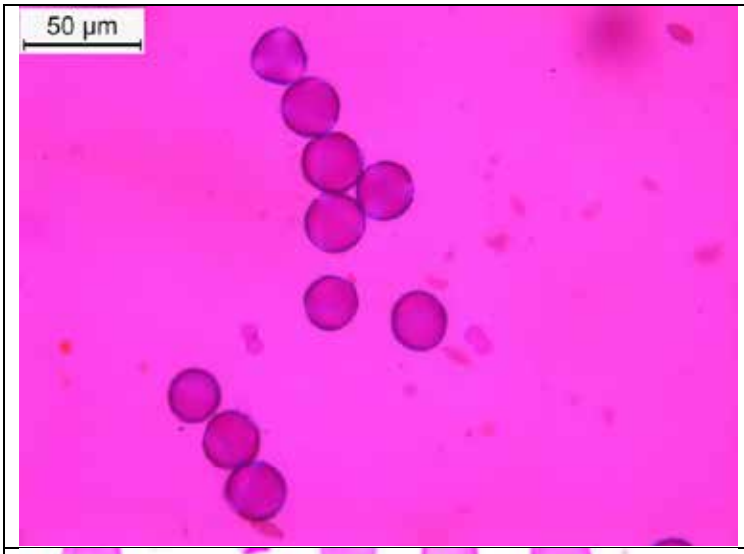


Aquilegia caerulaea.2/ Rocky Mountain Columbine- Colorado Blue Columbine

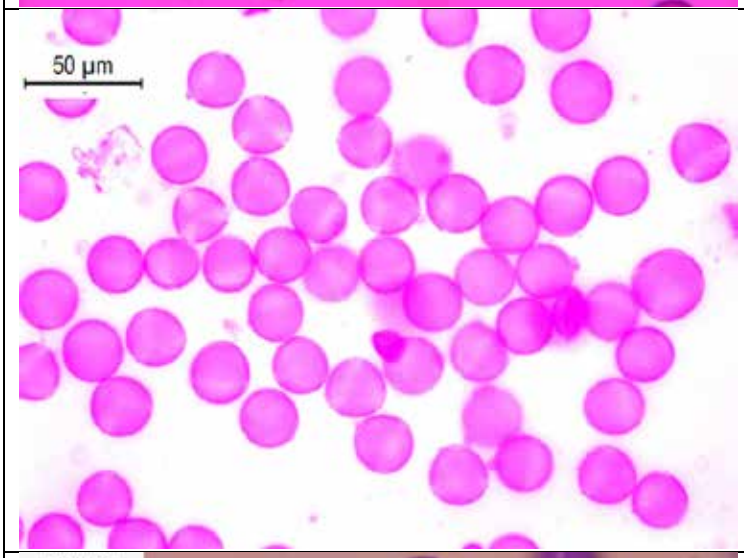
Aquilegia caerulaea



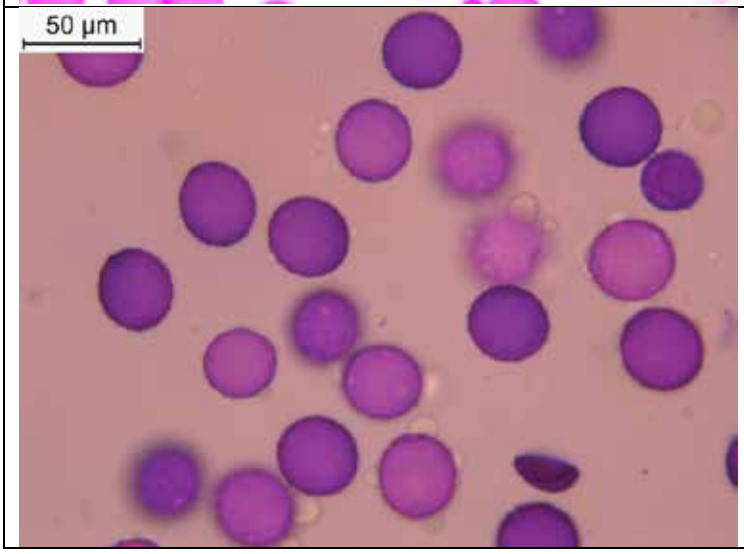
Aquilegia elegantura.2/Western Red Columbine



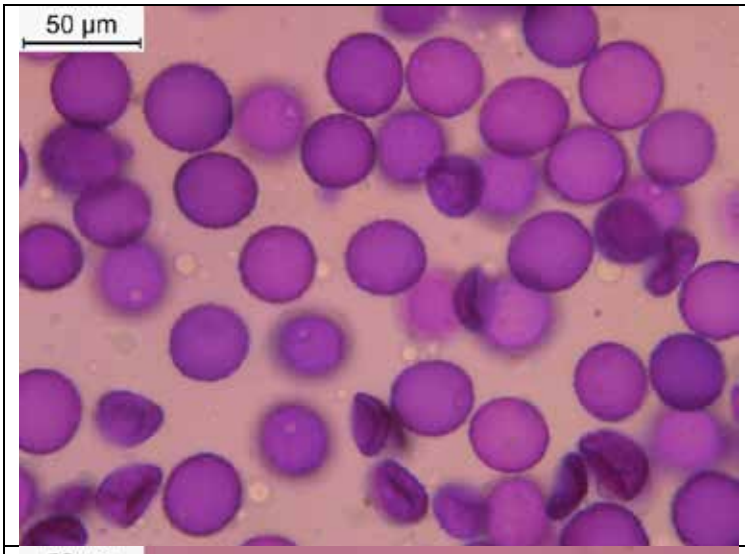
Aquilegia elegantula.3/ Western Red Columbine



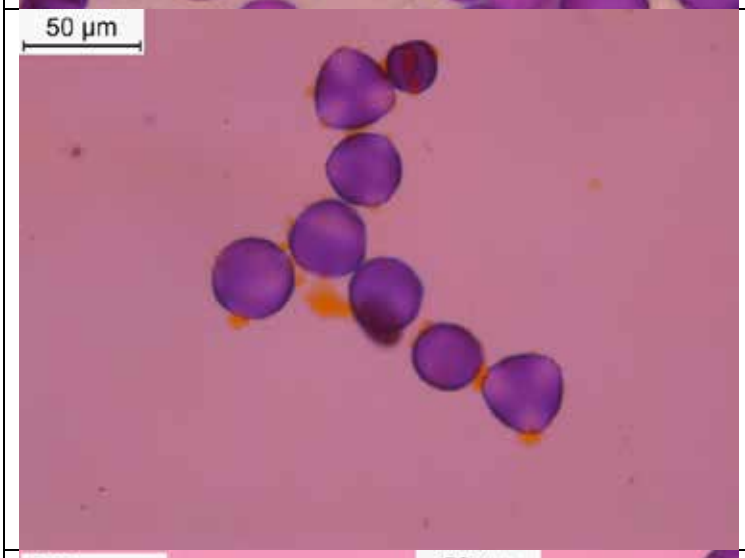
Aquilegia elegantula/ Western Red Columbine



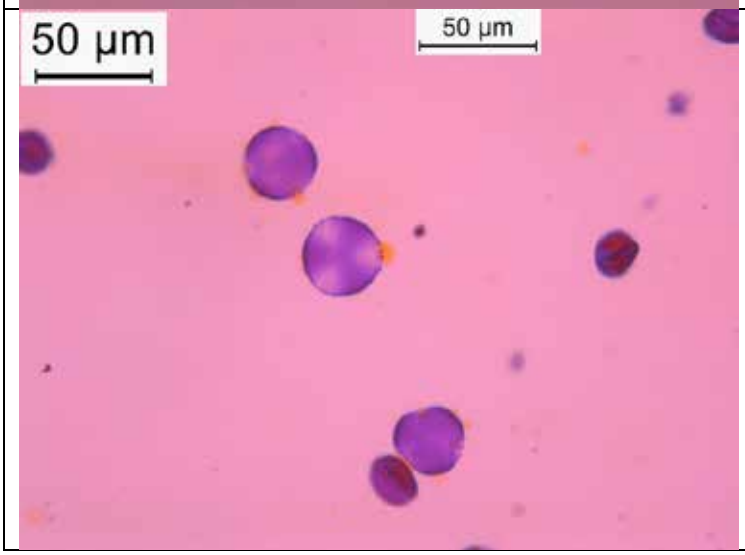
Campanula parryi.2/Parry's Bellflower



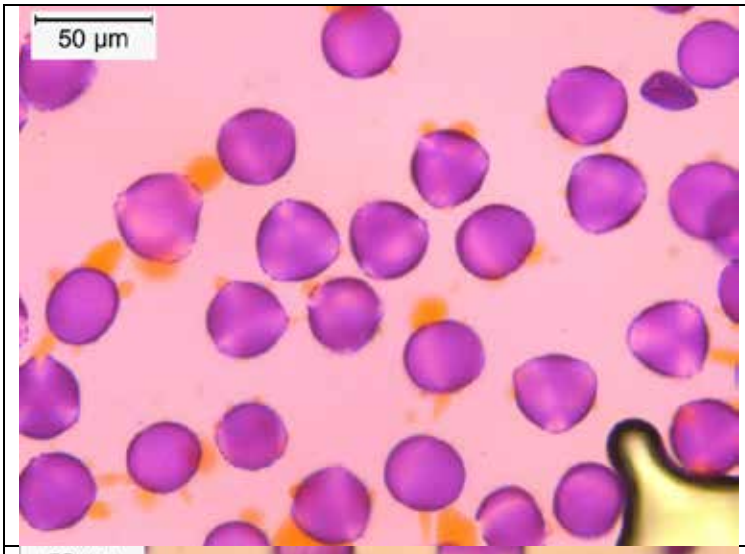
Campanula parryi/Parry's Bellflower



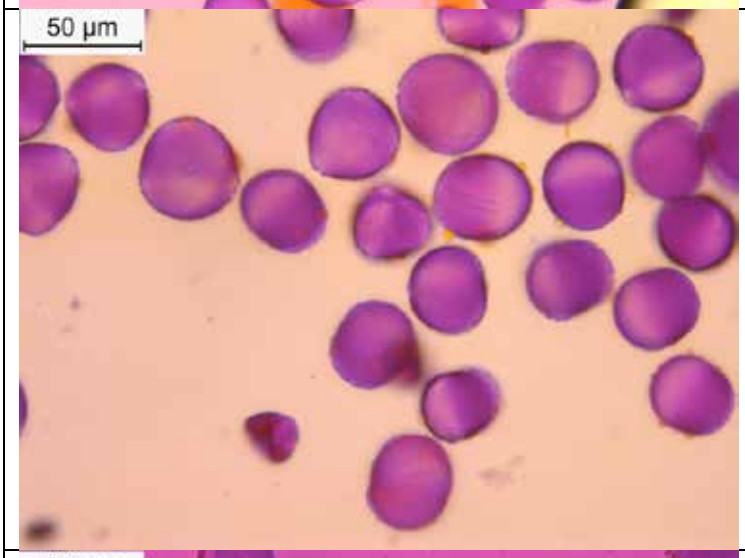
Castilleja sulphurea/ Sulphur Indian Paintbrush



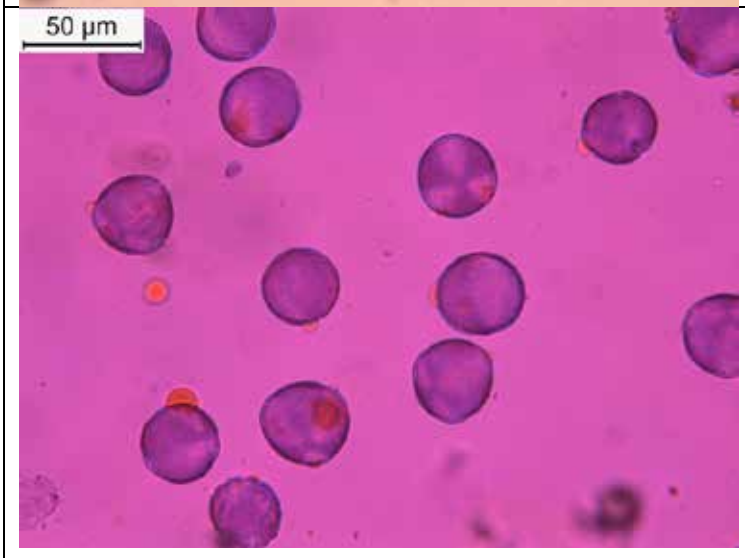
Castilleja sulphurea.2/ Sulphur Indian Paintbrush



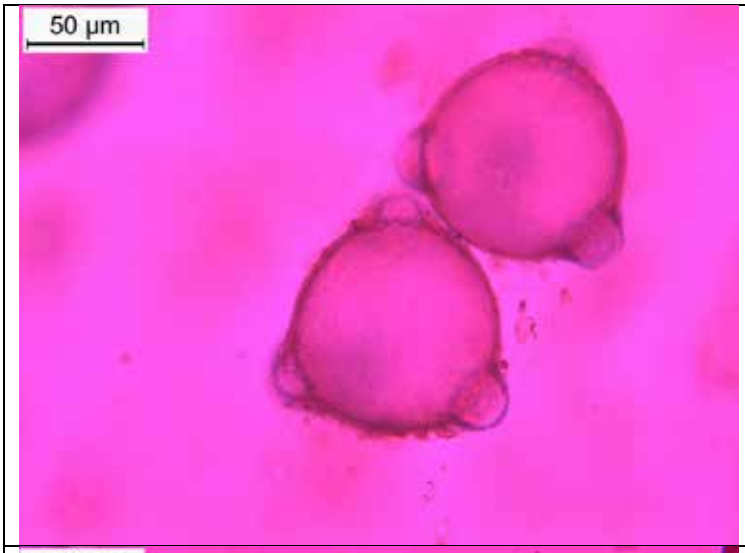
Castilleja miniata.2/Giant Red Indian Paintbrush



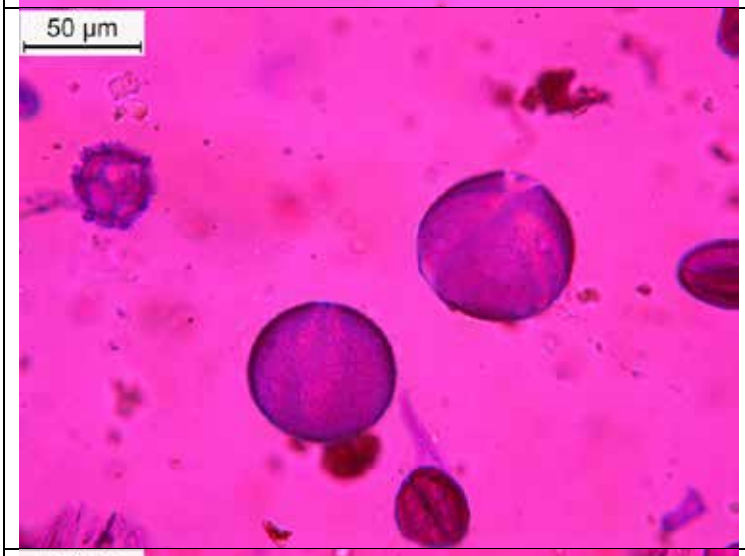
Castilleja miniata/ Giant Red Indian Paintbrush



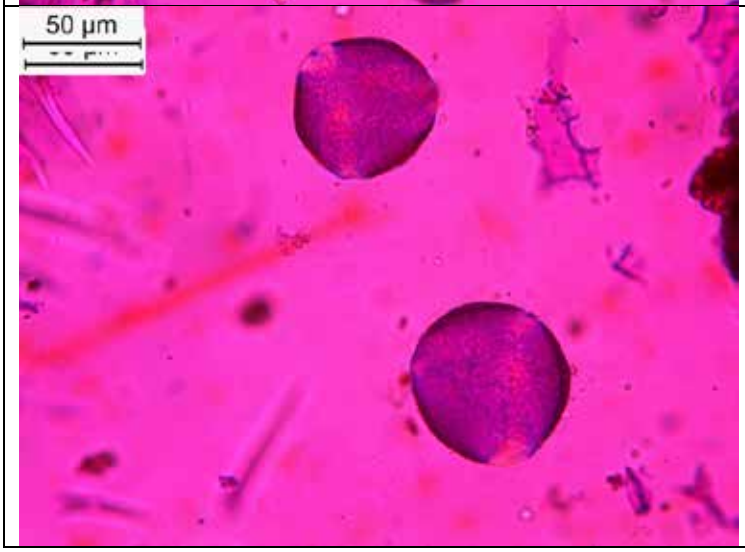
Castilleja rhexiifolia/Split Leaf Indian Paintbrush



Chamerion angustifolium/Fireweed

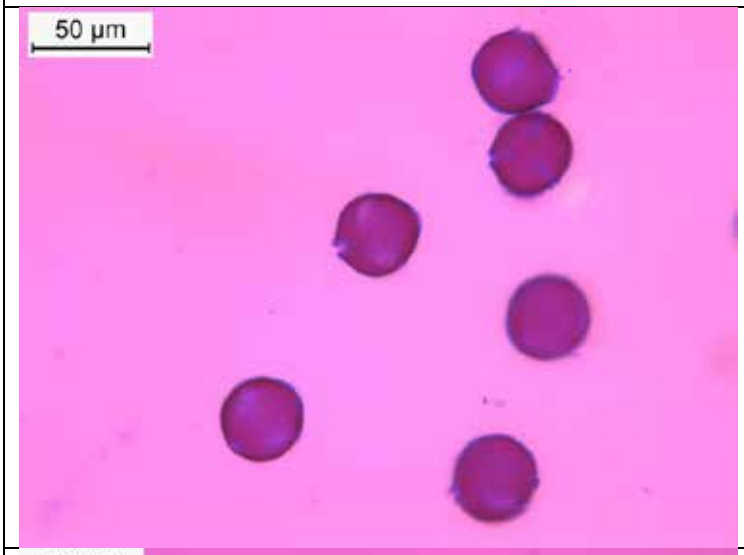


Claytonia lanceolata.2/Western Springbeauty



Claytonia lanceolata

Corydalis aurea/Golden Corydalis

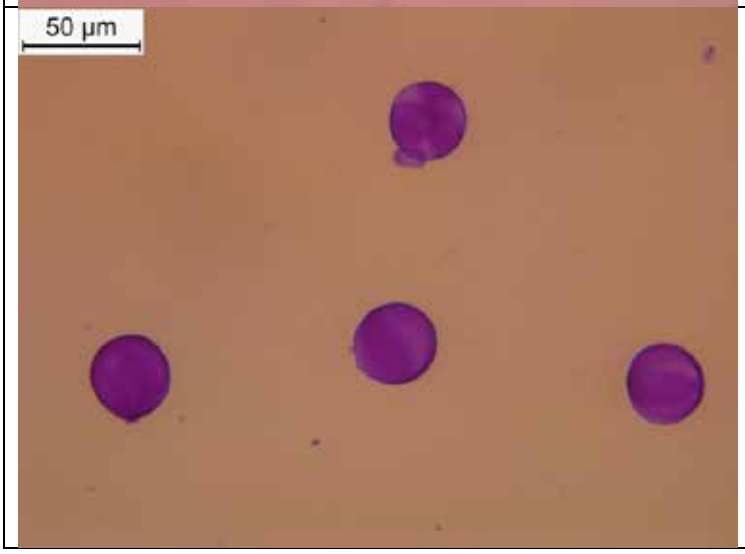


Corydalis caseana.2/Sierra Fumewort

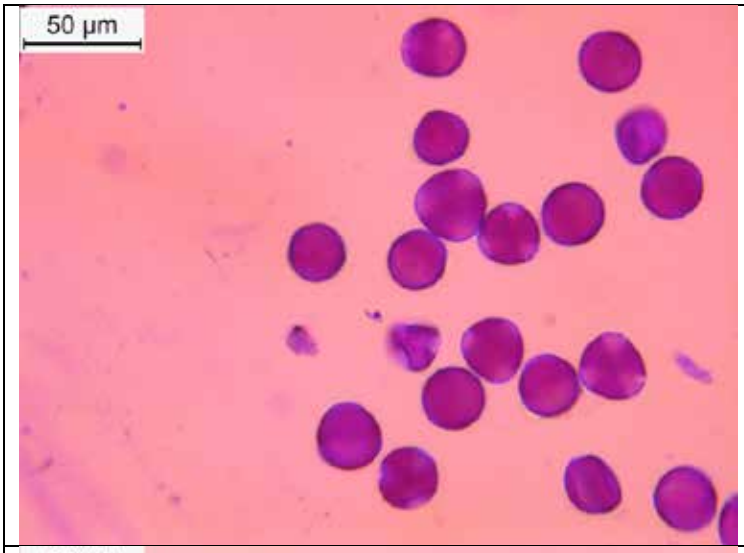
Corydalis caseana.3/Sierra Fumewort

Corydalis caseana

Delphinium barbeyi.2/Tall Larkspur

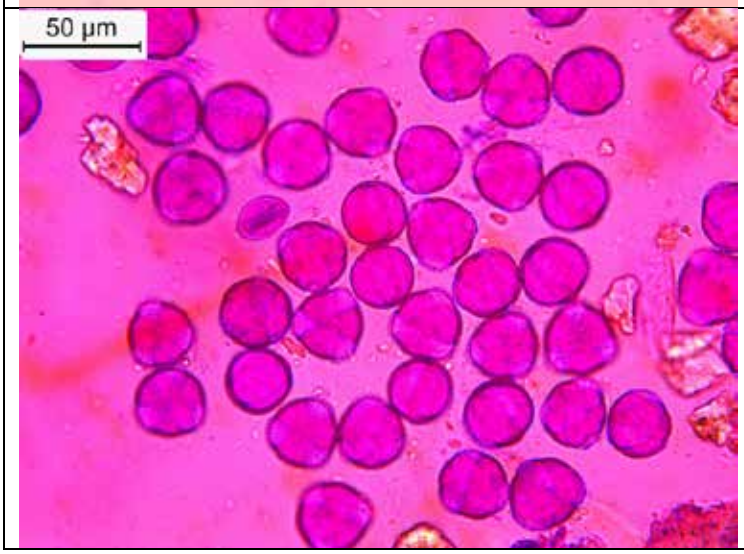


Delphinium barbeyi.3/Tall Larkspur

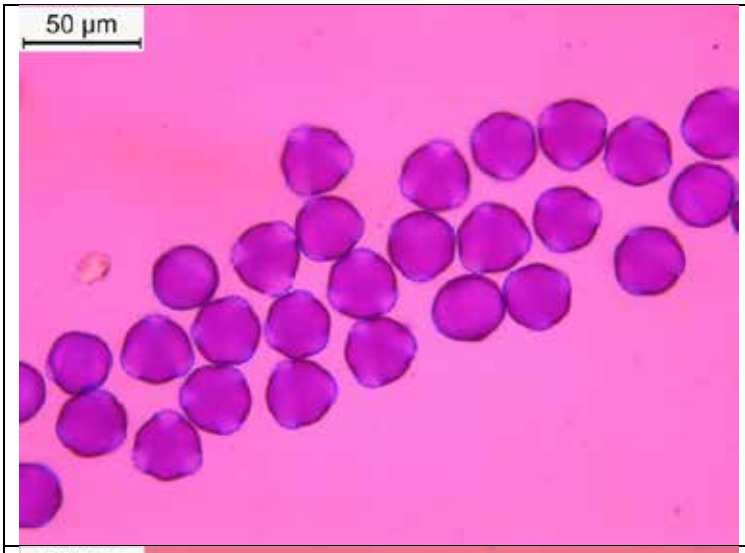


Delphinium barbeyi.4/Tall Larkspur

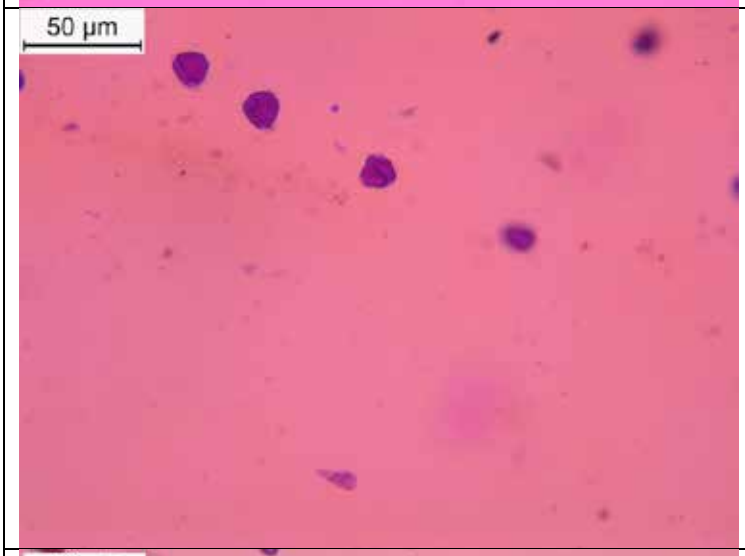
Delphinium barbeyi



Delphinium nutallianum/Nuttall's Larkspur

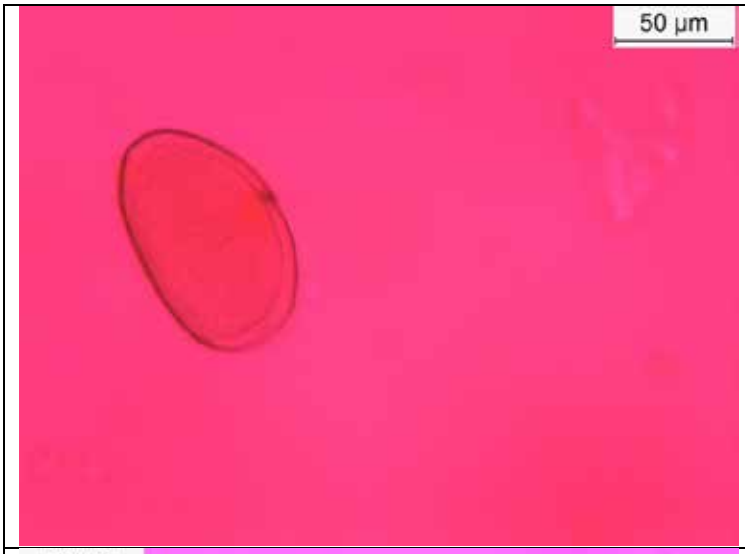


Delphinium nutallianum.2/Nuttall's Larkspur



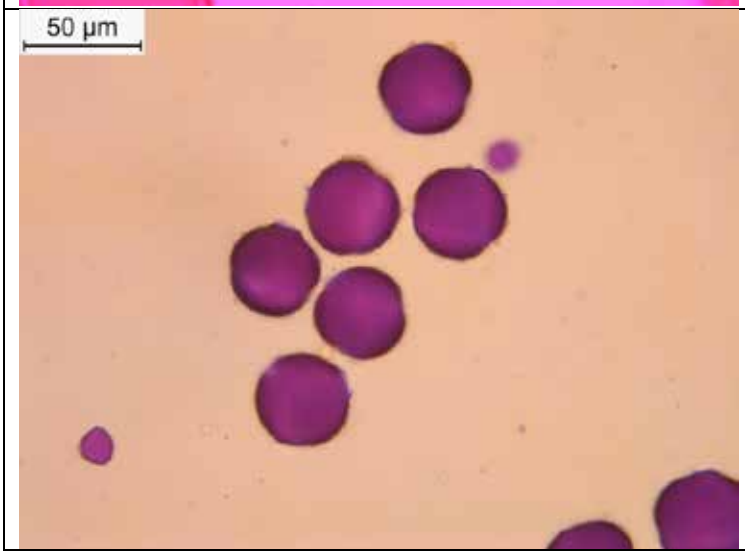
Dodecatheon pulchellum.2/Shooting Star

Dodecatheon pulchellum/Shooting Star

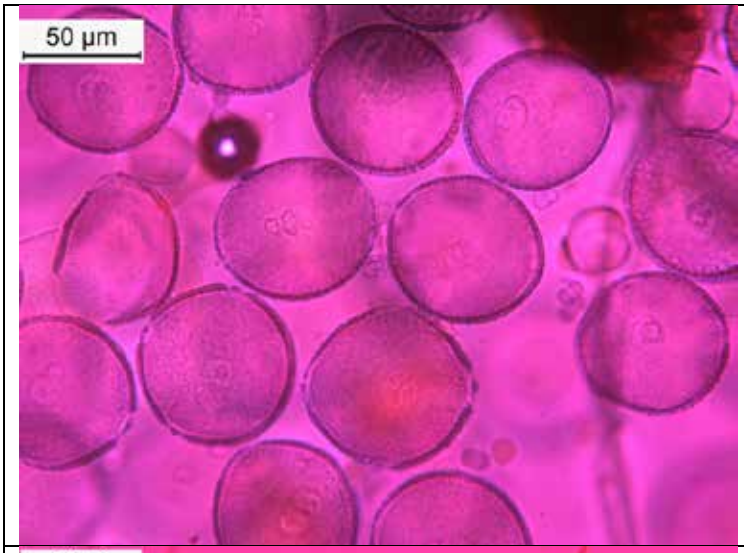
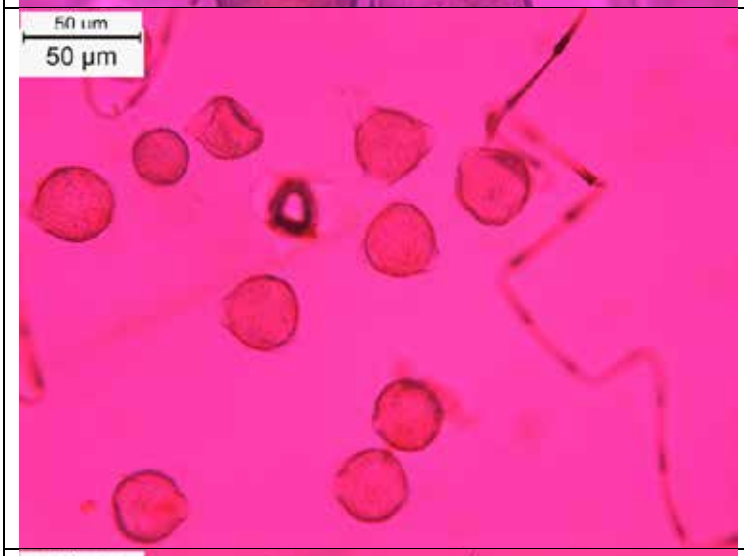


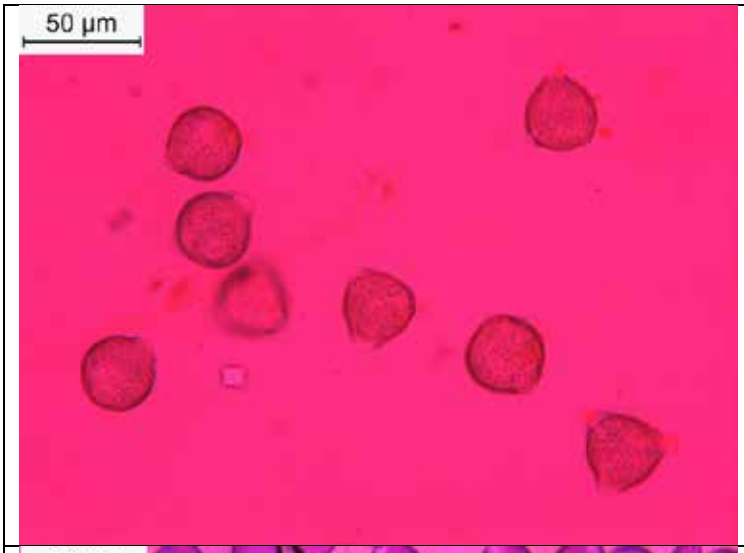
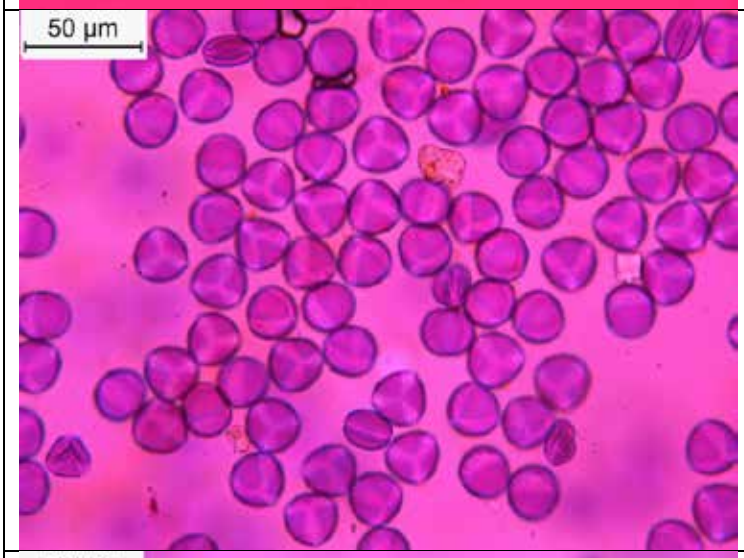
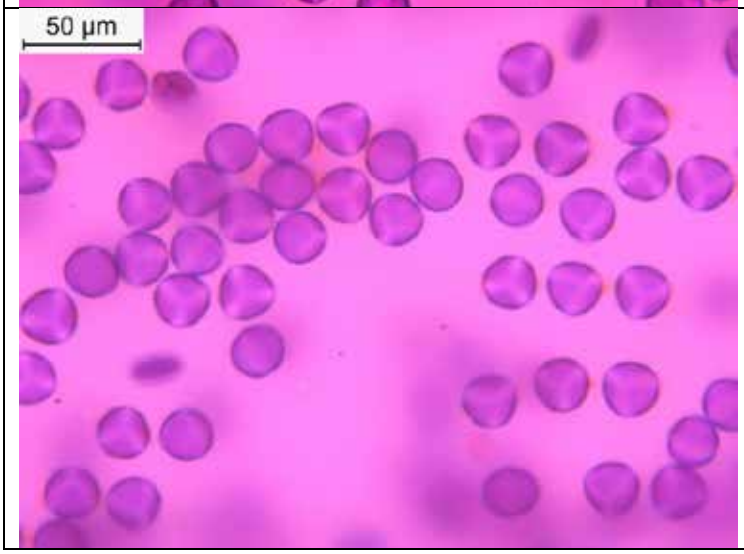
Erythronium grandiflorum.2/Glacier Lily

Erythronium grandiflorum/Glacier Lily

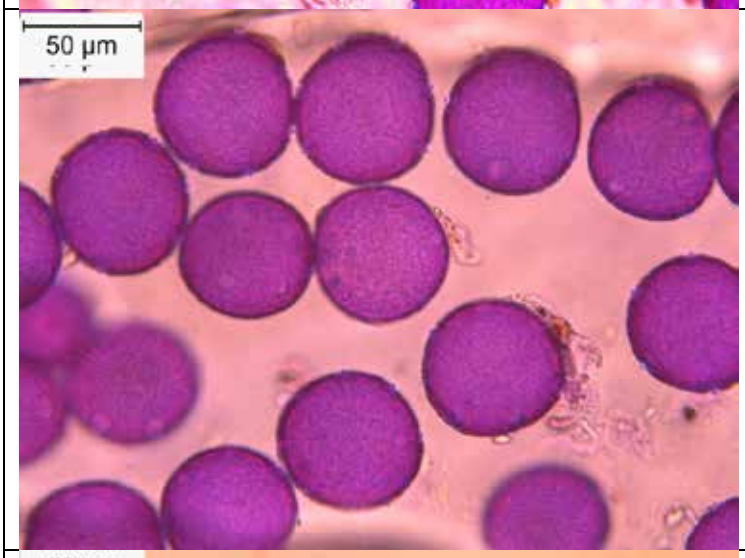


Frasera speciosa/Elkweed

	Gentianopsis crinita/Greater Fringed Gentian
	Geum.2/Avens- in the rose Family
	Geum.3

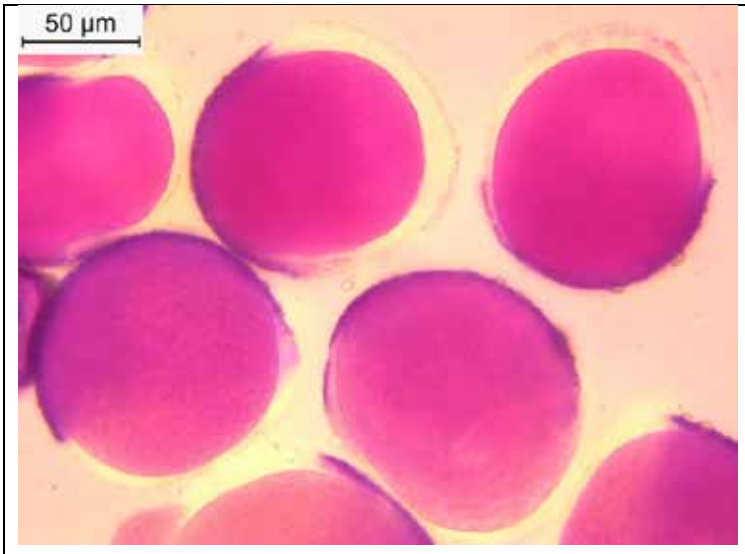
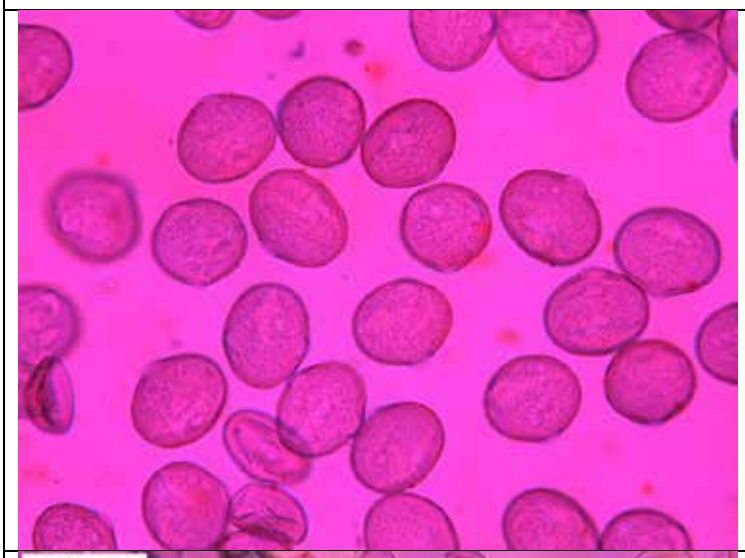
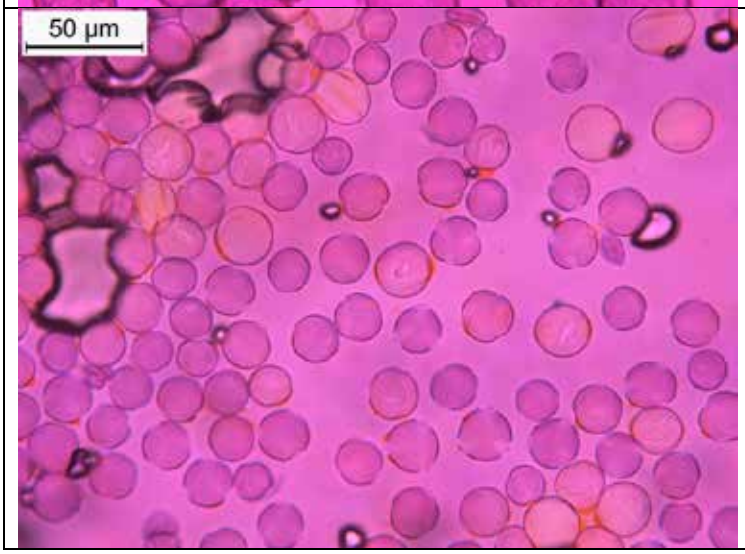
	Geum
	Hydrophyllum fendleri/Fendler's Waterleaf Image Not Available
	Hydrophyllum fendleri.2/Fendler's Waterleaf Image Not Available

Ipomopsis aggregata.2/Scarlet Gilia



Ipomopsis aggregata/Scarlet Gilia

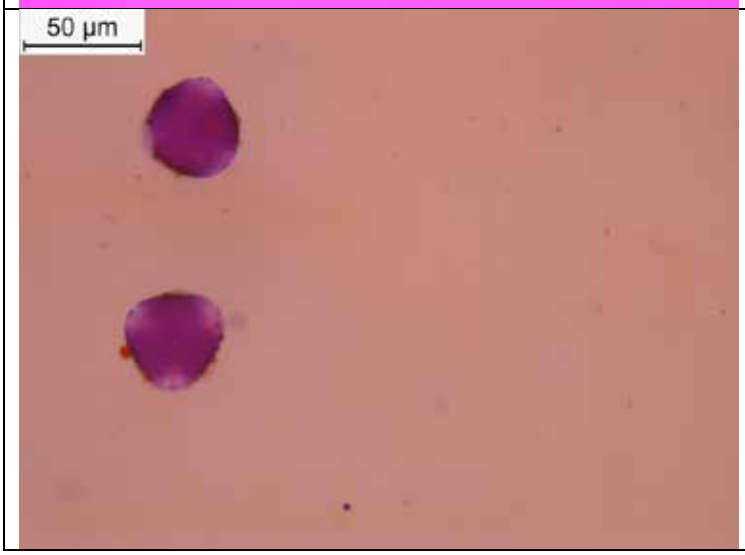
Ipomopsis tenuituba/ Slendertube Skyrocket

	Iris missouriensis/Western Blue Flag, Rocky Mountain Iris
	Lathyrus leucanthus/Aspen Pea Image Not Available
	Linaria.2

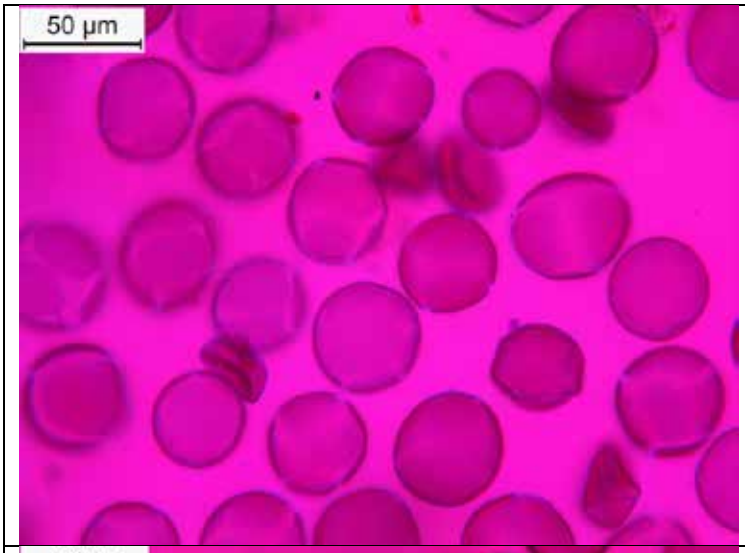
	Linaria.3
	Linaria.4
	Linaria

Linum lewisii/Wild Blue Flax

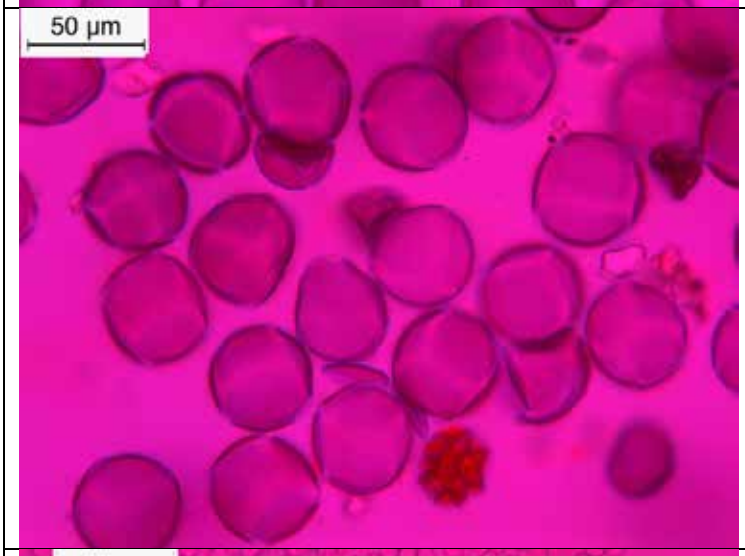
Lonicera involucrata/Twinberry Honeysuckle



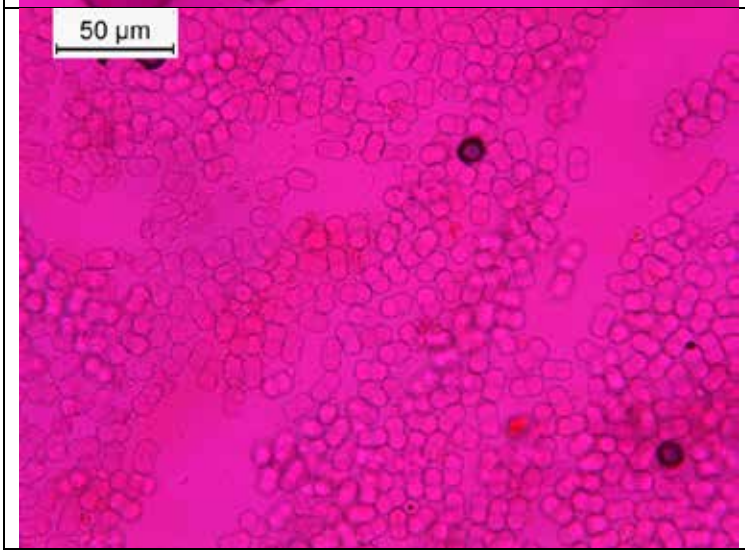
Lupinus argenteus/Silvery Lupine



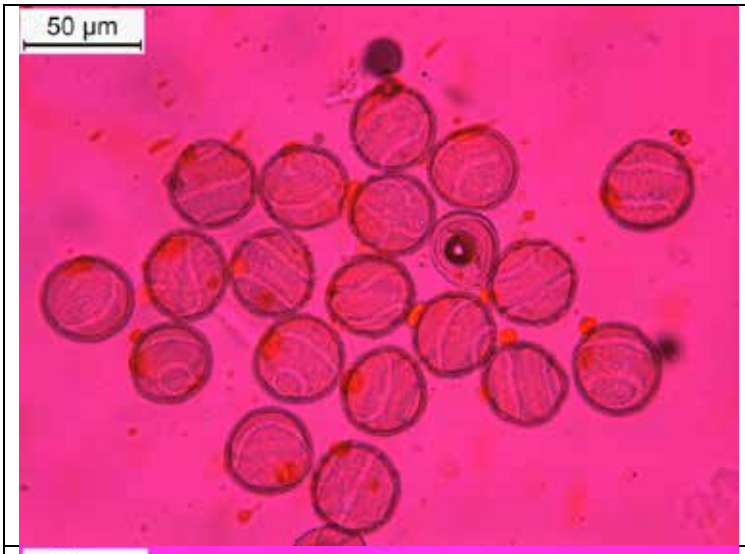
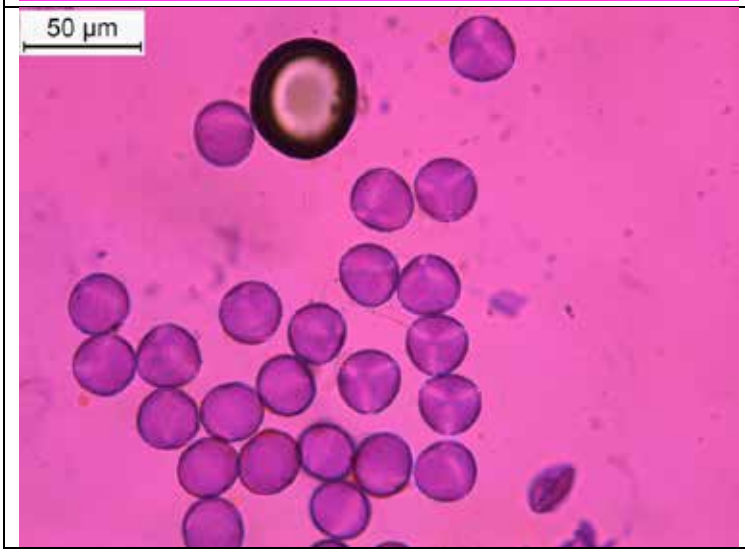
Mahonia repens.2/Creeping Oregon Grape

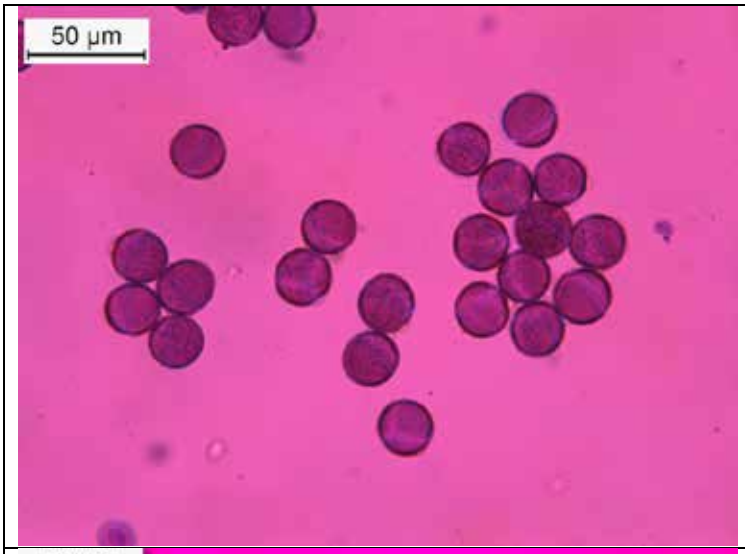


Mahonia repens/Creeping Oregon Grape

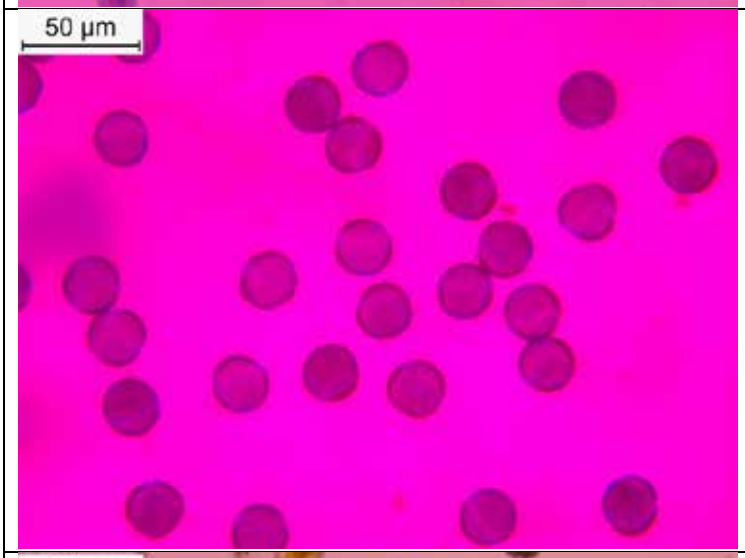


Mertensia ciliata/Mountain Bluebells

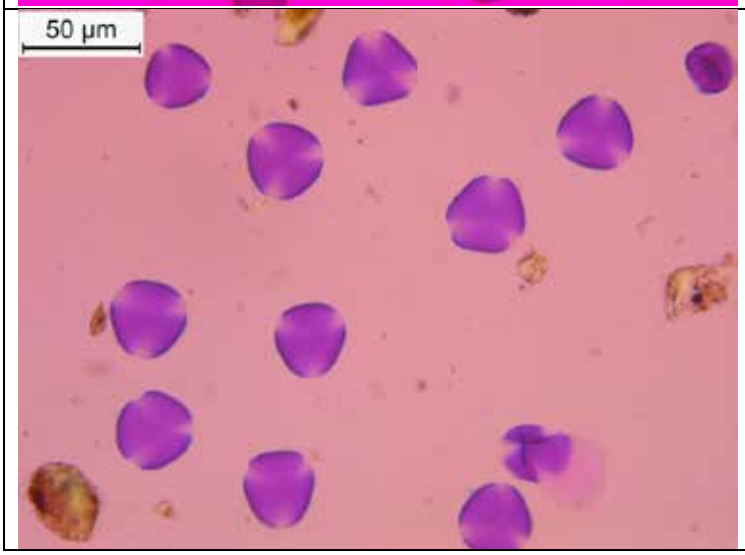
	Mimulus guttatus->Erythranthe guttata-Common Yellow Monkeyflower
	Oenothera flava/Yellow Evening Primrose
	Pedicularis bracteosa/Bracted Lousewort



Pedicularis procera.2/Giant Lousewort

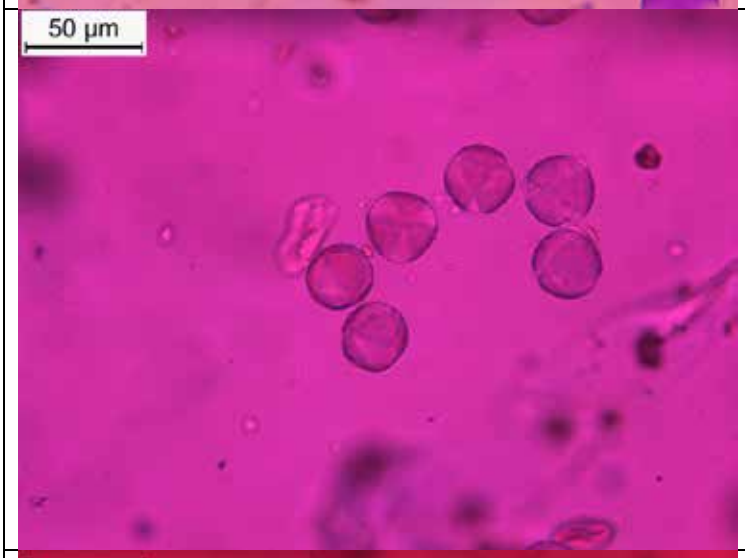


Pedicularis procera/Giant Lousewort

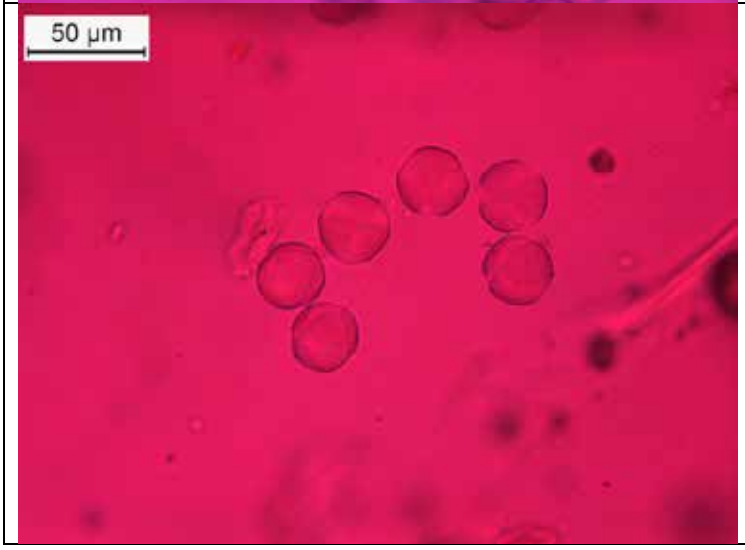


Penstemon strictus.2/Rocky Mountain Penstemon

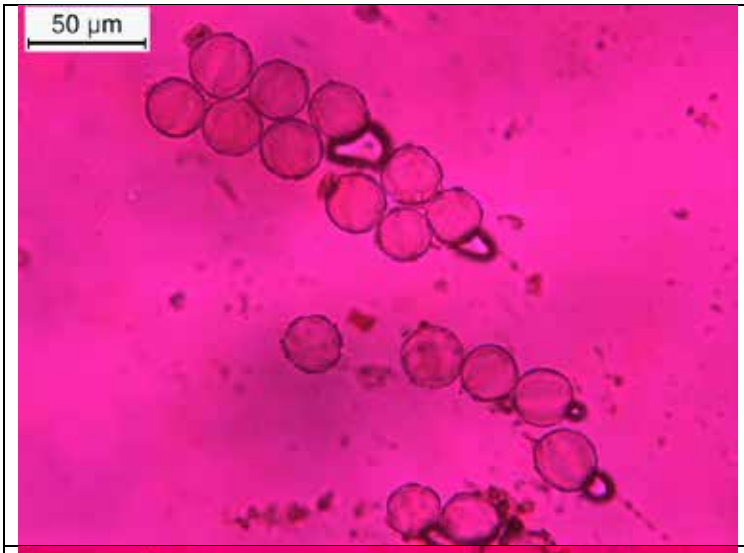
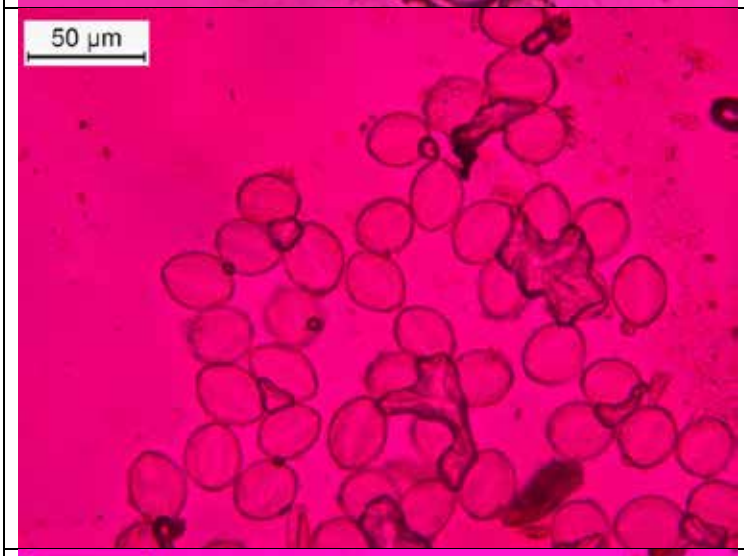
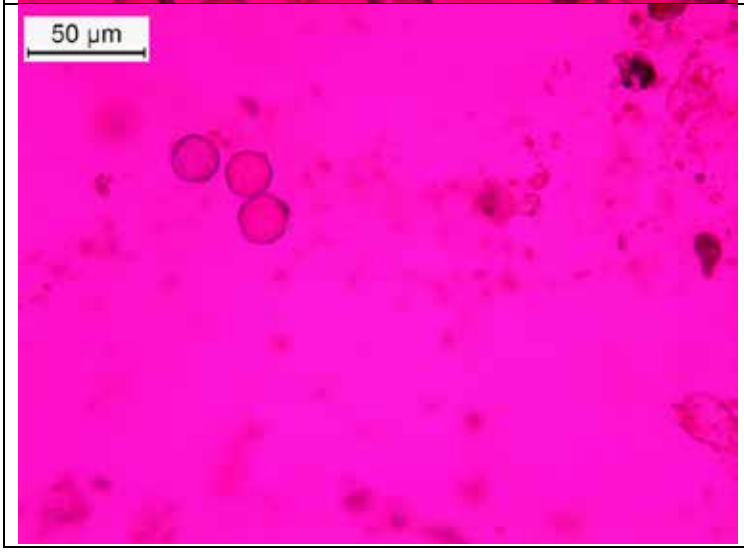
Penstemon strictus

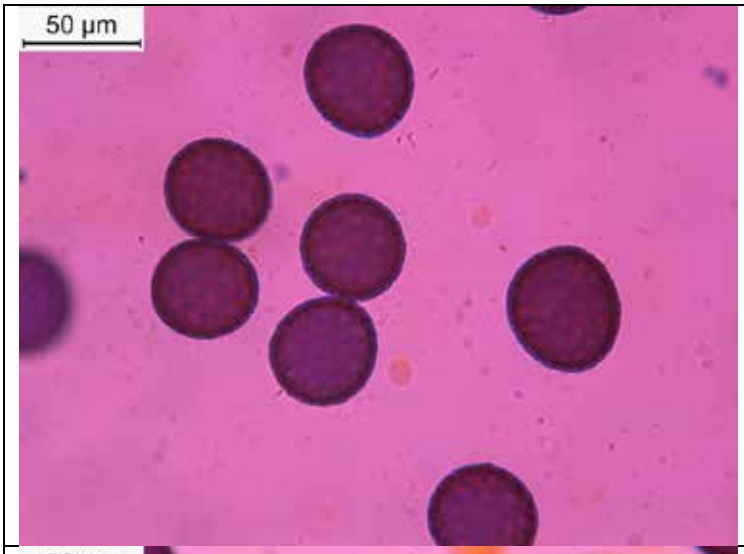
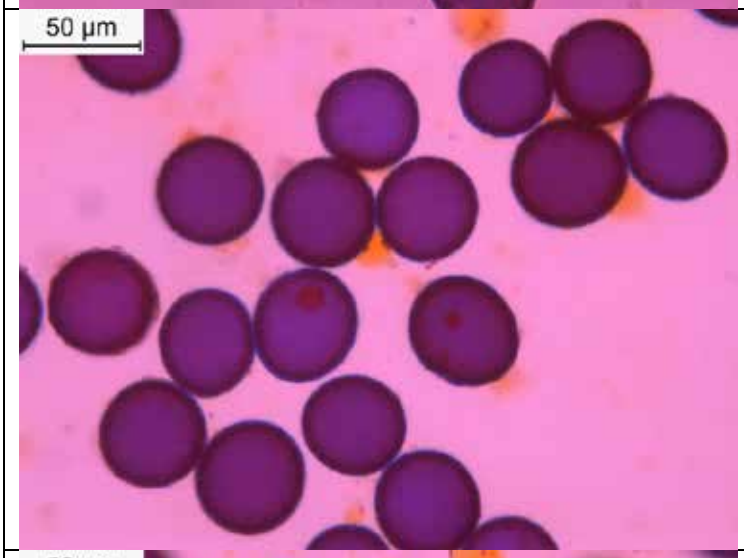
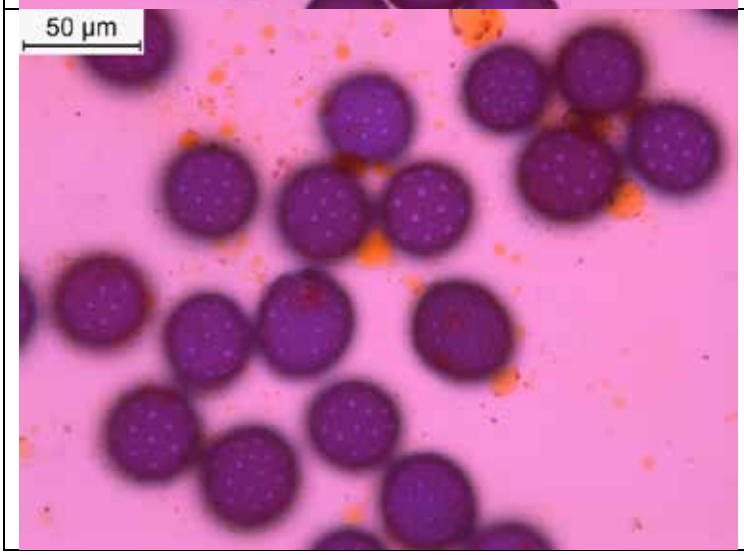


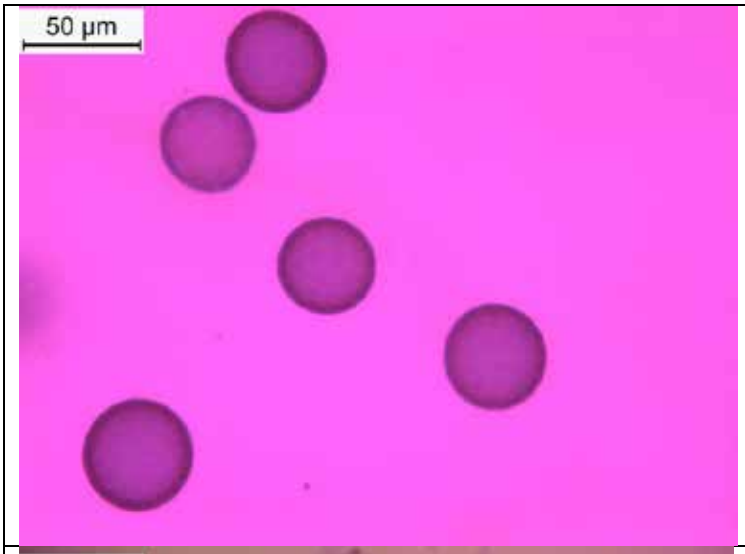
Penstemon whippleanus.2/Whipple's Penstemon



Penstemon whippleanus/Whipple's Penstemon

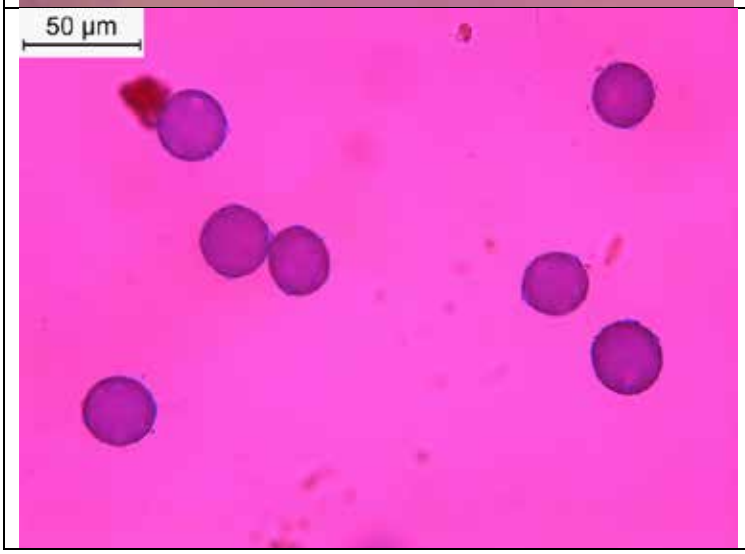
	Phacelia heterophylla.2/Varied Leaf Phacelia Image Not Available
	Phacelia heterophylla/Varied Leaf Phacella Image Not Available
	Phacelia sericea/Blue Alpine Phacelia

	Polemonium foliosissimum/Towering Jacobs Ladder
	Polemonium pulcherrinum.2/Showy Jacob's Ladder
	Polemonium pulcherrinum.3

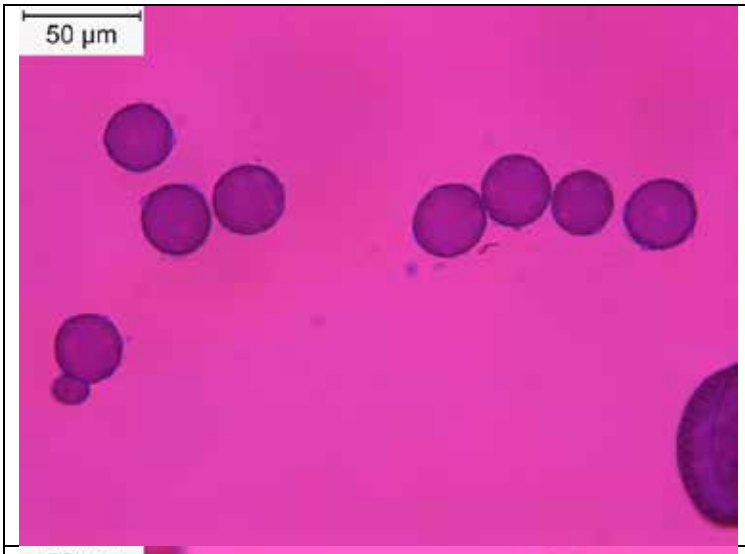


Polemonium pulcherrimum/Showy Jacob's Ladder

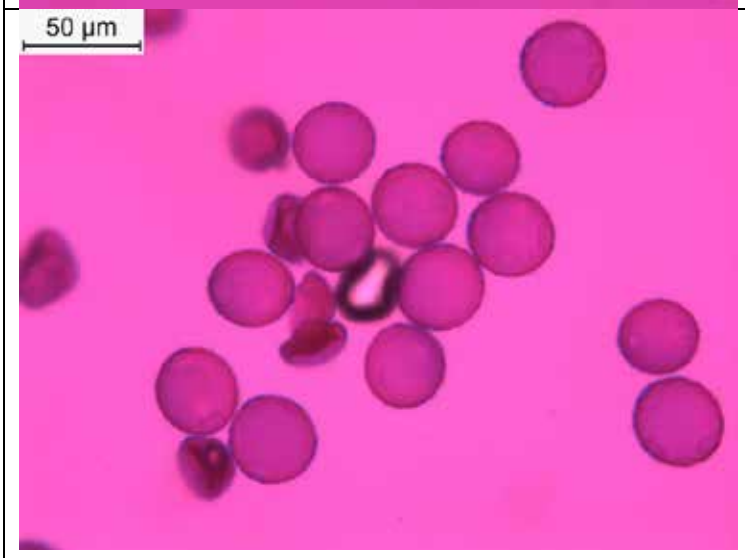
Ribes cereum/Wax Currant



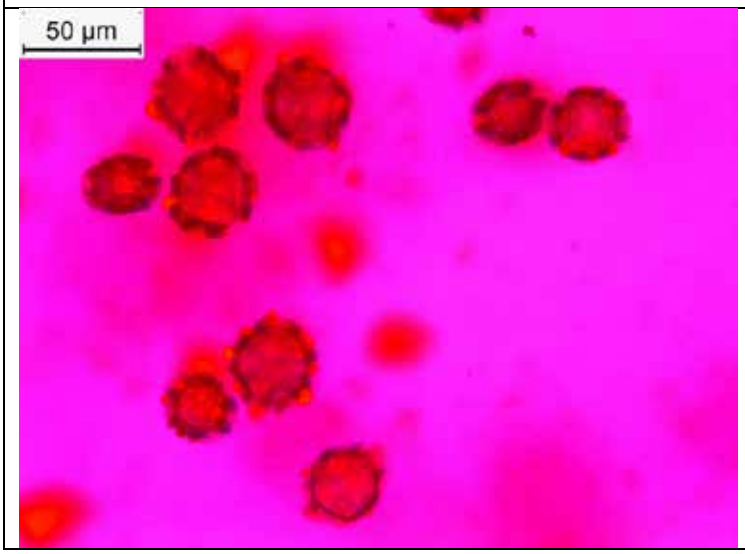
Ribes montigenum.2/Mountain Gooseberry



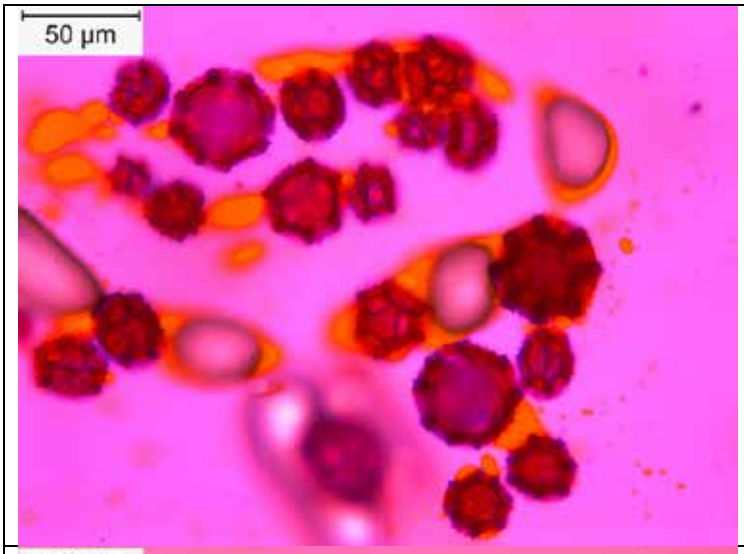
Ribes montigenum/Mountain Gooseberry



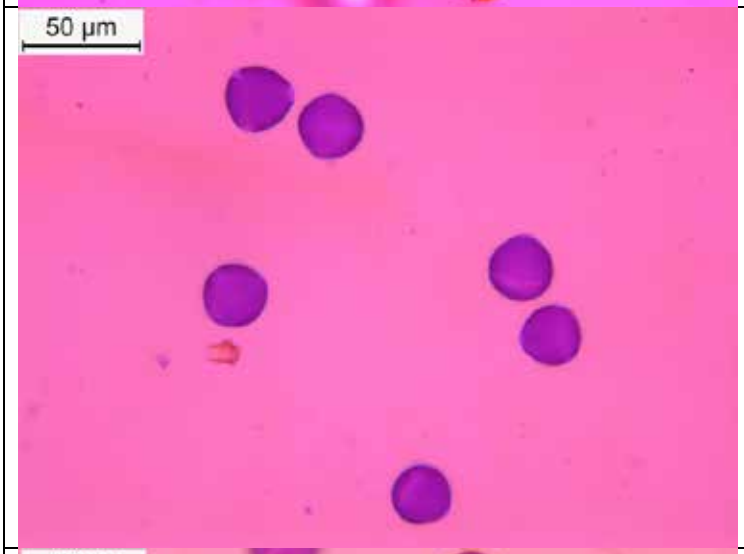
Symphoricarpos rotundifolius/Round Leaved Snowberry



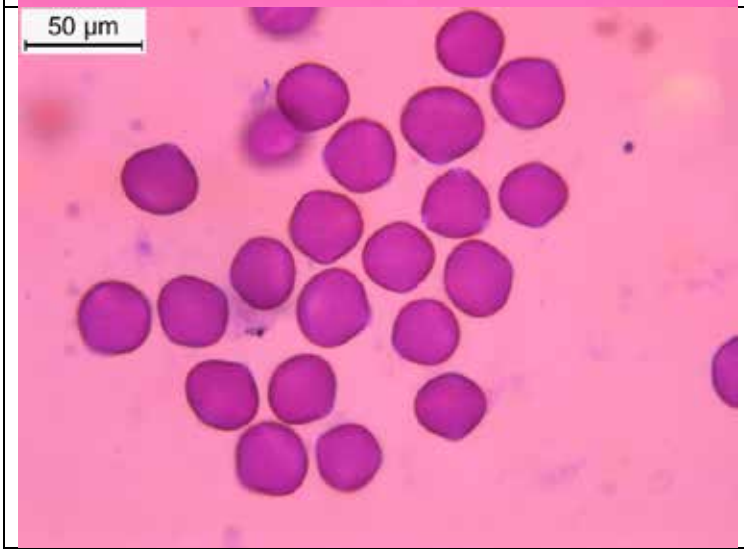
Taraxicum officinale.2/Common Dandelion



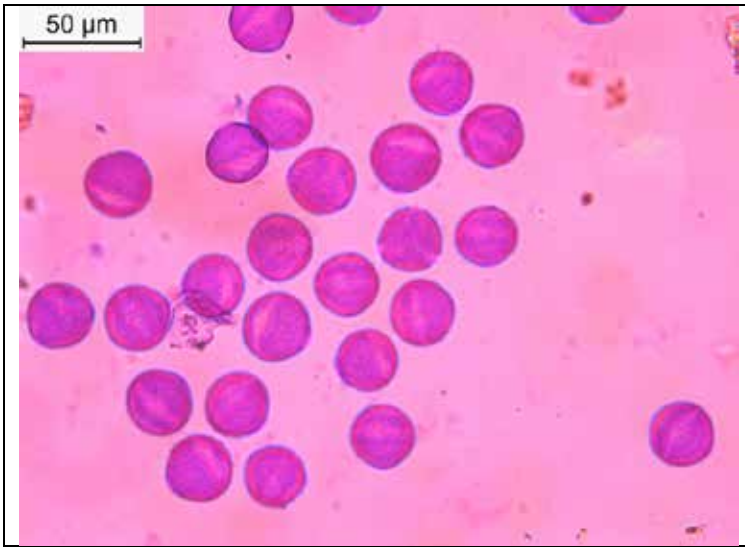
Taraxicum officinale/Common Dandelion



Trifolium repens.2/White Clover

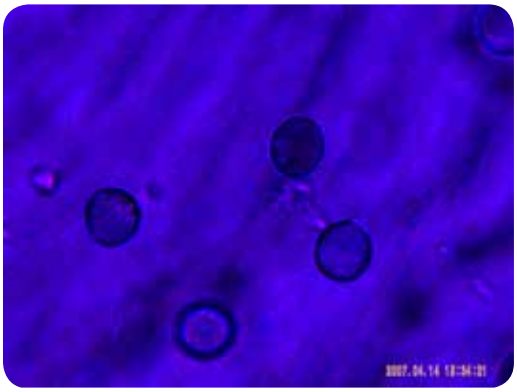


Trifolium repens.3/White Clover

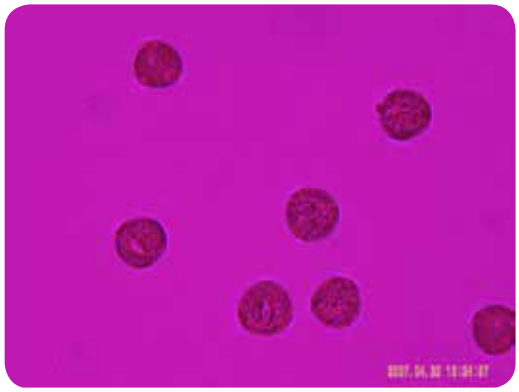


Trifolium repens/White Clover

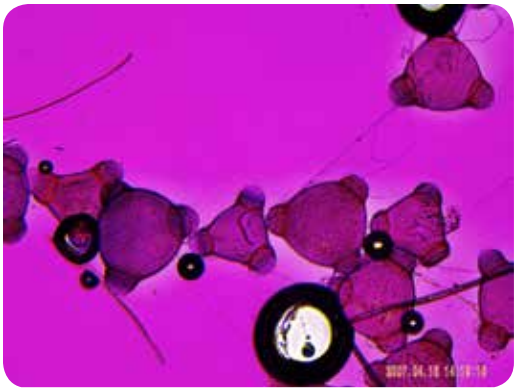
Beardlip Penstemon (Penstemon barbatus)



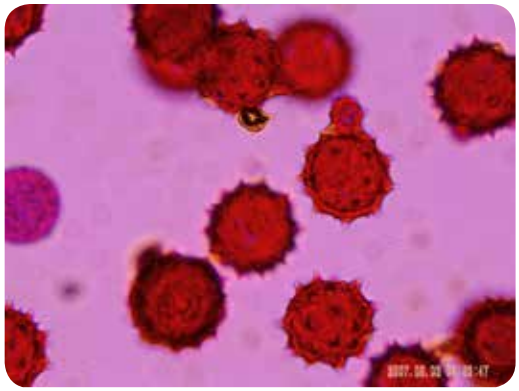
Columbine (not native to CAVO)



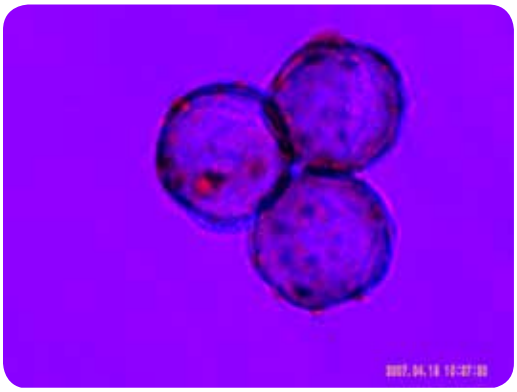
Gumbo Evening Primrose (Oenothera cespitosa)



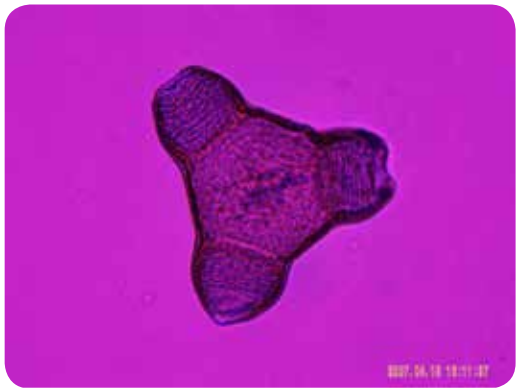
Indian Blanket (Gaillardia pulchella)



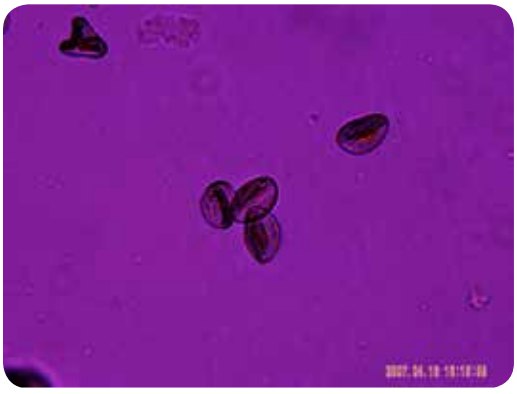
Platte Lupine (Lupinus plattensis)



Scarlet Gaura (Gaura coccinea)



Wholeleaf Indian Paintbrush (Castilleja integra)



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