CAMPUS FIELD GUIDE

Species Relationships at the University of Colorado Boulder

Joanne Marras Tate
Robert Buehler
Mathew Sharples, PhD

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STUDIO FOR THE ARTS

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TABLE OF CONTENTS

Mountainous

INTRODUCTION

Humanity has an inherent need for nature to be a part of their everyday lives. The term described by E. O. Wilson as *Biophilia* describes humanity's intrinsic desire and need to connect with nature and the natural environment. Biophilia connects "science and the humanities, biology and culture" in a "dramatic manner," asking us what exactly "binds us so closely to living things?"

Through connections with nature, emotions can be felt, and positive impacts experienced when this "Biophilia effect" is evoked through sensorial experiences of nature that can encompass different senses such as sight, sound, smell, or feel. The innate connection to, and our understanding of nature varies throughout the world. In Boulder, many different understandings of nature can be encountered today, including preservationist beliefs to extractive industries.

The University of Colorado Boulder sits upon land within the territories of the Ute, Cheyenne and Arapaho peoples, while the state of Colorado has ties to 48 different Native American tribes. Each tribe has developed different ways of existing within their environment and interacting with nature.

Our need to experience nature surpasses the pure necessity of plants and algae creating the oxygen we breathe or the reliance on plants and animals for the clothes we wear and the food we eat. The ways in which Humans use and appreciate Nature is far deeper than this, and is rooted in complex relationships which have developed over thousands of years—ranging from appreciating nature for ornamental and beautiful qualities, to our cultural connections and ancestral relationships with the organisms and the landscape, to our reliance on wild species for medicinal purposes to ease discomfort and even save lives.

Novelty and diversity are highly esteemed in nature, hence, as we develop as societies and individuals, our relationship with life becomes ever so complex. According to Wilson "our existence depends on this propensity," as "we come to understand other organisms, we will place a greater value on them, and ourselves." The biophilia hypothesis is based on the notion that humans consistently demonstrate this innate desire to spend time

with other organisms, trying to understand, interact, name and catalog every life form. This is the effort carried out here, by the NEST (Nature, Environment, Science and Technology) fellows who created this field guide. Joanne Marras Tate, Ph.D. candidate in the Department of Communication, Robert Buehler, M.F.A. candidate in Arts and Art History, and Mathew Sharples, Ph.D. from Ecology and Evolutionary Biology, have carried out a project that cataloged and researched some of the species and their relationships at the University of Colorado Boulder main campus, resulting in this field guide you are reading now.

This field guide intends to point out some of the local flora and fauna around the University of Colorado Boulder campus and the complex relationships shared between species, including us, outlining the many ways in which our worlds intertwine. The authors of this edition have compiled a number of species and their interactions, but it is hoped that this field guide will continue for many years ahead as an ongoing project. Students and guests of the University of Colorado Boulder are encouraged to continue to contribute to the guide to create a living document, gradually growing it to include more species, their interactions, importance, and impacts on us.

As the three fellows walked around campus identifying species and thinking about the different relationships they hold, there were several things discussed and noticed that need to be highlighted about species on campus. This includes water usage and the current decline in biodiversity. You will notice that in this field guide, we highlight native and nonnative species. In particular, we take a closer look at the flora on campus. The University of Colorado Boulder is located in what is considered a semi-arid grassland climate and biome, hence, many plants on campus are able to survive because of the irrigation systems that supply the necessary water for nonnative species to thrive. This is one important aspect of having a campus field guide: the infrastructure in place, and the hands of those who care and choose the species planted make a difference in what survives on campus.

Along with observations of campus plant composition, we also noticed—or failed to notice—many insects. We expected to see an abundance of insects during the spring and summer, but that was not the case. We did not conduct formal surveys, but based on observations, we would like to highlight here the importance of insects for ecosystems, and make note that our campus may be representative of a broader decline

in insect abundance generally. This trend follows many studies that have been conducted around the world documenting the decline of insects. A study published in 2017, carried out over a period of 27 years by Hallman and colleagues, estimated an average seasonal decline of flying insect biomass of 76% in Germany. We do not mean to correlate our observations with this study, but want to highlight how significant it is to be paying attention to our local environments. Flying insects facilitate the bulk of flowering plant pollination worldwide, and the bulk of our food supply diversity depends on such pollination events.

During our surveys, we encountered many different species, but the place where we observed more biodiversity is the area around Varsity Pond (Area "1" on the map), on the west side of campus. In this area, we observed many of the bird species, all of the aquatic flora and fauna, as well as all of the insects highlighted in this field guide. In order to better guide the reader, we selected a section of the main campus and highlighted them in the map so that you can search for and find some of the species we discuss in the field guide within one accessible area.

Having the possibility of making this field guide not only allowed the collaborators to increase their knowledge about the campus biodiversity, it also brought together an array of views, perspectives, and epistemologies. Arts, Communication studies, and Science/Natural History came together to create this piece of literature. It is imperative that more projects like this be encouraged and promoted, in order to not only create bridges between disciplines, but more importantly to increase the scope for public engagement and understanding of biodiversity and our interdependence.

The University of Colorado Boulder has a rich history of carrying out biological surveys and creating field guides, such as *Colorado Flora*. More recently, new developments in applications and online field guides, described as *New Generation field guides*, have been increasingly used to identify species and contribute to databases (i.e. iNaturalist), and the University of Colorado Museum of Natural History has been on the frontlines of digitizing *all* plant specimens known from the greater Southern Rockies ecoregion (www.soroherbaria.org/portal).

The collaborative effort of this field guide comes from NEST grant programs seeking to encourage students and community members to create and construct projects that

bridge disciplines. We merge in this project arts, science and humanities in order to bring forward an innovative field guide that highlights relationships and species interactions, moving beyond individual descriptions of species and thinking about the different ways we relate to them. We construct social meaning based on the local understandings of life at the University of Colorado Boulder, and from different perspectives, with hopes that this field guide will spark interest and knowledge about species on campus and beyond—serving as just a small survey sample of what lives on campus.

You will notice throughout the field guide explicit language choices. We want to highlight the importance of nature from a perspective that gives value to what Robin Wall Kimmerer describes as the "grammar of animacy," in which nature is not a "thing" but an agent, both a noun and a verb. She says: "*It* robs a person of selfhood and kinship, reducing a person to a mere thing. So it is that in Potawatomi and most other indigenous languages, we use the same words to address the living world as we use for our family. Because they are our family." Another aspect of this field guide is our explicit choice to use nonbinary language to describe the animals and plants.

We organized the field guide by species habitat, relationships—noticing that many of them overlap—and where they are most likely seen on campus, while also factoring in what species are more likely to be noticed across a longer portion of Colorado's quite short "growing season". The height of flowering and other biological activity on campus ranges from May to August, when most students are not on campus. However, we have made an effort to include as many species as possible whose presence should be noticeable in April, September, and sometimes even colder months. We acknowledge the small scope this field guide has on representing the biodiversity of the University of Colorado Boulder main campus and Boulder more broadly, and acknowledge the small representation of indigenous knowledge described; hence, we tried our best to make the organization of species as comprehensible as possible in this first edition and hope that you will help us continue this project.

ACKNOWLEDGMENTS

We would like to thank NEST Studio for the Arts for the opportunity to make this project possible through a NEST fellowship grant, including Tara Knight, Erin Espelie, Jorge Perez-Gallego and Joanne Guillery. We would also like to thank Vincent Aquino, the Lead Arborist for Facilities Management on Boulder's main campus for his support and institutional knowledge shared about the campus. We would also like to thank the University of Colorado Boulder Natural History Museum, Cameron Schofield, Jennifer Dillon with her graphic design expertise and knowledge, and Genevieve Belmaker at La Raza X Publishing, for their support and continuously believing in this project.

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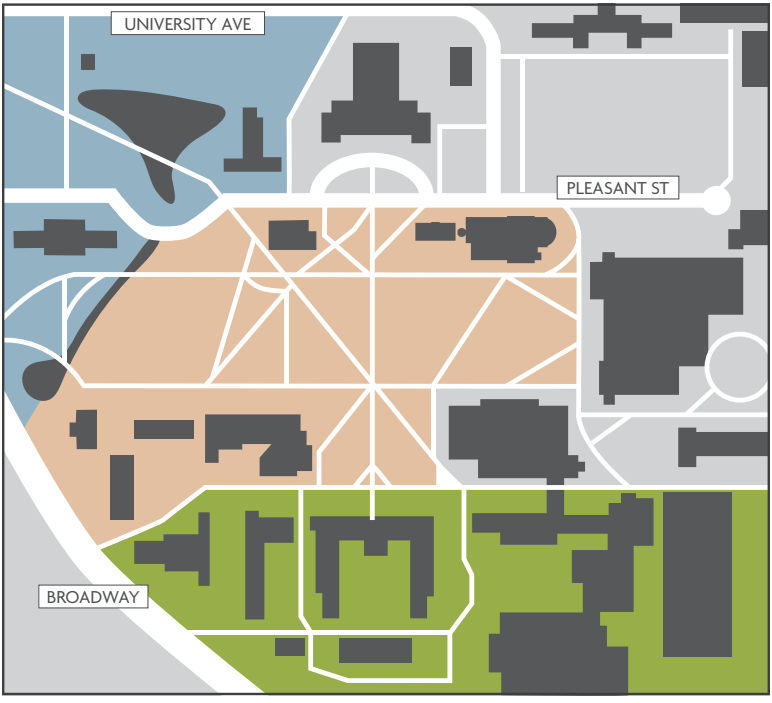
University of Colorado **Boulder**

CAMPUS MAP



- ▲ **Varsity Pond:** Aquatic species and high tree and shrub density
- **Norlin Quad:** Open grass area, many cottonwoods and conifers
- ● **High building concentration:** Urban

This is not a comprehensive map that encompasses the entire campus. This map hopes to encourage people to look for species in an accessible area of the main campus. Look for the colored shapes alongside the descriptions and illustrations that indicate where species are likely to be found, though they can and will be found in other areas.

SPECIES LIST (ALPHABETICAL)

- Aerial yellowjack (*Dolichovespula arenaria*) + Fiske Planetarium
- American painted lady (*Vanessa virginiensis*) + Fiske Planetarium
- American robin (*Turdus migratorious*)
- Amur carp (*Cyprinus rubrofuscus*)
- Bald-faced hornet (*Dolichovespula maculata*)
- Black-capped chickadee (*Poecile atricapillus*)
- Blue or prairie flax (*Linum lewisii*)
- Blue spruce (*Picea pungens*)
- Bull thistle (*Cirsium vulgare*)
- Canada goose (*Branta canadensis*)
- Chickweed starwort (*Stellaria media*)
- Chokecherry (*Prunus virginiana*)
- Colorado barberry (*Berberis fendleri*)
- Colorado blue columbine (*Aquilegia coerulea*)
- Common water strider (*Aquarius remigis*)
- Cooper's hawk (*Accipiter cooperii*)
- Crow (*Corvus brachyrhynchos*)
- Cursed buttercup (*Ranunculus sceleratus*)
- Differential grasshopper (*Melanoplus differentialis*) + Fiske Planetarium
- Eastern cottontail rabbit (*Sylvilagus floridanus*) + Fiske Planetarium
- Eastern redbud (*Cercis canadensis*)
- Eastern yellowjacket (*Vespula maculifrons*)
- Engelmann spruce (*Picea engelmannii*)
- Fox squirrel (*Sciurus niger*)
- Great Plains yucca (*Yucca glauca*) + Fiske Planetarium
- Green bottle fly (*Lucilia sericata*)
- House finch (*Haemorhous mexicanus*)

- Hoverfly (Syrphidae)
- Human (*Homo sapiens*)
- Lilac (*Syringa vulgaris*)
- Mallard duck (*Anas platyrhynchos*)
- Mountain chickadee (*Poecile gambeli*)
- Myrtle spurge (*Euphorbia myrsinites*) + Fiske Planetarium
- Northern flicker (*Colaptes auratus*)
- Oregon grape (*Mahonia aquifolium*)
- Pillbug (*Armadillidium vulgare*)
- Pin oak (*Quercus palustris*)
- Plains cottonwood (*Populus deltoides*)
- Ponderosa pine (*Pinus ponderosa*)
- Prairie thistle (*Cirsium canescens*)
- Raven (*Corvus corax*)
- Red-tailed hawk (*Buteo jamaicensis*)
- Shingled hedgehog mushroom (*Sarcodon imbricatus*)
- Small periwinkle, or creeping myrtle (*Vinca minor*)
- Turkey vulture (*Cathartes aura*)
- Wayfaring tree (*Viburnum lantana*)
- Western painted turtle (*Chrysemys picta*)
- Western wallflower (*Erysimum capitatum*) + Fiske Planetarium
- Yellow iris (*Iris pseudacorus*)

SPECIES LIST (BY AREA)

Varsity Pond

American painted lady (*Vanessa virginiensis*)
American robin (*Turdus migratorious*)
Amur carp (*Cyprinus rubrofuscus*)
Bald-faced hornet (*Dolichovespula maculata*)
Bull thistle (*Cirsium vulgare*)
Canada goose (*Branta canadensis*)
Chickweed starwort (*Stellaria media*)
Chokecherry (*Prunus virginiana*)
Common water strider (*Aquarius remigis*)
Crow (*Corvus brachyrhynchos*)
Cursed buttercup (*Ranunculus sceleratus*)
Differential grasshopper (*Melanoplus differentialis*)
Eastern cottontail rabbit (*Sylvilagus floridanus*)
Eastern redbud (*Cercis canadensis*)
Fox squirrel (*Sciurus niger*)
Human (*Homo sapiens*)
Hoverfly (Syrphidae)
Lilac (*Syringa vulgaris*)
Mallard duck (*Anas platyrhynchos*)
Oregon grape (*Mahonia repens*)
Pillbug (*Armadillidium vulgare*)
Raven (*Corvus corax*)
Shingled hedgehog mushroom (*Sarcodon imbricatus*)
Small periwinkle, or creeping myrtle (*Vinca minor*)
Wayfaring tree (*Viburnum lantana*)
Western painted turtle (*Chrysemys picta*)
Western wallflower (*Erysimum capitatum*)
Yellow iris (*Iris pseudacorus*)

Norlin Quad

Aerial yellowjacket (*Dolichovespula arenaria*)
Bald-faced hornet (*Dolichovespula maculata*)
Black-capped chickadee (*Poecile atricapillus*)
Blue spruce (*Picea pungens*)
Chickweed starwort (*Stellaria media*)
Colorado barberry (*Berberis fendleri*)
Crow (*Corvus brachyrhynchos*)
Eastern cottontail rabbit (*Sylvilagus floridanus*)
Eastern yellowjacket (*Vespula maculifrons*)
Engelmann spruce (*Picea engelmannii*)
Fox squirrel (*Sciurus niger*)
Green bottle fly (*Lucilia sericata*)
House finch (*Haemorhous mexicanus*)
Human (*Homo sapiens*)
Mountain chickadee (*Poecile gambeli*)
Northern flicker (*Colaptes auratus*)
Oregon grape (*Mahonia aquifolium*)
Pin oak (*Quercus palustris*)
Plains cottonwood (*Populus deltoides*)
Ponderosa pine (*Pinus ponderosa*)
Prairie thistle (*Cirsium canescens*)
Raven (*Corvus corax*)
Small periwinkle, or creeping myrtle (*Vinca minor*)
Wayfaring tree (*Viburnum lantana*)

High building concentration

Blue or prairie flax (*Linum lewisii*)
Blue spruce (*Picea pungens*)
Chickweed starwort (*Stellaria media*)
Colorado blue columbine (*Aquilegia coerulea*)
Crow (*Corvus brachyrhynchos*)
Differential grasshopper (*Melanoplus differentialis*)
Eastern cottontail rabbit (*Sylvilagus floridanus*)

Fox squirrel (*Sciurus niger*)
Human (*Homo sapiens*)
Prairie thistle (*Cirsium canescens*)
Raven (*Corvus corax*)
Small periwinkle, or creeping myrtle (*Vinca minor*)
Wayfaring tree (*Viburnum lantana*) (all)

△ □ ○ **Sky**

Cooper's hawk (*Accipiter cooperii*)
Red-tailed hawk (*Buteo jamaicensis*)
Turkey vulture (*Cathartes aura*)

△ □ ○ **Fiske Planetarium**

American painted lady (*Vanessa virginiensis*)
Differential grasshopper (*Melanoplus differentialis*)
Eastern cottontail rabbit (*Sylvilagus floridanus*)
Great Plains yucca (*Yucca glauca*)
Myrtle spurge (*Euphorbia myrsinites*)
Western wallflower (*Erysimum capitatum*)

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High-Altitude Birds

Red-tailed hawk (*Buteo jamaicensis*), turkey vulture (*Cathartes aura*), and Cooper's hawk (*Accipiter cooperii*) are among the more common birds soaring high above ground level in Boulder County. A year-round resident in Boulder County, the red-tailed hawk primarily returns to the same nest in a cottonwood grove once per year. They range from 19–25 in (48–63 cm) in length and have up to a 4 foot wingspan. Their color ranges between individuals, from chocolate brown to nearly all white, but all share a rust red tail. Mating pairs incubate and feed the young in collaboration. These birds prey on rodents, smaller birds, snakes, and insects.

Cooper's hawks exhibit similar behavior, sharing the rearing of their young and brooding once per year. They are seen most often in the spring and fall because populations found in this area are mostly migratory. They are becoming increasingly common in urban areas throughout Boulder, feeding primarily on small birds and mammals. They have a long rounded tail with black bands, a rusty breast, dark wing tips, and also have red eyes. They are 14–20 in (35–50 cm) in length, with short stubby wings that allow them to maneuver between trees while pursuing prey. They are known to ambush prey, even taking advantage of bird feeder visitors.

Unlike the red-tailed and Cooper's hawks, which are known to interact with campus wildlife, turkey vultures are almost exclusively seen soaring overhead with their impressive wingspan of up to 6 feet and an unmistakable, featherless, red head. The naked head represents an evolutionary loss of feathers there to reduce potential diseases associated with scavenging of dead animals.

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House Finch and Students

We often separate ourselves from nature through the ever-expansion of industrial society. But guess what? From a taxonomic perspective, humans are animals (*Homo sapiens*; Class Mammalia in the Primate Order) whose DNA sequences are most similar to that of chimpanzees of all living species. Our extinct relatives are richly represented in the fossil record, and these relatives have all come and gone since we last shared a common ancestor.

Humans too interact with several species on campus. Humans have adapted to live on all continents and in all climates on this planet, building structures to suit and adapt to their current environmental conditions. You will notice how structures built by the human species are used by other species and have formed the basis of novel, urban ecosystems.

The house finch (*Haemorhous mexicanus*) is a very social bird that often visits feeders offered by humans, also taking advantage of human structures. On campus, they nest at different locations. Nests are built by the females twice per year. Females have a plain brown coloration, while males showcase an orange-red face, chest, and rump. Males feed the incubating females in their nest. House finches are often observed on campus, foraging for food and sometimes engaging in partial migrations.

House finches were originally described from Mexico, hence the descriptive part (known as the "specific epithet") of its scientific name, "*mexicanus*," being native to Mexico and the southwestern United States. House finches have spread in recent human history across North America, even being introduced to Hawaii, located in the middle of the Pacific Ocean. Their introduction has consequently displaced native bird species. There are many other examples of species being introduced to different parts of the world via human migrations and commerce, and intentional addition of exotic species to control the proliferation of others has also been widespread.

House finch

Human

Oak, Fox Squirrel, and Crow

There are up to 300 species of squirrels and relatives worldwide, classified in the Sciuridae family (recently introduced to Australia by humans). Squirrels are rodents, with different species showcasing strikingly different habits, such as being ground-dwelling, flying, or tree climbing/nesting squirrels. On campus, you will usually find the fox squirrel (*Sciurus niger*). The fox squirrel is considered native to Colorado and inhabits woodlands and suburban areas. They build a drey nest, which is typically in the form of a mass of twigs high in a tree, like the pin oak (*Quercus palustris*). Pin oaks, also known as swamp Spanish oak deriving from 'palustris' (which in Latin means "of swamps"), belong to the Fagaceae, the beech and oak family. This family has been present on the continent for many millions of years, as represented by their robust fossil record here across time and space.

Acorns from a variety of oaks are considered cultural treasures and are utilized in the West for food and traditional uses. Pin oak flowers are aggregated into monoecious catkins, which means that flowers are found in dense clusters of wind-pollinated male or female flowers, thus reducing self-pollination. Partly because they are wind-pollinated (evident in part by their small drab flowers lacking petals), oaks represent a famous model system for studying interspecies hybridization in plants. Their leaves are generally broad and lobed, becoming a bronze color in the autumn and remaining on the tree deep into winter and into the next spring.

Around the base of the tree you may notice that fox squirrels conduct some hoarding or caching. This is a particular behavior that entails the storage of food in locations hidden from the sight of animals of the same or competitor species, including crows (*Corvus brachyrhynchos*) and ravens (*Corvus corax*) on campus. Fox squirrels are omnivores, foraging on a range of foods from berries to seeds to baby birds and mice. Crows also forage on a variety of foods, sometimes what the squirrel or human provides, as well as wild fruits, insects, and fish. When crows or ravens "steal," they are usually nearby and walking nonchalantly while waiting for the squirrel to bury some food. After observing, they later retrieve it and either eat it or store it at another location.

Crows are non-migratory, so you may witness them all year round. Crows are similar to the common raven, but have a smaller bill and lack shaggy throat feathers. Crows have

a squared tail and a higher-pitched call than the raven's deep, low, coarse, raspy call. Crows are probably the most recognized bird on campus, often reusing the same nest every year, where they often collect bright and shiny objects. Crows and ravens are intelligent animals that are able to mimic human voices and use tools, as well as being social animals living with large extended families with languages unto themselves. Within families, helper behavior also occurs: if a crow has not mated, they help take care of youngsters from others.

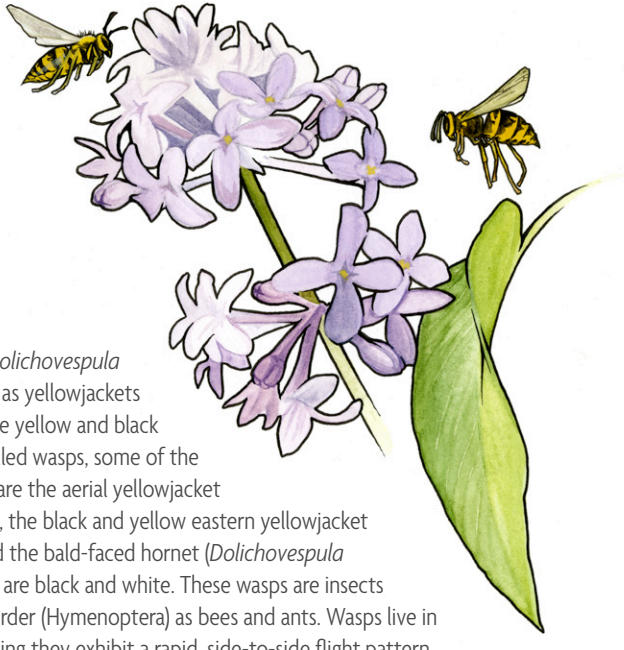
Hoverfly, Chokecherry, and Robin

Hoverflies, also known as flower flies (Syrphidae family), have considerable variation in size and appearance. Species range from 4 to 25 mm and vary in morphology from large wasp or bee mimics to small black flies. They are among the most abundant and conspicuous of all of the various fly lineages in the northern hemisphere and all share the ability to hover motionless. They are among the most significant Dipteran (the taxonomic rank/order containing all flies) pollinators and in that sense are comparable in ecological importance to bees, visiting many thousands of flowering plant species worldwide. Around campus they can be found around the different species of cherries and others when flowering.

There are many species of ornamental cherries on campus, derived from a variety of places around the world. A widespread native species encountered on and around campus is chokecherry (*Prunus virginiana*). They vary in size from shrubs to small trees up to 30+ feet (10 m) tall, depending on growing conditions. They have broad, egg-shaped and toothed leaves, with numerous white flowers that develop into small cherries drooping from the plant in long clusters. Chokecherries thrive on the plains and in montane environments, commonly found in gulches, canyons, and other moist places. Of interest, the genus *Prunus* includes such familiar friends as all cherries, all plums, all peaches, nectarines, apricots, and even almonds. It is a good one to know, with such broad importance to humans and ecosystems alike, and every member of *Prunus* bears flowers very similar to that of the chokecherry—making them easily recognizable.

Chokecherry is a significant part of Native American diets and contemporary cuisine. The chokecherry's pit is poisonous, but even so, the fruit is an important plant for the local fauna. Many animals eat their fruits, including a variety of songbirds such as the American robin (*Turdus migratorius*). Robins are found throughout the state of Colorado and North America generally. Although most robins complete seasonal migration patterns, they can still be seen during the entire year in this area. There are seven different subspecies of American robins, and they all possess rusty red color variation on their chests.

- Hoverfly
- Chokecherry
- American robin



Yellowjacket and Lilac

The genera *Vespula* and *Dolichovespula* are commonly referred to as yellowjackets because of their distinctive yellow and black markings. Often simply called wasps, some of the commonly found species are the aerial yellowjacket (*Dolichovespula arenaria*), the black and yellow eastern yellowjacket (*Vespula maculifrons*), and the bald-faced hornet (*Dolichovespula maculata*). Some of them are black and white. These wasps are insects that belong to the same order (Hymenoptera) as bees and ants. Wasps live in colonies, and prior to landing they exhibit a rapid, side-to-side flight pattern.

Yellowjackets are predators of other insects as well as being important pollinators. You will often see yellowjackets around lilacs (*Syringa vulgaris*) on campus and across Boulder generally ("vulgaris" is Latin for "common," likely referring to the local commonality of the lilac in its native habitat). Lilacs are originally from Europe and they were introduced to North America as ornamental plants in the 18th century during an explosive and collaborative craze in gardening shared between the Old and New Worlds. The heritage of that craze is hard to ignore in places like England and California in the present day. Lilac leaves are broad and heart shaped, and lilacs bear small, densely-clustered flowers with four petals each, these are found in seven colors ranging from white to purple, and blooming throughout the summer. They belong to the olive and ash family, Oleaceae.

Bald-faced hornet

Lilac

Chickweed Starwort

Stellaria media (the chickweed starwort) is a member of the carnation family (Caryophyllaceae) and is one of the most widespread of all plant species, inhabiting six continents and innumerable smaller landmasses worldwide. Although this species likely first evolved in Europe, chickweed starwort's propensity for highly disturbed habitats (from urban sidewalks to agricultural fields to trail corridors) has greatly facilitated this starwort's worldwide spread over the past few centuries. Completing a full life cycle in a matter of weeks and producing copious quantities of seeds have also aided in this species' remarkable spread. There are over 100 species of starworts found across a diversity of ecosystems worldwide, including several native to Colorado. Some of them are narrowly restricted (=endemic) to small geographical areas and may face extinction as native habitats continue to contract.

Stellaria media, however, faces an extinction risk of 0%. Perhaps most instrumental of all to the worldwide spread of *S. media* has been the ability to both self-pollinate as well as to cross-pollinate via insects. This mixed mating system means the plant is able to establish a new population through the spread of just a single seed, while also maintaining a level of genetic diversity impossible in fully self-pollinating lineages. This prostrate herb is inconspicuous and sprawls along the ground in discrete clumps beneath trees, shrubs, and rocks all over campus, sometimes even blooming during the heart of winter after snowfall yields to a prolonged thaw. Some individuals will lack petals entirely, making this plant difficult to spot when petals are absent; however, lacking petals makes evolutionary sense, since if a flowering plant is predominantly self-fertilizing, one evolutionary tendency is to stop allotting energy towards production of noticeable petals. Petals or not, if you know this plant, then you'll know at least one plant in whatever city you live or work in one day. Give some appreciation for the unnoticed small ones once in a while.

▲ ■ ● Chickweed starwort

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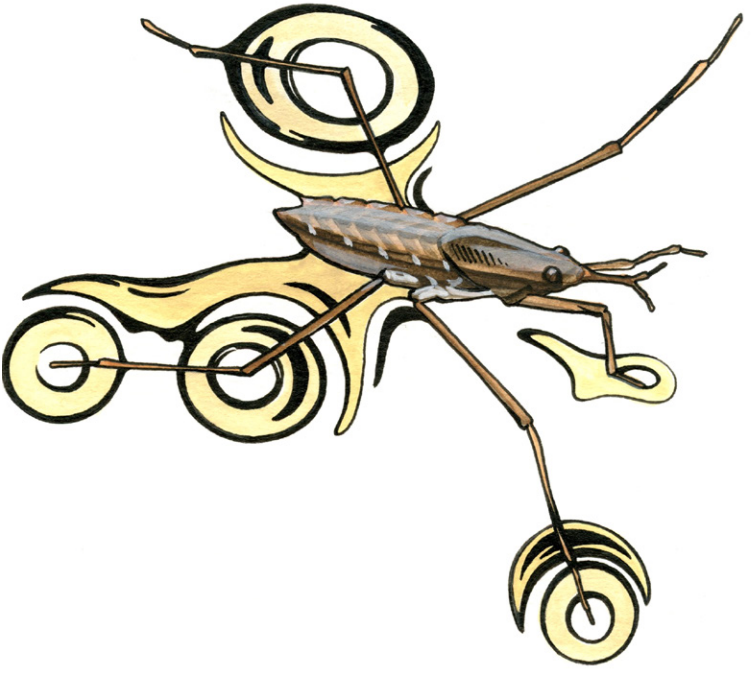
Painted Turtle, Water Strider, and Carp

At Varsity Pond there are many species of aquatic plants and animals. The western painted turtle (*Chrysemys picta*) is the Colorado State Reptile, designated through efforts by a 4th grade class in 2008. Painted turtles are a common sight around many lower elevation Colorado ponds and lakes. They are the most widespread native turtle of North America, but you will often see them basking (sun bathing) over rocks and logs at the pond because they are "cold-blooded" animals. As with the vast majority of animal diversity on Earth, this means that they regulate their temperature through the environment rather than internally like mammals and birds do. During winter, painted turtles hibernate in muddy bottoms, remaining there from early October to mid- or late April.

The painted turtle is the only species member to the genus *Chrysemys*, which is part of the pond turtle family Emydidae. The turtle's upper shell is olive to black, with the edges of shields (or plates) bound with yellow. The turtle's head, neck, and legs have yellow lines, with the lower shell brightly colored with red and yellow. They also have a red spot that appears behind the eye. Females are larger than males, reaching 9 in (23 cm) in upper shell length, while males reach 7 in (18 cm). Painted turtles are all over North America due to their resilience in occupying a generalist suite of climates. They also have a high reproductive rate and are able to cope with and live in polluted wetlands and artificially constructed ponds.

Indigenous nations of North America have turtles represented in stories and myths, including creation stories. Turtles are one of the animals that helped with the creation of Earth, using their powerful carapace as a foundation upon which landmasses were built. For the Arapaho, turtles alongside ducks worked together.

Another species that hibernates during winter months close to the painted turtles is the common water strider (*Aquarius remigis*), a species of aquatic insect known as pond skaters due to their ability to glide over water surfaces. This predatory insect that usually feeds on mosquito larvae, as well as other insects that accidentally land on the water surface, relocates to protected sites on land for hibernation. *Aquarius remigis* grows slightly longer than 0.5 in (1.3 cm) and is dark brown to black in color.



Sharing Varsity Pond with painted turtles are Amur carp (*Cyprinus rubrofuscus*), specifically koi—and their colored varieties. There are many color varieties recognized by the Japanese such as the aka bekko (red color with black-like forms similar to stepping stones). Koi is a member of the Cyprinidae family and the species is native to East Asia. The koi found living at Varsity Pond were introduced by the public, and individuals may live from 100–200 years!

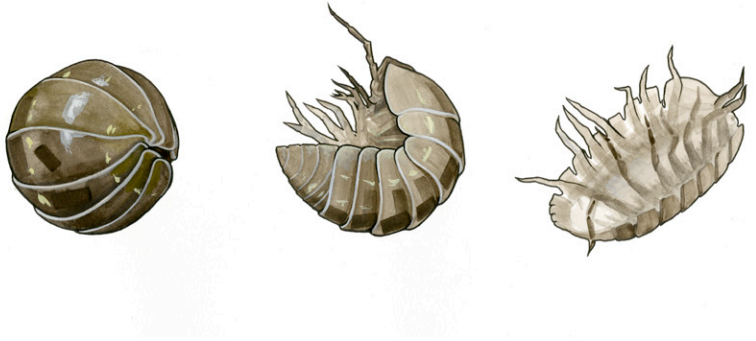
- Western painted turtle
- Common water strider
- Amur carp

Iris, Buttercup, Mallard Duck, and Canada Goose

Around Varsity Pond there are many aquatic plants thriving. Yellow iris (*Iris pseudacorus*) individuals are able to perform water recycling and purification. They cleanse water through their root systems by consuming nutrient pollutants, helping prevent eutrophication (excessive amount of nutrients leading to pond death). The yellow iris is native to Europe, western Asia, and northwest Africa, but can be found in many areas around North America through cultivation. Another species connected to wet ("riparian") habitats on campus is the cursed buttercup (*Ranunculus sceleratus*). *Ranunculus*, the genus of buttercups, is common in wetlands across the world and is a good one to know wherever you live. The name means "little frog" and is the Latin diminutive of "rana," in reference to this fact that many buttercup species are found near water. Buttercups' yellow, bowl-shaped, lustrous flower petals are not only beautiful to the human eye but also serve multiple functions. The smooth, mirror-like surface increases reflection of sunlight to the center of the flower, helping alter the temperature of the reproductive organs and also helping to better attract pollinating insects.

Another species that is familiar at the pond is the mallard duck (*Anas platyrhynchos*). The females are all brown with orange and black bills, while males showcase a colorful mix of plumage. From the head down, males have bulbous green heads, larger compared to females, a white necklace, a chestnut or rust brown colored chest, and a mixing of gray and white on their sides. Mallard ducks have yellow bills, legs, and feet; the white tails and underwings range from 27–28 in (69–71 cm). You will most likely see the same ducks every year, since they return to their place of birth for nesting.

This behavior is also observed with Canada goose (*Branta canadensis*). The family units of Canada geese stay together during nesting and rearing. During this period, neither chicks nor parents fly because adults molt their flight feathers and the young are not yet fully developed, and have not yet learned how to fly. Native to the Arctic and other northern regions of the North American continent, Canada geese are extremely adaptable birds, able to coexist in human-altered areas. This advantage, however, did not stop the species from being decimated in the early 1900s due to hunting and habitat loss. They were reintroduced into Colorado during the 1950s and 60s. Canada geese have a long black neck, head, and bill, with gray brown bodies and a distinct white strap that wraps their chins to cheeks. They are normally migratory birds. In Colorado they have become adapted to the local changing environment and are seen year round.



Pillbug

Armadillidium vulgare can be found under damp rocks and logs. When disturbed they roll into a ball, which makes them commonly known by this ability, that is both a defensive behavior and to keep them moist. The process, called conglobation, gives them the common name roly-poly, and because of their pill-like shape they are also known as pill-bug. Pillbugs, however, are not bugs or insects at all!

Pillbugs are isopods, a type of non-insect arthropod that represents a terrestrial crustacean. Crustaceans are often aquatic, and pillbugs are indeed more closely related to shrimp and lobster than to insects and spiders. Pillbugs evolved from aquatic habitats into terrestrial habitats many millions of years ago, but still hold the evidence of where they came from: gills. This is one of the reasons they are found in damp areas, as their gills need to be moist in order to breathe. Pillbugs are decomposers, feeding primarily on decaying plant leaves. Pillbugs were introduced from Europe and are today found around the world in urban areas.

- Yellow iris
- Cursed buttercup
- Mallard duck
- Canada goose
- Pillbug


Cursed
buttercup

Yellow iris

NOTES

NOTES

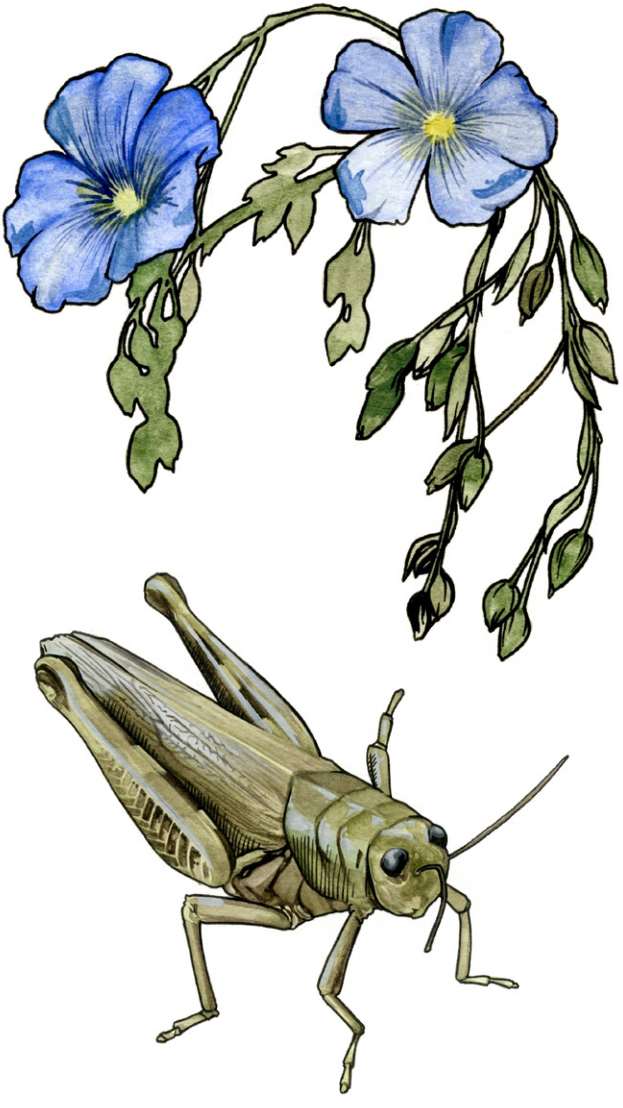
Flax and Grasshopper

Flax is a commonly cultivated plant throughout the world. The common flax, also known as linseed (*Linum usitatissimum*), is often grown for their edible seeds, linseed oil, and for the fabrication of linen textiles. "Usitatissimum" translates to "most useful," a descriptive term indeed. On campus, the genus *Linum* is represented by the blue or prairie flax (*Linum lewisii*). The blue flax produces blue to dark blue flowers and grows up to 32 in (80 cm) high. Their flowers open after sunrise and close in the early afternoon, then swiftly lose their petals soon after the flower closes. Blue flax is widespread throughout North America, ranging from Alaska and Canada as far south as northern Mexico. Their native habitat includes prairies, meadows, montane forests, and bare open slopes, and they are pollinated by flies, bees, and other insects. They are known to have particular importance to native bees and would be good additions to any garden or lawn looking to reduce its water usage.

Flax is consumed by different species of grasshoppers, such as the differential grasshopper (*Melanoplus differentialis*), which is the most prevalent grasshopper in central North America. They can be distinguished by chevron shaped stripes located on their hind legs. The differential grasshopper is sometimes considered an agricultural pest. Another *Melanoplus* species native to Colorado was Rocky Mountain locust (*Melanoplus spretus*) that became extinct by the end of the 1800s due to human activity and disruption of their life cycle. There is much research focused on creating pathogenic fungi able to function as a biological control of different grasshopper species around the world.

Blue or prairie flax

Differential grasshopper



Myrtle Spurge, Yucca, Eastern Cottontail Rabbit, Western Wallflower, and American Lady Butterfly

The eastern cottontail rabbit (*Sylvilagus floridanus*) is a common sight around campus, and since they do not hibernate you will see them year round. They have a gray to light brown tone, with black-tipped hairs and a distinctive white fluffy tail. They are native to the plains and are the most common rabbit species in North America. They can outrun most predators and attain speeds up to 18 mph (29 km/h). The diet of eastern cottontails is primarily herbivorous and dependent on forage availability as seasons change.

Even with a varied diet, including woody plants in winter, eastern cottontails should not eat myrtle spurge (Euphorbiaceae: *Euphorbia myrsinites*). The genus *Euphorbia* has more than 2,000 species (making it one of the largest groups of plants on Earth) and shares the trait of having a poisonous white secretion, as well as unusual and unique floral structures. Myrtle spurge, also called "donkey tail" or "creeping spurge," is on Colorado's list of noxious weeds and is required to be eradicated by private landowners to prevent spreading. They are drought-tolerant plants native to Eurasia and were first introduced to North America as a garden ornamental, looking similarly to cacti and other succulents. Myrtle spurge is an aggressive plant that proliferates easily and outcompetes native plants, perhaps such as seedlings of the yucca.

Soapweed, or the Great Plains yucca (*Yucca glauca*), belongs to the asparagus-agave family (*Asparagaceae*). Yuccas tend to be dominant species in arid grasslands, deserts, and dry mountain slopes. *Yucca glauca* is native to central North America and occurs throughout the plains from southern Canada down to Texas. There are up to 40 species of *Yucca* (including the iconic Joshua trees of the Mojave Desert) and historically they have been an important resource for indigenous peoples across northern and central America.

Another genus commonly used by indigenous peoples as a medicinal plant and found on campus is *Erysimum*, the name of which is based upon the Greek "eryomai" meaning "to help or save." On campus you can find western wallflower (*Erysimum capitatum*) and identify them by their numerous flowers with four yellow to orange petals of about 1 inch in length on average. Wallflowers are important sources of food for local wildlife, including caterpillars of a number of butterfly and moth species. A common butterfly spotted on main campus is the American painted lady (*Vanessa virginiensis*), easily distinguishable by the two large eyespots on the bottom side of their wings. American painted ladies are generalist pollinators, foraging on nectar from several different flowering plant species.

△ □ ○ Myrtle spurge (Fiske Planetarium)
△ □ ○ Great Plains yucca (Fiske Planetarium)
▲ ■ ● Eastern cottontail rabbit
▲ □ ○ Western wallflower
▲ □ ○ American painted lady

Northern Flicker and Plains Cottonwood

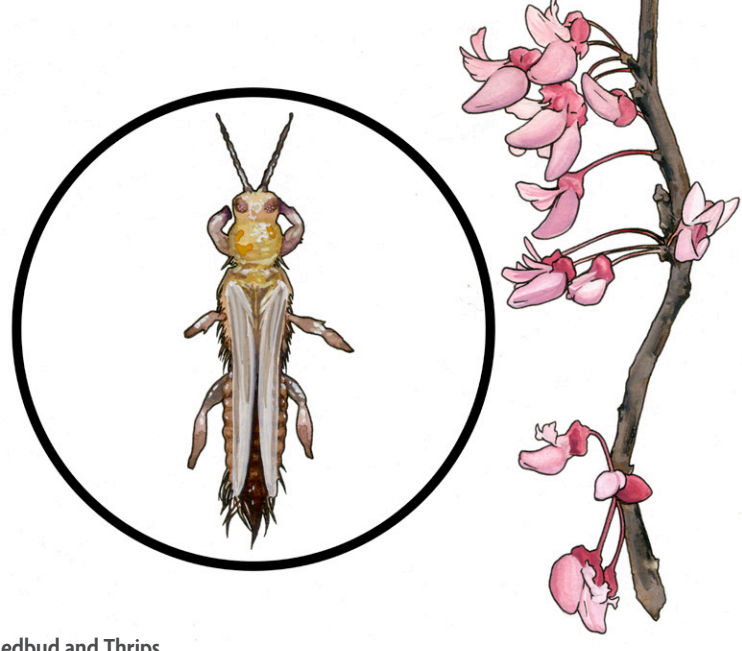
Northern flickers (*Colaptes auratus*) are large woodpeckers that feed primarily on ground insects, in part through producing an antacid saliva that neutralizes acid defenses of ants. They have a brown head and a gray face and neck, and males have a red mustache. Flickers are non migratory in Colorado. The different subspecies of eastern and western flickers hybridize in the areas where they overlap on the Great Plains. Flickers peck holes and nests in cacti, wood posts, and trees, such as the plains cottonwood (*Populus deltoides*), where females and males work together to build nests and incubate their eggs.

The plains cottonwood has coarse-toothed triangular leaves. Their seeds are fluffy and light, and you can see them floating through the air during the spring. Through their tufted seeds, these native trees (as well as willows, both in the willow family, Salicaceae) can disperse to distant suitable habitats, being closely tied to permanent water in a semi-arid climate. They can reach amazing heights of up to 180 ft and provide shelter for many kinds of wildlife in an otherwise open, exposed landscape, cultivated or wild.

In 1876, CU Boulder students planted many cottonwood trees on campus. While many of them have been removed, you can still find a cottonwood tree from 1876 behind the Old Main building.

Northern flicker

Plains cottonwood



Redbud and Thrips

When entering the Center for Student Engagement (C4C) building during the spring, you will notice redbud trees (*Cercis canadensis*) flowering, facing the building entrance along the bike path. Redbuds are commonly planted as ornamental trees because of their vivid spring flowers that range from lavender to pink tones. Redbuds belong to the Fabaceae (the legume/bean family), one of the most diverse, widespread, and ecologically critical groups of plants on Earth. The Fabaceae are economically important to humans, as they provide many of the fruits we and our domesticated animals consume (e.g., alfalfa, all beans, clovers, gums, peanuts, peas, soybeans) and are common horticultural plants (e.g., *Mimosa*).

Fabaceae are furthermore essential to soil nutrient maintenance and oftentimes dominate entire natural landscapes (e.g., *Acacia* species). Fabaceae have a relationship with nitrogen-fixing bacteria in their roots and represent one of the only plant lineages on Earth capable of sequestering atmospheric nitrogen into the soil for biological usage. Redbud flowers are edible and have a bean-like flavor, and should be sampled. Within their flowers are often thrips, very tiny insects ranging from 1–2 mm in length and having slim bodies with narrow wings fringed with hairs. Their coloration ranges from yellow,

brown, white, or black. Thrips can be a pest, as well as a symbiont, having a specific relationship with the plant in which they live (such as being pollinators). Some species are specialists, feeding on potentially one plant species, while others are generalists, which feed on the flowers and leaves of many unrelated plants.

▲ ■ ● Eastern redbud

Thistles, Green Bottle Fly, and Viburnum

Thistles are widely distributed across Colorado and the northern hemisphere generally. Thistles (species of *Cirsium*) are prickly plants that belong to the daisy and sunflower family (Asteraceae), likely the largest plant family on Earth. Thistles typically have prickly stems, leaves, and flower heads with often white or purple flowers. There are 15 native species across Colorado and 5 non-native thistle species. On campus, and around Boulder, you can see a variety of thistles, including native prairie thistles (*Cirsium canescens*), as well as bull thistle (*Cirsium vulgare*), a Eurasian species that is highly invasive and difficult to remove. Many species of thistle are considered weeds by humans, but they are an important source of nectar for a variety of insects.

The green bottle fly (*Lucilia sericata*) realizes many different niches, or "roles," within ecosystems, ranging from pollinators to decomposers. Adults showcase a brilliant metallic blue to green color. Their young (larvae), commonly known as maggots, are solely decomposers, and are often used in forensic research.

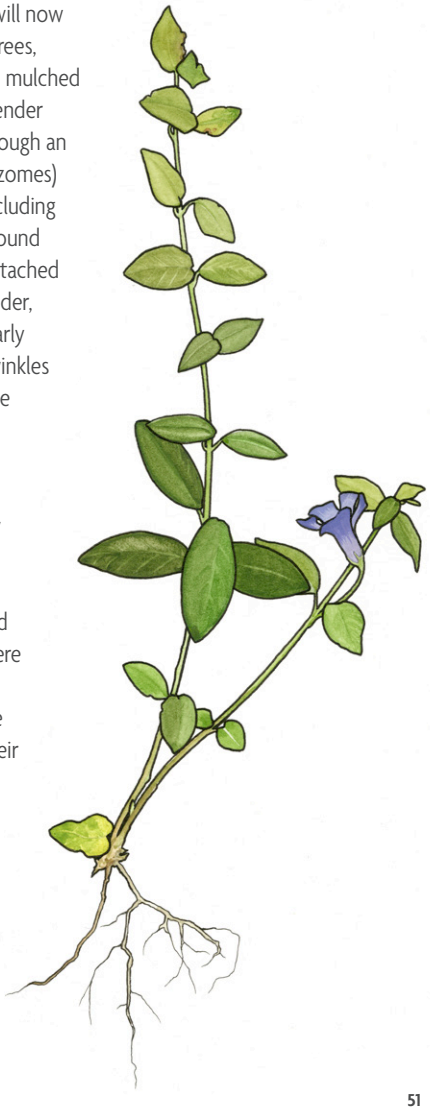
The wayfaring tree (*Viburnum lantana*) is also known for its ecological importance for insects. *Viburnum lantana* belongs to the elderberry family (Adoxaceae) and can be found as an upright shrub or small tree up to 5 ft (1.52 m) tall. This white flowered shrub with oval to heart shaped leaves is common on campus and is at times escaped from cultivation in local gulches. The undersides of their leaves, twigs, and buds are covered with dense gray hair.

▲ ■ ● Bull thistle
▲ ■ ● Green bottle fly
▲ ■ ● Wayfaring tree

Small Periwinkle

Small periwinkle, or creeping myrtle (*Vinca minor*), is a trailing groundcover plant that you will now notice everywhere on campus—under trees, mixed with shrubs, and by themselves in mulched beds. They are mostly evergreen with slender stems and form colonies that spread through an underground stem system (known as rhizomes) that can furthermore create a carpet excluding other plants. Their flowers are solitary, found within the leaf axils of the oppositely-attached leaves. Petal pigments can be blue, lavender, or white and flowers mainly appear in early spring through mid-summer. Small periwinkles are native to central and southern Europe and southwestern Asia around most of the Mediterranean basin, and they were introduced in North America as an ornamental plant but have subsequently escaped cultivation. They have caused particular issues as an invasive species in the eastern U.S. and can be seen escaped from cultivation on the University Hill here in Boulder. However, they represent no threat to the native Colorado flora, since they don't do well here very far from their mulched beds.

▲ ■ ● Small periwinkle



Barberry

The genus *Berberis* (barberries) occurs in many regions across the world. Native to temperate and semi-tropical climate, *Berberis* species live in regions across Asia, Africa, Europe, North America, and South America. They are known for synthesizing the chemical compound berberine that is extracted from different species within the Berberidaceae family as well as the Ranunculaceae, including Oregon grape (*Mahonia spp.*) and the Colorado barberry (*Berberis fendleri*).

The medicinal properties of these plants have been known for thousands of years by different peoples worldwide. In North America, *Berberis canadensis* has been used by the Cherokee as a treatment for diarrhea symptoms. The dark yellow color extracted from certain barberry species has been used as a dye, while the fruits are often used by different cultures, such as in the Middle East, for culinary purposes. On campus, there are several different species of *Berberidaceae* cultivated, including Oregon grape, which you will also notice natively in our foothills around Chautauqua. *Berberis* are often grown for their yellow flowers, their red to purple to blue-black berries, as well as for their ornamental leaves, which all make them popular garden and ornamental shrubs.

▲ ■ ● Colorado barberry

Columbine

Well known today as the Colorado State Flower, the Colorado blue columbine (*Aquilegia coerulea*), a member of the buttercup family (Ranunculaceae), has a long history as an herbal remedy by Native American nations. The genus *Aquilegia* is derived from the Latin meaning "eagle," referencing the spurs present at the base of the flower that resemble a claw-like shape. The spurs contain nectar, and both variation in spur length and flower color across the ca. 70 species of the columbine genus worldwide has driven fascinating evolutionary diversification of this group of plants. The nectar in the spurs of *Aquilegia coerulea*, for example, is likely only accessible to hawkmoth pollinators, whereas spurs of other, red-flowered species of *Aquilegia* house nectar likely only accessible to hummingbirds.

The common name, columbine, means "dove," representing the flower's possible resemblance to five doves clustered together. People in Colorado have long been fascinated with this herb and in 1925 a protection law was enacted. In Colorado, gathering of blossoms and buds is regulated and limited, and uprooting a flower on public lands is illegal. You cannot pick Colorado blue columbines from private land without owners' consent. So, when you find columbines blooming on campus, be mindful of the Colorado blue columbine's protected status in private and public areas alike. This plant is an example of how people connect and relate to nature through healing, fascination, and inspiration. Various species bearing different floral colors are planted across campus.

▲ ■ ● Colorado blue columbine

NOTES

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Chickadees, Boxes, and Ponderosas

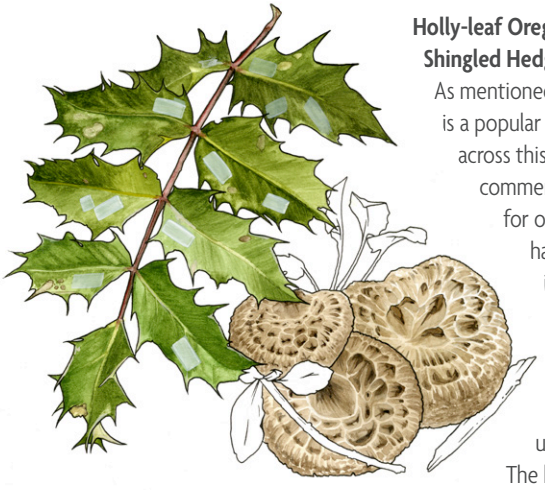
Perhaps you've seen wooden bird boxes like this around Boulder. These have been installed under the direction of Scott A. Taylor, assistant professor of Ecology and Evolutionary Biology at CU Boulder, and Kathryn Grabenstein, a Ph.D. student in Dr. Taylor's lab. They are investigating how environmental changes and urbanization are affecting the distributions of two different bird species, the black-capped (*Poecile atricapillus*) and mountain chickadees (*Poecile gambeli*). They are observing how these two similar bird species interact and hybridize at different elevations—from the plains all the way up to our highest, subalpine forests. Chickadees are indeed cute, with a distinct spherical body shape and large heads. Black-capped chickadees range from 4.7 to 5.9 inches (12–15 cm) in length and mountain chickadees from 4.3 to 5.5 inches (11–14 cm).

The wooden boxes serve as cavities where the birds can nest, and researchers can then assess their degree of hybridization, as well as certain human and parasitic impacts. This box is found in one of the trees in which you would usually see chickadees making nests, a ponderosa pine (*Pinus ponderosa*). Ponderosas have long, clustered needles, usually found in bunches of 2 or 3 per cluster. Ponderosas are native to Colorado and are the most prevalent tree in the lower foothills here; they are particularly common west of CU Boulder's main campus around Chautauqua. When in doubt, you can get close to their thick and plated bark, smell the bark, and notice their distinctive vanilla or butterscotch scent.

Black-capped chickadee

Ponderosa pine


BOULDER
CHICKADEE
STUDY



Holly-leaf Oregon Grape and Shingled Hedgehog Mushroom

As mentioned, the genus *Berberis* is a popular group of shrubs grown across this campus and many other commercial landscaping situations for ornamental purposes. They have evergreen foliage that is often spiny-edged, and yellow to sometimes red flowers that bloom in spring and summer, eventually developing into usually red or purple berries. The holly-leaf Oregon grape (*Mahonia aquifolium*) is sometimes considered a species of *Berberis* and is common on and around campus. Ranging from 1–10 feet (0.3–3.0 m), this often creeping shrub has papery leaves divided into 3 to 4 pairs of leaflets plus a terminal leaflet. The holly-like leaves turn a rusty color in winter and remain on the plant year-round, unlike most locally adapted flowering plants. Oregon grape is found natively in our foothills and mountain slopes, often in association with conifer understory.

The shingled hedgehog mushroom (*Sarcodon imbricatus*) is also commonly found in coniferous forests. The relationship between plant roots and this fungus is known as mycorrhizal, having a positive effect on both plant and fungi growth. This relationship yields mutual benefits, with fungus filaments in the soil providing nutrients and enhanced water absorption to the plant, and the plant providing sugars from photosynthesis to the fungus. Shingled hedgehog mushroom is commonly found in Colorado and usually grows at higher elevations in coniferous forests and woods. The name *imbricatus* means "tiled" or "with overlapping tiles," referring to their toothed scaly brown top.

▲ ■ ● Oregon grape

▲ ■ ● Shingled hedgehog mushroom

The Engelmann and Blue Spruce

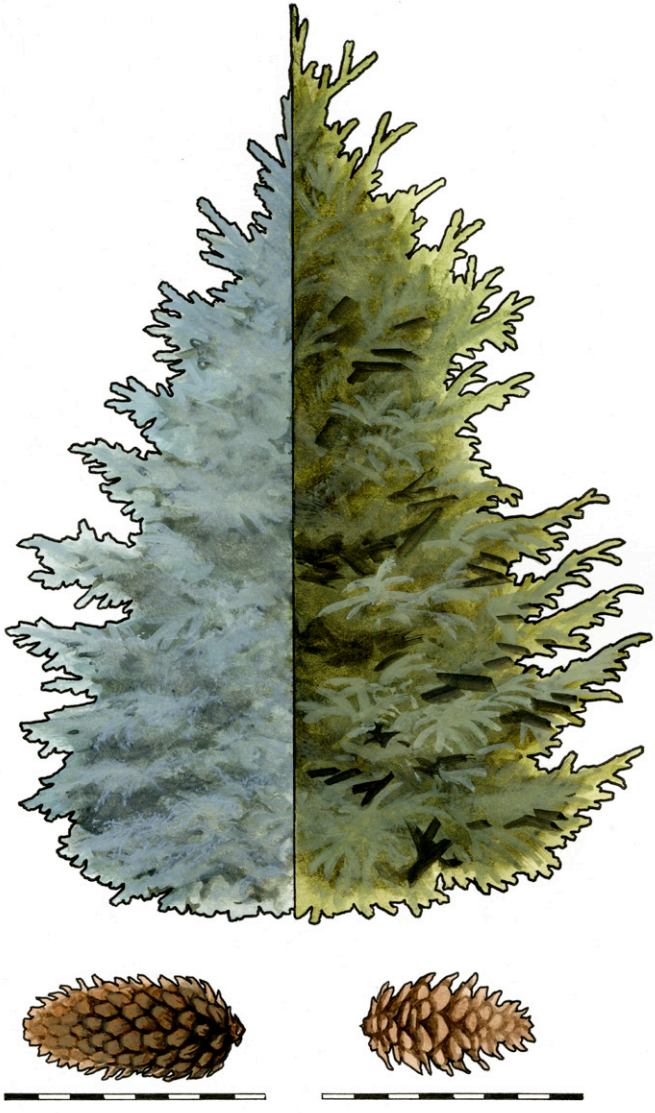
The blue color given by the waxy layer covering the leaves of the blue spruce (*Picea pungens*), their magnificent size (up to 50 m/160+ft tall and 1.5 m/5 ft in girth!), age (some living 600 years!), and overall form all contribute towards making this an impressive plant. Being close to this large, conical, evergreen conifer can be a splendorous moment—especially when you have never seen anything like them before. Their exuberant presence has led to the tree being designated as the State Tree of Colorado (and also previously the State Tree of Utah), and they are widely cultivated across the world.

Blue spruces are also known as green and Colorado spruce. Native Americans from the Navajo and Keres nations use the blue spruce in traditional medicine, ceremonies, and as gifts. If you look around, you will notice that blue spruces are one of the most common conifers on campus! Their waxy, needle-like leaves are arranged spirally, and they bear densely growing horizontal branches. The name 'pungens' comes from describing the sharp or "pungent" single pointed leaves, which you can feel when you try to hold one of their leafy sprigs. Seed cones are green to violet, maturing into a tawny color. The cones of blue spruces hang down and range on average from 2.4–4.3 in (6–11 cm), having dozens of elliptic to diamond-shaped papery scales.

Another very common tree on campus is the Engelmann spruce (*Picea engelmannii*), also known as mountain spruce or silver spruce. They are native to western North America, ranging from central British Columbia and southwest Alberta to southwest California, southeast Arizona, and southern New Mexico. Engelmann spruces are emblematic of our subalpine boreal forests and are by far the most common constituent of such forests across Colorado. Amazingly, they are able to survive at the alpine tree line, forming a "krummholz" transition zone between subalpine forest and alpine tundra. Engelmann spruce can grow up to 213 ft (65 m) tall and can have a trunk diameter of up to 6.5 ft (2 m). Their cones are pendulous, slender and cylindrical, ranging from 1.2–2.75 in (3–7 cm). Blue spruces are often confused with the taller and generally less blue Engelmann spruce. Color and cone size (smaller on average with *P. engelmannii*) can help us distinguish between the two. There will be issues distinguishing them if the tree is a hybrid between our two native spruce species!

Engelmann spruce

Blue spruce (*Picea pungens*)



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