Monocots are a monophyletic group, sister to Eudicots. Traditionally, flowering plants are divided into two groups: separating the monophyletic monocots from the paraphyletic "dicots" (including non-eudicot basal angiosperms). Review the morphological differences between monocots and dicots covered in weeks 2-3.

Alismatales - Araceae (109 gen/2830 spp) – Arum family. 1) Herbs (some epiphytes). 2) Lvs simple or compound; broad, and having an apparent petiole ('pseudo-lamina'), often net-veined. 3) Calcium oxalate crystals usually present, functioning as a physical deterrent to herbivory. 4) Inflorescence a specialized, fleshy spike consisting of - spathe - bract (often colorful) surrounding the flowers - spadix - axis on which the flowers are borne (male above; female below, when both present) - often with a sterile extension above called an 'appendix'. 5) Flowers - usually unisexual - tepals 4-6, or 0, scale-like, or fused in a cup, inconspicuous - superior or inferior ovary - fruit a berry.

Inflorescence often with fetid odor; sometimes thermogenic. Eg. Amorphophallus titanum, sometimes described as having the largest flower (up to 3-4m tall; actually an inflorescence).

“Liliaceae” (288 gen/4950 spp) – Lily family, sensu Cronquist. This family, as traditionally recognized, is treated in a very broad sense in Hitchcock & Cronquist and in this class. However, current classification schemes treat its members in a narrower sense, dividing them between more than 15 different families, and 2 different orders (Liliales and Asparagales). Check the readings for more detail.

1) Herbs. 2) Stems often modified as underground rhizomes, corms, or bulbs (eg., onion and garlic). 3) Flowers usually actinomorphic, 3-parted: 3 sepals and petals, or 6 tepals - stamens 6 (in 2 whorls) - ovary superior (sometimes inferior) - fruit a capsule or berry.

Asparagales - Iridaceae (78 gen/1750 spp) – Iris family. 1) Herbs, aquatic or terrestrial. 2) Underground stems as rhizomes, bulbs or corms. 3) Lvs mostly basal and linear, 2-ranked and ‘equitant’ (overlapping in 2 ranks). 4) Flowers actinomorphic or zygomorphic - 3 sepals and petals, or 6 tepals - stamens 3 - ovary of 3 fused carpels, inferior; fruit a capsule.

In Iris, 3 petaloid styles are winged and showy. The stamens are in line with the petaloid styles; a flap of tissue covers the stigmatic surface, so that an insect backing out of the flower will not transfer self-pollen from the stamen to the stigma.

Asparagales - Orchidaceae (775 gen/19,500 spp) – Orchid family. Perhaps the
largest family of plants in terms of number of species (20,000 - 45,000); many tropical epiphytic orchid species probably still unknown. 1) Herbs, terrestrial or **epiphytic**. Epiphytic plants are supported by some structure other than their own stem (usually other plants) and are not rooted in soil. Very common in tropical wet forests, epiphytic lifestyle imposes serious drought conditions on plants. Orchid adaptations for drought resistance include **sunken stomata; thick waxy cuticle; absorbent scales** for water retention; swollen stems (‘pseudobulbs’) capable of swelling to absorb water; **thickened aerial roots** with multi-layered epidermis called a ‘velamen’. 2) Mycotrophic; many parasitic. 3) Flowers **zygomorphic** - one petal modified as a ‘labellum’ (lower lip) - pollen aggregated into **pollinia** (1 or 2 stamens) - style, stigma, and stamens fused to form the **column**. 4) Fruit a capsule, with many tiny seeds lacking endosperm, require a fungal relationship to germinate successfully.

The predominantly wind-pollinated families of monocots mostly belong to a large clade known as the **commelinids**, together with animal pollinated lineages such as bromeliads and gingers; wind pollination has probably evolved independently several times within this clade.

Poales - **Typhaceae** (2 gen/28 spp) – Cattail family. Small number of species, but world-wide in distribution. 1) Aquatic herbs. 2) Lvs simple, alternate, basal, linear. 3) Inflorescence a dense spike of male flowers at tip of shoot and female flowers at base of shoot (monoecious). 4) Flowers with reduced perianth (bract-like tepals, or bristles) - 1-6 stamens - 2 fused carpels, one ovule per carpel, and one carpel aborting - superior ovary - fruit a single seeded follicle or drupe, wind dispersed.

The leaves of Typha spp. were important weaving materials for WA native peoples, used to make mats, baskets, clothing, shelters, etc.

Poales - **Juncaceae** (6 gen/400 spp) – Rush family. 1) Herbs (aquatic or terrestrial). 2) **Stems typically round and solid.** 3) Lvs basal, 3-ranked, leaf sheaths open or closed. 4) Flowers actinomorphic - 3-parted (wind pollinated, but with **perianth of 6 tepals** – like “little lilies”) - ovary of 3 fused carpels, usually with many ovules, superior - fruit a capsule.

Poales - **Cyperaceae** (122 gen/4500 spp) – Sedge family. One of the most important families of wetland plants; one genus, Carex, contains between 1,000 and 2,000 species. 1) Herbs (many aquatic, but terrestrial, too). 2) **Stems triangular**, solid or hollow – “sedges have edges”. 3) **Lvs 3-ranked; sheath closed.** 4) Inflorescence a **spikelet** of many small flowers; **each flower subtended by a bract**, one empty bract at base of spikelet. 5) Flowers bisexual or unisexual (then usually monoecious) - technically actinomorphic - perianth absent or reduced to hairs or small bracts - usually 3 stamens; sometimes only 1 or 2 - ovary of 2-3 fused carpels, but always reduced by abortion to contain a single ovule - fruit an achene. The ovary is surrounded by a structure called a
perigynium in *Carex* and related genera.

Poales - **Poaceae** (650 gen/8700 spp) – Grass family. Also called Gramineae, for the fruits (grains). The grass family is the most important family of plants economically, containing all of the cereal grains: wheat, rice, maize, barley, sorghum, millet, rye, oats, etc.

1) Herbs, though bamboo achieves tree-like proportions. 2) **Stems round** and usually **hollow** (but sometimes solid). 3) **Lvs 2-ranked; leaf sheaths open** (overlapping), **ligule present** at junction of sheath and blade. 4) Growth by **intercalary meristem**, which is at base of internodes and leaf sheaths, rather than at tip of stem. This allows regeneration when tip is cut, as in grazing or mowing of prairies/lawns. Hypotheses of coevolution of grazers and grassland. 5) Inflorescence a **spikelet** of many small flowers (as in sedges) - sometimes only one floret per spikelet - each spikelet subtended by two empty bracts called **glumes** - each individual flower (floret) enclosed by two bracts: **lemma** (bract at base of individual floret) and **palea** (bract that faces the lemma, thereby enclosing the floret). 6) Flowers (individual flowers called **florets**) technically zygomorphic - perianth absent or reduced to **lodicules** (little more than swollen bits of tissue) - 1-3 stamens - ovary of 2-3 fused carpels, but reduced to a single locule with one ovule - superior ovary. Fruit is a special type of achene with the seed coat fused, called a **caryopsis** (or commonly grain).

Summary of comparison between grasses, sedges and rushes:

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<th>Juncaceae</th>
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<td><strong>Leaf orientation</strong></td>
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**Guest lecture by David Giblin: Floristics informatics and revising Hitchcock**

Impact of herbarium – document diversity, make specimens and data available for research, inform land management practices, pioneer/leader in collections informatics (new innovations adopted elsewhere; Ben Legler). 2.3m records online at PNW portal; 3.6k taxa (subsp + vars) in WA (8 taxa difference vs last year – taxonomic revisions, new introductions/discoveries); 350 research articles in 10 years from WTU; 125 collecting trips since 2002; 3 undescribed spp from
WA in WTU herbarium. Discoveries continue to be made – collections in field and specimens in museum. Average 70 years between collection and description of new species.

**Species-area curve**: more spp recorded with increasing area searched, until all spp found. Asymptotic curve. Search different microclimates at each collecting locality. Eg cheatgrass on S facing slopes only (dry and sunny, preferred microclimate). Want to visit as many localities as possible to fully represent flora of WA, especially remote areas with poor access. To decide on collecting destinations, compare w historical collections to determine under-collected areas.

**Collections over time**: spikes in collections/year during Hitchcock’s period of activity (1930-1955), and recent years coinciding with the activity of Dick Olmstead, David Giblin, & Ben Legler. Good basis for flora of PNW revision.

**N Cascades project**: visit under-collected areas in N Cascades national park. Different local climates in different parts of park, including some areas of typical E-side vegetation (*B. sagittata, P. ponderosa*) – remnant of pre-glacial times? Lots of new spp records for park. Alpine flora and climate change: treeline moving up in elevation, alpine spp must migrate N to survive. Over 11 trips, asymptote on spp-area curve reached (from 30 spp records/ trip to <10). 3000 spp to NOCA (N Cascades national park herbarium). New localities for 10 state-listed rare spp.

**San Juan islands project**: 473 islands, glaciated 12k years ago, 850 spp, W lowland forest & grassland (rare community now). Quantify patterns in spp distribution. Survey small islands <30 ha. Test island biogeography hypotheses: equilibrium number of spp = local extinction vs arrival rates. More spp at equilibrium predicted on islands that are larger, and closer to the mainland. 350 taxa collected: 67% native. >20 new localities for state-listed taxa. 1 new species. More spp on larger islands, BUT spp richness not affected by distance from mainland. Island flora highly individual to island: most species found on only 1-3 islands, very few spp found on many islands. Most widely distributed spp: natives all perennial, exotics all (mostly) annual.

**Collections informatics**: consortium of PNW herbaria. Funding from NSF. Data from multiple (29) herbaria, image specimens, create centrally accessible online database. 2.3m specimen records, 700k images. Largest portal in N America, created w/in last 12 years.

**Update to Hitchcock & Cronquist**: $300k estimated required funding. Fundraising activities to support. $160k secured, $90k in proposals awaiting review. Result of fieldwork and databasing: informatics helpful. Aimed to be completed by 2017. Need for revision: 33% more taxa, 37% revised = 51% of generic keys need revision. Need 1000 drawings. Changes at both generic and family levels, eg *Saxifraga, Mitella*, Boraginaceae, Scrophulariaceae.