

HAMPSHIRE FLORA GROUP WORKSHOPS: DEVELOPING IDENTIFICATION SKILLS

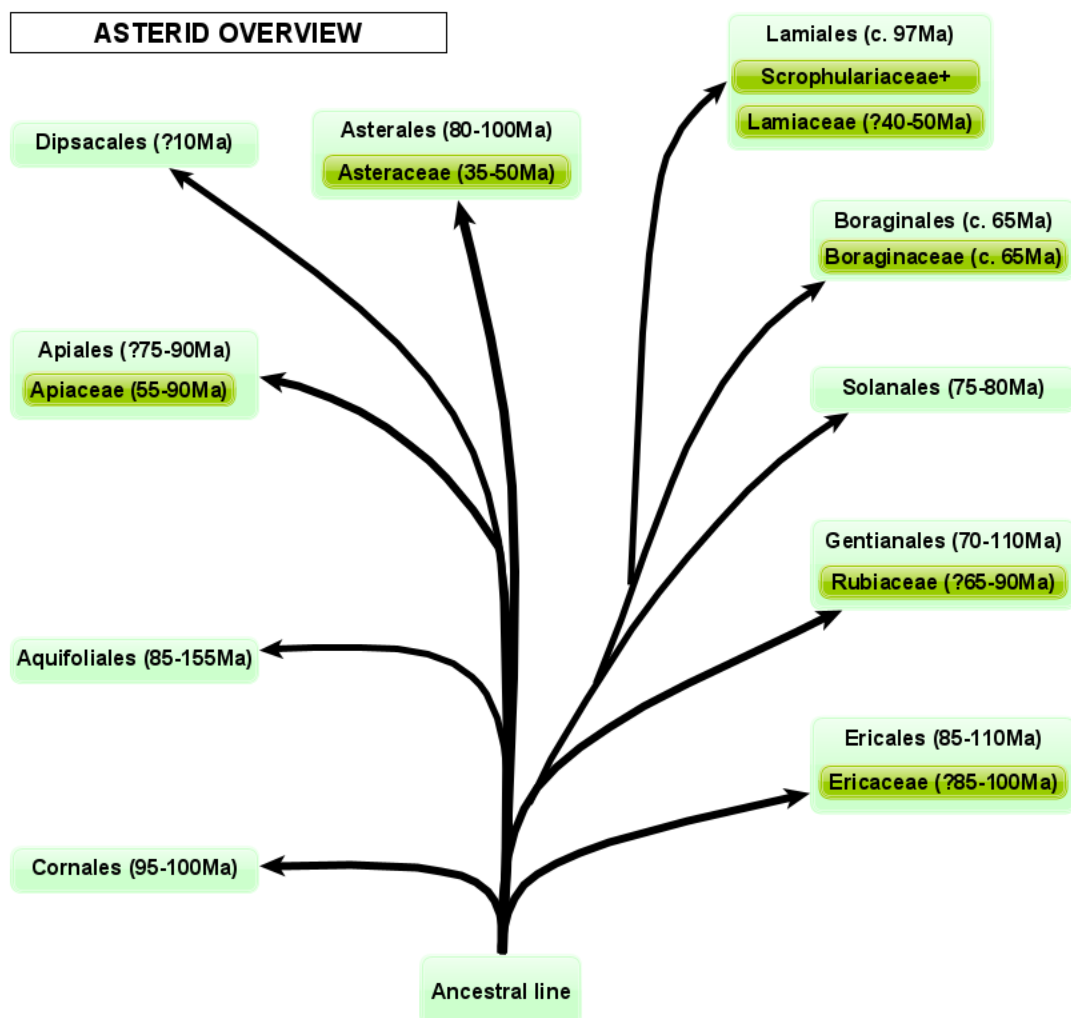
MODULE 4: ASTERIDS (EXCLUDING ASTERALES)



Asterids: a broad grouping

In Module 1 we dealt with the evolutionary divergence of the main groups of seed plants and the broad classification of flowering plants that results from that in modern taxonomy. You may like to refer to pp. 30-34 of that module for an overview. From there you will know that the Asterids have a documented history going back to the Cretaceous period (100+Ma).

Here's a reminder of the evolutionary history of the Orders and the "big families" in the Asterids found in Britain. In this workshop we're going to be looking in more detail at the Ericaceae, Rubiaceae, Boraginaceae, Apiaceae, and a complex of families in the Lamiales Order that has undergone some major changes in classification recently. Asterales will be dealt with in the next workshop, and the Asteraceae family also has two workshops, run from time to time, devoted entirely to it.



Let's remind ourselves of the most common characteristics of the Asterids, and the exceptions that crop up in various Orders and families.

Common characteristics

- flowers bisexual, or bisexual mixed with single-sex;
- petals fused (at least at base) into a corolla (note that this needs careful checking in some genera);
- number of stamens equal to, or less than, the petals or corolla lobes;
- stipules absent.

Some families are also notable for having strong floral zygomorphy (mirror symmetry) in at least some of their members. This version of the table is a bit less comprehensive than that in Module 1, to concentrate attention on the big families and the more widely established non-natives. Orders or families with names on a yellow background are exceptions in **all** native and long-established members in Britain; others have exceptions in **some** native or long-established members in Britain.

Common Feature	Exceptions
Bisexual flowers	Ericales (Ericaceae) Lamiales (Oleaceae; Plantaginaceae; Callitrichaceae) Aquifoliales (Aquifoliaceae) Asterales (Asteraceae) Dipsacales (Dipsacaceae) Apiales (Araliaceae; Apiaceae)
Petals fused	Cornales (Cornaceae) Ericales (Diapensiaceae) Lamiales (Oleaceae, petals 0 or free) Aquifoliales (Aquifoliaceae, sometimes) Apiales (Araliaceae, Hydrocotylaceae, Apiaceae)
Stipules absent	[Ericales (Balsaminaceae, reduced to glands)] Gentianales (Rubiaceae) [Solanales (Solanaceae 'false stipules')] Lamiales (Scrophulariaceae, only rarely in <i>Buddleja</i>) Aquifoliales (Aquifoliaceae, small and deciduous) Dipsacales (Adoxaceae; Caprifoliaceae) Apiales (Araliaceae, sometimes minute; Hydrocotylaceae)

The following table shows traits found in at least some members of the main Orders. Unusual traits in the Order are shown in parentheses.

There are obviously Orders that have great diversity in one or more traits, so for that trait there is no “general rule”, and one has to dig deeper into families and genera. The most useful traits are those that crop up in one or two Orders, as these can quickly narrow down your search against other features.

Trait	Ericales	Gentianales	Boraginales	Lamiales	Asterales	Apiales
Saprophytes	(✓)					
Partial parasites (hemiparasites)				✓		
Full parasites (holoparasites)				✓	✓	
Carnivorous species	(✓)			✓		
Latex present		✓			✓	
Leaves absent or apparently so	(✓)			✓		
Leaves all basal	✓			(✓)	✓	✓
Leaves alternate	✓		✓	✓	✓	✓
Leaves opposite	✓	✓	(✓)	✓	✓	
Leaves whorled (or apparently so)	✓	✓		(✓)		
Flowers actinomorphic (rotational symmetry)	✓	✓	✓	✓	✓	✓
Flowers weakly zygomorphic (mirror symmetry)	(✓)		(✓)	✓	(✓)	✓
Flowers strongly zygomorphic (mirror symmetry)	✓		(✓)	✓	✓	✓
Flowers 2-lipped				✓	(✓)	
Inflorescence of 1 or 2 flowers	✓	✓	(✓)	✓	✓	
Inflorescence a raceme, spike or head	✓			✓	✓	
Inflorescence a panicle	✓	✓		✓		
Inflorescence an umbel	✓				(✓)	✓
Inflorescence a cyme	✓	✓	✓	✓		
Inflorescence a dense head on a common receptacle					✓	
Flowers bisexual	✓	✓	✓	✓	✓	✓
Flowers monoecious				(✓)	(✓)	
Flowers polygamous (i.e. some bisexual and others not)		(✓)		(✓)		✓
Flowers dioecious	(✓)	✓		(✓)	✓	(✓)
Calyx 0 or not obvious, or reduced to hairs or bristles		✓		✓	✓	✓
Calyx 1-2-merous				(✓)		
Calyx 3-merous	✓			(✓)		
Calyx 4-merous	✓	✓		✓		
Calyx 5-merous	✓	✓	✓	✓	✓	✓
Calyx > 5-merous	(✓)	(✓)				

Trait	Ericales	Gentianales	Boraginales	Lamiales	Asterales	Apiales
Corolla 0 or not obvious	<			<	(<)	
Corolla apparently 1-merous					<	
Corolla apparently 2-merous				✓		
Corolla 3-merous or apparently so	✓			(✓)	✓	
Corolla 4-merous	✓	✓		✓	(✓)	
Corolla 5-merous	✓	✓	✓	✓	✓	✓
Corolla > 5-merous	(✓)	(✓)		(✓)		
Flowers hypogynous (ovary superior)	✓	✓	✓	✓	✓	
Flowers epigynous (ovary inferior)	(✓)	✓		(✓)	✓	✓
Stamens 1				✓		
Stamens 2				✓		
Stamens 3	✓			(✓)		
Stamens 4	✓	✓		✓		
Stamens 5	✓	✓	✓	(✓)	✓	✓
Stamens > 5	✓	(✓)				
Styles 0 or insignificant		(✓)				
Styles 1 (sometimes branched)	✓	✓	✓	✓	✓	✓
Styles 2		✓		✓		✓
Styles 5						(✓)
Stigmas insignificant			✓	{✓}		✓
Stigmas simple, capitate or discoid	✓	✓	✓	✓	✓	✓
Stigmas simple, ±elongated	✓			✓	✓	
Stigmas 2-fold or bifid			✓	✓	✓	
Stigmas 3-fold or trifid	✓				✓	
Stigmas 4-fold or quadrifid					✓	
Stigmas 5-fold or 5-fid	✓				✓	
Stigmas > 5-fid	(✓)					
Ovary 1-celled	✓	✓	✓	✓	✓	
Ovary 2-celled		✓		✓	✓	✓
Ovary 3-celled	✓				✓	
Ovary 4-celled	✓		✓	✓	✓	(✓)
Ovary 5-celled	✓				✓	✓
Ovary > 5-celled	(✓)					
Ovaries paired		✓				

Order Ericales

This Order, as you will see from the traits table above, is one of the more protean of the ones we must deal with in the Asterids, despite the relatively small number of families found in Britain.

Study family: Ericaceae (Heather family)

Other important families: Balsaminaceae (Balsam family)
Primulaceae (Primrose family)

In this and the following Order accounts, the table deals with just the families listed above. Family accounts in Stace (2019) can be used for minor families.

ERICALES	Constant traits	Common traits	Exceptions
	Stipules absent		
	Styles 1		
BALSAMINACEAE	Leaves simple, stalked		
	Flowers strongly zygomorphic		
	Flowers bisexual		
	Sepals 3		
	Petals 5 but apparently 3		
	Ovary superior		
	Stamens 5, fused at top of filaments and anthers		
	Ovary 5-celled		
PRIMULACEAE	Flowers actinomorphic		
	Flowers bisexual		
	Stigma capitate		
	Ovary 1-celled		
		Ovary superior	<i>Samolus</i>
ERICACEAE	Leaves simple		
	Flowers actinomorphic or weakly zygomorphic		
		Plants with chlorophyll	<i>Hypopitys</i>
		Flowers bisexual	<i>Empetrum</i>
		Ovary superior	<i>Vaccinium</i>

Ericaceae: the Heath family

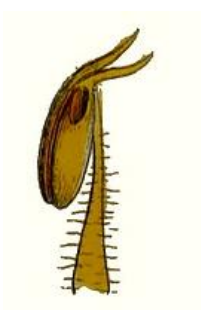
Given the diversity of form in the Ericales, especially in the other major family (Primulaceae), it would be hard to say that Ericaceae is a typical family; but it has the advantage of several features that can be considered characteristic. It is dominated by trees, shrubs, and dwarf shrubs; the first two largely introduced from gardens and sometimes invasive, and the last largely native and often dominating important vegetation communities, especially in the uplands. These all have fused petals, campanulate (but deeply lobed in our only native species of *Rhododendron*), cylindrical or globose flowers and stamens arising from the receptacle; but the herbaceous Wintergreen genera and the saprophytic Yellow Bird's-nest (*Hypopitys*) have free petals and stamens arising on the corolla. They have been assigned to separate families in the past. So too has Crowberry (*Empetrum*), which has flowers 3-merous in contrast to the 4- or 5-merous flowers of all other species.



Typical flowers of Erica showing the apical narrowing of the corolla

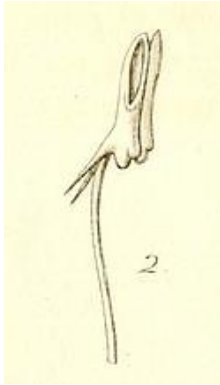
Saprophytic plant with no chlorophyll				<i>Hypopitys</i>		
Herbaceous plant	Flower borne singly			<i>Moneses</i>		
	Flowers in raceme	Flowers all on one side of axis, leaf stalks <2cm			<i>Orthilia</i>	
		Flowers all round axis, longest leaf stalks >2cm			<i>Pyrola</i>	
Woody plant	Sepals and petals 3-merous			<i>Empetrum</i>		
	Sepals and petals 4-5-merous	Ovary inferior, fruit with persistent calyx lobes on top			<i>Vaccinium</i>	
		Ovary superior	Leaves with rust-coloured hairs on underside, petals barely fused			<i>Rhododendron groenlandicum</i>
			Leaf underside hairless or not rusty; petals obviously fused	Most leaves opposite or whorled	Sepals and petals 5; corolla falling before fruiting	
		Sepals and petals 4			Leaves opposite; corolla shorter than calyx, divided >½ way to base	
						Leaves mostly in whorls of 3-5; corolla longer than calyx, normally divided <½ way to base
		All leaves alternate or spiral	Corolla wide open, 2-2.5cm across, actinomorphic			<i>Kalmia latifolia</i>
			Corolla wide open, ≥4cm across, ±zygomorphic			<i>Rhododendron</i>
			Corolla cylindrical or narrowed at end			Continued...

Woody plant; sepals and petals 4-5-merous; ovary superior; leaf underside hairless or not rusty; petals obviously fused; all leaves alternate or spiral; corolla cylindrical or narrowed at end	Either fruit or inflated calyx succulent at maturity	Leaves spine-tipped; fruit succulent			<i>Gaultheria mucronata</i>	
		Leaves not spine-tipped	Calyx becoming inflated and succulent at maturity			<i>Gaultheria (other)</i>
			Calyx of mature fruit dry and small	Erect tree or shrub; fruit maturing red, usu. warty, 10-25mm across		
		Procumbent shrub; fruit red or black, 6-10mm across			<i>Arctostaphylos</i>	
	Fruit a dry capsule with a non-succulent calyx	Sepals and petals 4			<i>Daboecia</i>	
		Sepals and petals 5	Leaves 2.5-16cm long, flat	Leaves to 16cm, with spiny teeth		<i>Leucothoe</i>
				Leaves to 10cm, finely toothed or crenate		<i>Pieris</i>
		Leaves <5cm long, margins strongly turned under	Calyx and flower stalks glandular-hairy; corolla purple			<i>Phyllodoce</i>
	Calyx and flower stalks glabrous; corolla pink			<i>Andromeda</i>		



Andromeda polifolia

There are features of the family that are commonly used in keys but are omitted here because they're often harder to discern in the field. They include appendages to the anthers; these can take the form of "awns" on the ends of the anthers (paired and sometimes reflexed in *Andromeda*, *Arbutus*, *Arctostaphylos*, *Gaultheria*, *Leucothoe*, *Pieris*); spurs on the back of the anthers (*Erica*, *Calluna* and some *Vaccinium*); or warty patches (*Pieris*). Some genera have no appendages (e.g. *Daboecia*, *Kalmia*, *Phyllodoce*, *Rhododendron*).



Erica chloroloma

Most members of the family disperse their pollen not by extensive splitting but through pores (e.g. *Arbutus*, *Arctostaphylos*, *Daboecia*, *Erica*, some *Phyllodoce*, most *Rhododendron*, *Vaccinium*) or slits (e.g. *Calluna*, *Kalmia*, some *Phyllodoce*, some *Rhododendron*).

Order Gentianales

This Order is a small one in Britain and, once we leave aside the non-native Apocynaceae (Periwinkles), fairly constant in its features in each of the major families.

Study family: Rubiaceae (Bedstraw family)

Other important families: Gentianaceae (Gentian family)

GENTIANALES	Constant traits	Common traits	Exceptions
	Flowers actinomorphic		
	Petals fused at least at base		
	Stamens borne on corolla-tube		
	Styles 1-2, if 1 then often bifid		
	Stigmas capitate		
	Stamens 4-5	<i>Blackstonia</i>	
RUBIACEAE	Leaves apparently whorled ¹		
	Stipules present ¹		
	Sepals 0 or minute		
	Ovary inferior		
	Ovary 2-celled		
	Stamens borne at top of corolla-tube	<i>Coprosma</i>	
GENTIANACEAE	Leaves opposite		
	Stipules absent		
	Flowers actinomorphic		
	Flowers bisexual		
	Sepals fused at least at base		
	Ovary superior		
	Ovary 1-celled		

¹ Actually, leaves opposite, but accompanied by leaf-like stipules

Rubiaceae: the Bedstraw family

Worldwide, this is a large family (about 13,000 species), formerly placed in its own order (Rubiales). Luckily for us, most of its diversity is tropical and we are left with just five native genera and a few non-native species. The most distinctive, but not necessarily the most obvious, feature of the family is the presence of stipules: leaves in the family are opposite, but since in most genera the stipules are roughly the same shape and size as the leaves and borne around the stem in a similar position, they appear to be whorled.

Most members of our native genera have a fruit made up of two fused nutlets, which will be familiar to anyone who has played with Cleavers. In the remainder, the fruit is a succulent berry.



Galium sternerii showing opposite leaves (oriented top left to bottom right), stipules masquerading as leaves, and fruit

Leaves plainly opposite, often with smaller stipules or leaves at same node	Evergreen shrub			<i>Coprosma</i>		
	Trailing to ascending herb	Leaves all obviously opposite, stalked, with small stipules; fruit succulent			<i>Nertera</i>	
		Only upper leaves obviously opposite, sessile; fruit of 2 nutlets	Leaves linear to lanceolate		<i>Asperula cynanchica</i>	
			Leaves oblong to elliptical		<i>Galium murale</i>	
Leaves apparently whorled, all of ± same size	Most or all flowers with 5 corolla lobes	Sprawling annual; whorls of ≥ 6 “leaves”; corolla deep pink; fruit of 2 nutlets			<i>Phuopsis</i>	
		Evergreen scrambler; whorls of 4-6 “leaves”; corolla yellowish green; fruit succulent			<i>Rubia</i>	
	Most or all flowers with 4 corolla lobes	Calyx obvious, c. 0.5-1.5mm, enlarging in fruit; corolla pale to deep mauvish pink			<i>Sherardia</i>	
		Calyx absent or minute; corolla of various colours including some pink but not mauvish pink	Corolla tube > 1mm	Ovary and fruit smooth or papillose		<i>Asperula</i>
				Ovary and fruit with hooked bristles		<i>Galium</i>
		Corolla tube < 1mm	At least some whorls with > 4 “leaves”			<i>Galium</i>
			All whorls with 4 “leaves”	Flowers in terminal panicles; ovary and fruit with hooked bristles		<i>Galium</i>
				Flowers in axillary whorls; ovary and fruit smooth		<i>Cruciata</i>

Order Boraginales

This is a slightly contentious Order; there is continuing debate about whether it should exist at all - and if so, how its members should be divided up into families. Fortunately, there is only one major family in Britain, and we don't have to worry too much about whether a few non-natives are included in it or placed in a different family. (We follow Stace (2019) and let them have a separate family, Hydrophyllaceae.)

Study family: **Boraginaceae (Borage family)**

BORAGINACEAE	Constant traits	Common traits	Exceptions
	Leaves simple and \pm entire		
	Stipules absent		
	Flowers bisexual		
	Perianth 5-merous		
	Sepals and petals fused at base		
	Stigma capitate		
	Ovary superior		
	Ovary 2-celled, becoming deeply 4-lobed		
	Style 1, arising from meeting of ovary cells (bifid in <i>Echium</i>)		
		Hairy or bristly-hairy plants	<i>Cerinthe</i> ; <i>Mertensia</i>
		Leaves alternate	<i>Plagiobothrys</i>
		Flowers in scorpioid (\pm spiralled) cymes	<i>Lithospermum</i> ; <i>Aegonychon</i> ; <i>Buglossoides</i> ; <i>Echium</i> ; <i>Asperugo</i>
		Flowers actinomorphic	<i>Echium</i> ; (<i>Lycopsis</i>)
		Corolla-tube with folds, bumps, scales or hairs at throat	<i>Heliotropium</i> ; <i>Echium</i> ; <i>Cerinthe</i> ; <i>Brunnera</i> ; (<i>Mertensia</i>); <i>Amsinckia</i>
		Stigmas 1	<i>Echium</i>

Boraginaceae: the Borage family

This is a very distinctive family when several of its features are taken into consideration at once; it could be mistaken for the closely related Hydrophyllaceae, often placed in the Boraginaceae itself. The main difference is the ovary in the Boraginaceae, which is initially 2-celled but then 4-lobed and forms a fruit of 4 nutlets, but unlobed in Hydrophyllaceae and forms a capsule in fruit; the style is bifid (as in *Echium* and *Heliotropium*).

Verbenaceae and Lamiaceae have 4-celled ovaries also making a fruit of 4 nutlets, but both those families have opposite leaves, which is a rare feature in Boraginaceae and not consistently present throughout the plant. The spiralled (scorpioid) cymes which are typical of most Boraginaceae genera are absent from these two families. Finally, Boraginaceae stems are round, not square.

The bristly hairs found in most genera are single-celled, and so their strengthening is in their outer wall; tuberculate hair bases are quite common.



Cynoglossum officinale showing the characteristic 4-lobed fruit with a central style

Style bifid at apex, 1 stigma / branch	Inflorescence of strongly coiled cymes; flowers actinomorphic			<i>Heliotropium</i>			
	Inflorescence of cymes arranged in a narrow panicle; flowers distinctly zygomorphic			<i>Echium</i>			
Style unbranched, with single stigma	Nutlets fused into 2 pairs when mature			<i>Cerithe</i>			
	Nutlets separate	All anthers completely exerted	Annual with tap-root; calyx divided nearly to base; filaments glabrous, shorter than anthers	<i>Borago</i>			
			Rhizomatous perennial; calyx divided c. ½ way to base; filaments hairy, longer than anthers	<i>Trachystemon</i>			
	All anthers included or with tips only exerted	Calyx lobes 5, entire, not or hardly enlarging in fruit	Calyx lobes with teeth in sinuses, enlarging to envelop fruit		<i>Asperugo</i>		
			Nutlets with hooked or barbed bristles	Flowers and fruits all or mostly with a bract; nutlets < 4.5mm	<i>Lappula</i>		
				Flowers and fruits all or mostly without a bract; nutlets > 4.5mm	<i>Cynoglossum</i>		
			Nutlets smooth, warty, ridged or hairy	Plant glabrous, often strongly glaucous		<i>Mertensia</i>	
				Plant bristly to hairy, not or hardly glaucous	At least lower leaves opposite		<i>Plagiobothrys</i>
					All leaves alternate (or uppermost opposite in <i>Myosotis</i>)		Continued...

Style unbranched, with single stigma; nutlets separate; all anthers included or with tips only exerted; calyx lobes 5, entire, not or hardly enlarging in fruit; nutlets smooth, warty, ridged or hairy; plant bristly to hairy, not or hardly glaucous; all leaves alternate (or uppermost opposite in <i>Myosotis</i>)	Open flowers pendent; stigma exerted					<i>Symphytum</i>		
	Open flowers erect; stigma included or at corolla throat	Ripe nutlets smooth (edge sometimes hairy or keeled)	Basal and all or most stem leaves stalked				<i>Omphalodes</i>	
			All or most stem leaves sessile	Corolla (tubes + lobes) > 10mm	Calyx divided nearly to base		<i>Aegonychon</i>	
					Calyx divided c. ½ way		<i>Pulmonaria</i>	
			Corolla (tubes and lobes) < 10mm	Corolla-tube longer than lobes; calyx-hairs straight; corolla throat partially closed by hairy folds				<i>Lithospermum</i>
				Corolla-tube usu. shorter than lobes, if longer then calyx-hairs hooked; corolla throat closed by glabrous or papillose scales				<i>Myosotis</i>
			Ripe nutlets tuberculate and/or ridged	Basal leaves strongly cordate at base				
	Basal leaves ± cuneate at base	Leaves ovate to obovate, at least most basal ones >5cm wide		Corolla-lobes rounded; corolla-scales closing corolla throat; nutlets stalked			<i>Pentaglottis</i>	
				Corolla-lobes acute; corolla-scales not closing corolla throat; nutlets sessile			<i>Borago</i>	
	Leaves lanceolate to oblanceolate or linear-oblong, < 5cm wide	Nutlets with bumps or warts, but not wrinkled or ridged apart from keel; no collar-like base		Corolla yellow to orange; nutlets coarsely warty		<i>Amsinckia</i>		
				Corolla white to bluish-purple; nutlets with minute bumps		<i>Buglossoides</i>		
		Nutlets smooth, with bumps or wrinkles and ridges; distinct collar-like base		Corolla yellow; leaves coarsely hairy and glandular			<i>Nonea</i>	
	Corolla blue or yellow, if yellow then leaves softly hairy, not glandular			Perennial; corolla tube straight, 5 equal lobes		<i>Anchusa</i>		
		Annual; corolla tube curved, 5 slightly unequal lobes		<i>Lycopsis</i>				

Order Lamiales

This is a large and diverse Order, and the difficulties of getting to grips with it are increased by the recent major taxonomic revisions which have radically redefined family circumscriptions. Fortunately, there are islands of distinctiveness in it; consequently, many plants can be placed straightforwardly to families with a little careful observation.

Study families: **Veronicaceae (Speedwell family)**
 Scrophulariaceae (Figwort family)
 Lamiaceae (Dead-nettle family)
 Orobanchaceae (Broomrape family)

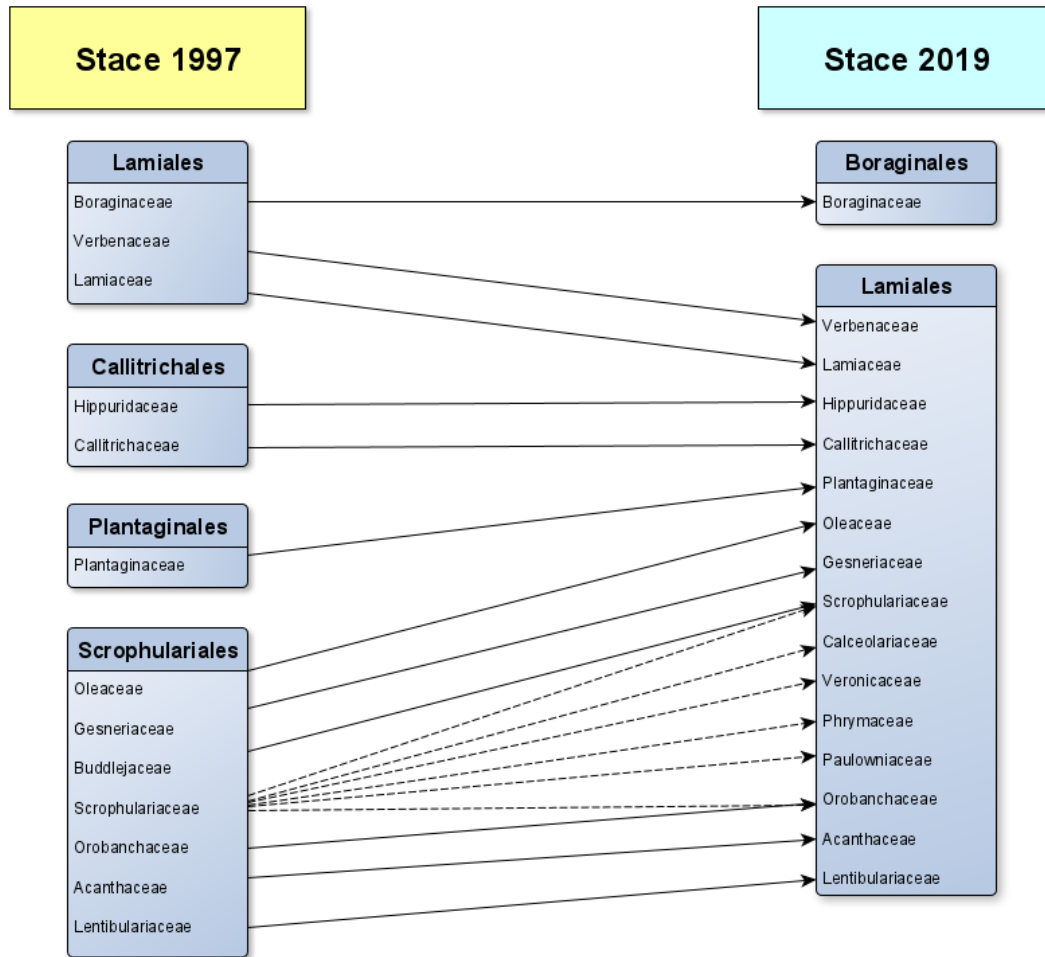
Other important families: Oleaceae (Ash family)
 Plantaginaceae (Plantain family)
 Callitrichaceae (Water-starwort family)

It will be as well to look at the recent changes in family attributions before going farther.

The great Asterid shake-up

The findings on which the Angiosperm Phylogeny Group have radically revised the classification of plant families are based in good science, but they are certainly breathtaking in some of their aspects. Families such as the Apiaceae, previously included in the Rosids on morphological grounds and earlier assessments of their evolutionary history have been brought in; many old orders have disappeared, and new ones have appeared in their place; families have been split or merged. For someone brought up on 20th-century taxonomy and ID guides these changes may be confusing or frustrating, but it is unlikely that any such radical rethinking will occur again soon, and we will need to accept them. The following diagram shows how the redistributions have affected Orders and families considered part of the Lamiales either previously or now. Dotted lines show family splits.

Stace's interpretation is in fact less radical than the recommendations of APG IV, where the Veronicaceae have been swallowed up by Plantaginaceae.



Overview of major Lamiales families

LAMIALES	Constant traits	Common traits	Exceptions
	Leaves without stipules		
	Ovary superior (or perianth 0)		
OLEACEAE	Woody plants		
	Leaves opposite		
	Leaves stalked		
	Flowers actinomorphic		
	Stamens 2		
	Style 1		
	Ovary 2-celled		
		Petals fused	<i>Fraxinus</i>
		Petals 4	(<i>Fraxinus</i>)
Continued...			

LAMIALES	Constant traits	Common traits	Exceptions
VERONICAEAE	Flowers at least slightly zygomorphic		
	Flowers bisexual		
	Calyx 4-5-lobed, not lipped		
	Style and stigma 1		
	Ovary 2-celled		
		Stamens 3-5	<i>Veronica</i>
PLANTAGINACEAE	Leaves sessile or with vestigial stalk		
	Flowers actinomorphic		
	Stamens 4		
	Style and stigma 1		
CALLITRICHACEAE	Aquatic or damp-ground herbs		
	Leaves opposite		
	Leaves simple		
	Leaves sessile		
	Flowers monoecious		
	Perianth 0		
	Stamens 1		
	Styles 2		
	Ovary 4-celled		
SCROPHULARIACEAE	Flowers bisexual		
	Calyx 4-5-lobed, not lipped		
	Stamens 4-5		
	Style 1		
	Ovary 2-celled		
		Corolla 4-5-lobed	<i>Nemesia</i>
<i>Continued...</i>			

LAMIALES	Constant traits	Common traits	Exceptions
LAMIACEAE	At least young stems quadrangular		
	Flowers \pm zygomorphic		
	Calyx 5-lobed		
	Style 1		
	Ovary 4-celled, deeply divided		
		Corolla 5-lobed, \pm 2-lipped	<i>Teucrium; Ajuga; Lycopus; Mentha; (Origanum)</i>
	Stamens 4 (2 long, 2 short)	<i>Lycopus; Rosmarinus; Salvia</i>	
OROBANCHACEAE	Partial or full root-parasites		
	Flowers zygomorphic		
	Flowers bisexual		
	Corolla tubular and 2-lipped		
	Stamens 4		
	Style 1		

Veronicaceae: the Speedwell family

This is the first of the major splits from the old Scrophulariaceae family, in the process of which Buddlejaceae was sunk into Scrophulariaceae. This has been done on molecular evidence, placing this family closer to the Plantaginaceae, Hippuridaceae and Callitrichaceae (and some authors roll all or some of these into one Plantaginaceae family). Morphologically there is nothing to distinguish Veronicaceae and Scrophulariaceae at the family level, and one needs to learn the genera in each.

Fortunately, this family breaks into two quite simply. One group includes all the Toadflax/Snapdragon-like genera with spurs or bumps on the base of their corollas. The other group includes *Veronica*, distinctive for having two stamens rather than 4; *Digitalis*, which will be familiar to most people; and a couple of single-species genera that are not too hard to learn.

Veronica has now assimilated the shrubby species formerly assigned to *Hebe*. It appears that many traits of the genus have evolved repeatedly at separate times, and 10 subgenera have been proposed to reflect this; but as there are no

obvious morphological differences between most of these groupings, they are not of use for ID. The exception is subgenus *Pseudoveronica*, which embraces the shrubby species.



Veronica arvensis

Corolla not spurred or pouched at base	Stamens 2		<i>Veronica</i>		
	Stamens (3)4(5)	Stems procumbent, rooting at nodes; leaves kidney-shaped	<i>Sibthorpia</i>		
		Stems not procumbent or rooting at nodes; leaves not kidney-shaped	Leaves narrowly lanceolate to ovate, not lobed; corolla tube >2x as long as calyx, strongly zygomorphic, lobes not widely spreading	<i>Digitalis</i>	
			Leaves oblanceolate or spatulate, lobed; corolla tube <2x as long as calyx, weakly zygomorphic, lobes widely spreading	<i>Erinus</i>	
Corolla spurred or pouched at base	Leaves palmately veined and lobed	Glandular-hairy plant; corolla ≥3cm, yellow with purple veins; pouched at base		<i>Asarina</i>	
		Glabrous or finely hairy plant; corolla ≤3cm, mauve to purple or white usu. with yellow centre		<i>Cymbalaria</i>	
	Leaves with midrib and often pinnate lateral veins, unlobed, entire or serrate	Corolla tube with rounded pouch at base, broader than long	Calyx lobes ± equal, shorter than corolla tube; corolla >2.5cm		<i>Antirrhinum</i>
			Calyx lobes obviously unequal, longer than corolla tube; corolla <2cm		<i>Misopates</i>
		Corolla tube with usu. pointed spur at base, longer than broad	Leaves ovate to obovate, rounded, truncate or cordate at base;	Mouth of corolla not completely closed by bosses; capsule opening by irregular apical pores	<i>Chaenorhinum</i> <i>organifolium</i>
				Mouth of corolla completely closed by bosses; capsule opening by 2 oblique lids	<i>Kickxia</i>
			Leaves linear, lanceolate or oblanceolate, narrowed to base	Mouth of corolla completely closed by swollen boss	<i>Linaria</i>
				Mouth of corolla incompletely closed by small swelling	<i>Chaenorhinum</i>

Scrophulariaceae: the Figwort family

The division of this family has left it with just seven genera found in Britain, one of which (*Buddleja*) it picked up on the way. Only three of the dispersed families have native British members. As well as the redistribution to Veronicaceae and all hemiparasitic members to Orobanchaceae, various exotic genera have been assigned their own families; the most prominent of these in the wild is the Phrymaceae (Monkeyflowers) which includes *Erythranthe*, formerly a part of *Mimulus*).

Like Veronicaceae, there is wide diversity among its genera, and morphologically the two families cannot be distinguished. One needs to become familiar with the genera.



Limosella aquatica

Corolla 4-lobed					<i>Buddleja</i>	
Corolla with 5 (occ. 6) lobes	Fertile stamens usu. 5, occ. 4 in some individual flowers				<i>Verbascum</i>	
	Fertile stamens 4 (ignore sterile staminodes)	Leaves all basal, sub-linear to spatulate; corolla actinomorphic to weakly zygomorphic				<i>Limosella</i>
		Some leaves at least on stems; corolla weakly to strongly zygomorphic	Corolla strongly lipped, with a swollen boss largely obscuring throat of corolla tube			<i>Nemesia</i>
			Corolla at best weakly lipped, without boss obscuring corolla throat	Corolla tube little longer than wide		<i>Scrophularia</i>
				Corolla tube >2x longer than wide	Corolla pendent, >2cm; stamens prominently exerted	
			Corolla not pendent, <2cm; stamens reaching top of corolla tube		<i>Chaenostoma</i> ³	

² The rather similar *Penstemon*, in Veronicaceae, has a strongly lipped tubular corolla.

³ Formerly known as *Bacopa* or *Sutera*.

Lamiaceae: the Dead-nettle family

This is quite a large family with about 7,500 species and about 240 genera. Although the British members of the family haven't changed recently, molecular work has brought in several genera from Verbenaceae, and this has upset previous subfamily divisions that were useful for categorising groups of genera. All species found in Britain should now fall into one subfamily Lamioideae, whereas Stace (2019) recognises four subfamilies; these still work for British material for field identification purposes.

Most species have square stems throughout their life, and all have opposite simple (but occasionally deeply lobed) leaves. The flowers occur in the axils of the leaves: sometimes singly and so making a pair, often numerous in dense cymes which meet round the stem to give the impression of a compound whorl. All flowers are zygomorphic to some extent, and most genera have the corolla lobes arranged as 2 lips to some extent, but with various degrees of fusion of the 5 lobes that are typical of the family. Many genera are scented (not always nicely).

Typically, stamens are 4, two long and two short, but a few genera have just two. The family has 4-lobed single-seeded fruit with a style emerging from the centre of them, like Boraginaceae and Verbenaceae but unlike the families formerly grouped under Scrophulariaceae.



Salvia pratensis

With 28 genera recorded in Britain and features not always constant within a genus, a synoptic key for ID is of little use; better to use the key in Stace (2019) or one of the field guides listed in Module 1. It may be helpful, though, to summarise the features in Stace's 4 subfamilies.

LAMIOIDEAE	SCUTELLARIOIDEAE	AJUGOIDEAE	NEPETOIDEAE
<i>Stachys, Betonica, Ballota, Marrubium, Leonurus, Lamiastrum, Lamium, Galeopsis, Phlomis, Melittis</i>	<i>Scutellaria</i>	<i>Teucrium, Ajuga</i>	<i>Nepeta, Glechoma, Prunella, Dracocephalum, Melissa, Satureja, Clinopodium, Hyssopus, Origanum, Thymus, Lycopus, Mentha, Lavandula, Rosmarinus, Salvia</i>
Plants unscented or unpleasantly scented	Plants unscented	Plants unscented, foetid or with resinous odour	Plants mostly pleasantly scented
Upper lip of corolla hooded (except <i>Marrubium</i>)	Upper lip of corolla hooded	Upper lip of corolla 0 or very short	Upper lip of corolla \pm flat, but hooded in <i>Prunella, Rosmarinus, Salvia</i>
Stamens 4 and shorter than corolla	Stamens 4, \pm exserted	Stamens 4, exserted	Stamens 2 or 4, sometimes exceeding corolla

Orobanchaceae: the Broomrape family

This family, which was previously limited to fully parasitic (holoparasitic) genera, has now been expanded to include the 7 genera of partial root-parasites (hemiparasites) with green leaves, formerly classified under Scrophulariaceae. This has long been proposed, but the molecular evidence has reinforced the case strongly. Worldwide it increases the size of the family 10-fold, to around 2,000 species. Bracts are a prominent and important feature of some genera. All genera have zygomorphic flowers, with calyces either 4-lobed, irregularly lobed or 2-lipped (sideways rather than top and bottom), and corollas two-lipped (top and bottom). The 4-lobed calyces of all the hemiparasitic genera except *Pedicularis* distinguish them from Scrophulariaceae, and the lack of chlorophyll and the 1-celled ovary in the holoparasites do the same. Apart from *Lathraea*, the holoparasites also have obviously 2-lipped calyces.



Melampyrum cristatum

Plants variously coloured but lacking green coloration	Flowers stalked; calyx with 4 equal lobes					<i>Lathraea</i>	
	Most flowers (except perhaps lowest in inflorescence) sessile; calyx 2-lipped	1 bracteole as well as 2 calyx-teeth each side of corolla; stigmas white or bluish; capsule valves fully separated					<i>Phelipanche</i>
		Bracteoles 0; stigmas usu. yellow, red or purplish; capsule valves joined at apex					<i>Orobanche</i>
Plants with obvious green colouring	Leaves alternate with toothed lobes and divided almost to base; calyx irregularly 2-5-lobed and lobes toothed					<i>Pedicularis</i>	
	Leaves opposite, entire or simply toothed $\leq \frac{1}{2}$ way to base; calyx regularly 4-lobed, with entire lobes	Calyx-tube inflated particularly at fruiting; seeds discoid and winged					<i>Rhinanthus</i>
		Calyx-tube not inflated; seeds not discoid or winged	Lower lip of corolla with 3 strongly emarginate lobes				<i>Euphrasia</i>
			Lobes of lower lip of corolla not emarginate, or central lobe sometimes faintly so	Mouth of corolla \pm closed by swollen bosses; capsules with 1-4 seeds			
		Mouth of corolla open, lower lip without bosses; capsules with > 4 seeds		Corolla yellow	Leaves \pm entire; corolla 7-9mm, usu. with some purple tinting; seeds few, >1mm, furrowed		<i>Odontites jaubertiana</i>
					Leaves serrate; corolla 16-24mm, pure yellow; seeds many, c. 0.5mm, smooth		<i>Parentucellia</i>
		Corolla pink or purple		Perennial; corolla dark purple. >12mm		<i>Bartsia</i>	
				Annual; Corolla pink to reddish-purple, < 12mm		<i>Odontites vernus</i>	
		Corolla white (rare)		Corolla 16-24mm; seeds many		<i>Parentucellia</i>	
Corolla 6-10mm; seeds few			<i>Odontites</i>				

Order Asterales

In Britain this is another small Order in terms of the number of families it contains, but one of them is huge. Fortunately, the main families we have to deal with (Campanulaceae and Asteraceae) are, by and large, each distinctive in several features. This Order is the subject of another workshop and will be dealt with in Module 5.



Centaurea pullata

Order Apiales

This order is again small in Britain and dominated by one large family. Many of the family traits seem anomalous compared with other Asterid Orders, but fortunately they are quite distinctive and constant. Note that *Hydrocotyle* has now been split from Apiaceae into its own family, Hydrocotylaceae; it differs in its stipulate leaves, and from most members of Apiaceae in its \pm orbicular leaves with palmately arranged primary veins.

Study family: **Apiaceae (Carrot family)**

Other important families: Araliaceae (Ivy family)

APIALES	Constant traits	Common traits	Exceptions
	Leaves alternate		
	Flowers in umbels		
	Ovary inferior		
	Sepals 0 or represented by 5 teeth at top of ovary		
	Petals 5, free		
	Stamens 5		
ARALIACEAE	Stipules absent		
	Flowers actinomorphic		
	Fruit a berry		
		Styles 1	<i>Fatsia; Aralia</i>
APIACEAE	Stipules absent		
	Styles 2		
	Ovary 2-celled		
	Fruit dry, with two 1-seeded portions breaking up along a line parallel to the axis		
		Herbaceous	<i>(Bupleurum)</i>
		Leaves 1- to 6-pinnate or -ternate	<i>Sanicula, (Astrantia), (Eryngium), Bupleurum, (Smyrniun)</i>
	Umbels compound	<i>Sanicula, Astrantia, Eryngium, Scandix</i>	
		Carpophore present ⁴	<i>Sanicula, Astrantia, Eryngium</i>

⁴ See explanation of term later in next section.

Apiaceae: the Carrot or Umbellifer family

A family of about 3,500 species found mostly in the temperate northern hemisphere. This is a distinctive family on several traits including the mostly compound umbels, the free petals and the distinctive fruit pattern. It is marked out from its segregate Hydrocotylaceae chiefly by the absence of stipules, although the rounded palmately-veined leaves of the latter are found in only a few Apiaceae genera. Members of *Sanicula*, *Astrantia* and *Eryngium*, with simple umbels, could be mistaken for plants in other families but the fruits remain true to the Umbellifer pattern. *Bupleurum* species, with their undivided entire leaves and often small inflorescences, may also puzzle at first sight: most other family members have leaves ternate, pinnate, or multiply so. *Bupleurum fruticosum*, which is a common and dominant plant in parts of the southern Europe and a rare garden escape here, is a woody shrub and so doubly surprising.

Sheathing bases to the stalks of the alternate leaves are common in the family, sometimes grotesquely inflated as in *Angelica*. In many species the flowers are actinomorphic in the centre of the umbel and zygomorphic at the outer parts, the larger petals outermost - a pattern sometimes referred to as *radiating*. *Heracleum sphondylium* (Hogweed) provides a good example.

The fruits of Apiaceae are highly distinctive: a 2-celled ovary, each cell with one ovule, develops into a double fruit (*Schizocarp*) separating along a line called the *commissure*, which may be accompanied by a central sterile pillar called the *carpophore*. The surfaces of the two fruit halves (*mericarps*) carry oil bodies called *vittae*. The two styles which top the fruit arise from a plate-like or mound-like base called a *stylopodium*. In a few genera this is encircled by a toughened ring or palisade, the remains of the sepals. This is most spectacular in *Eryngium* and *Astrantia* but is also a distinctive feature of *Oenanthe*. The fruit is an exceptionally important factor in identifying an unknown Umbellifer. Tutin (1980) is an excellent handbook, and Sell & Murrell (2009) has superb line illustrations of fruits for all species found in Britain.

The Apiaceae have a rich and diverse biochemistry which accounts for the many tasty vegetables and equally many toxic or irritant species. If this is an aspect that interests you, and you have a lot of stamina and the ability to read French, the 5-volume monograph by Reduron (2007-2008) will keep you occupied for a long time.

There is little point in constructing a synoptic key to 55 genera that are found in Britain, as it would be thoroughly unwieldy. You are recommended to use the more traditional keys in one of the Floras and handbooks listed. It is perhaps worth mentioning that the three genera that feature as frequent exceptions in the Order table earlier (*Sanicula*, *Astrantia*, *Eryngium*) are usually placed in a separate subfamily (Saniculoideae) from the remainder of the genera, which are placed in the Apioideae. They are distinguished by their simple umbels and the lack of a carpophore between the two seeds.



Daucus carota fruiting head

References and Further Study

All the books and material mentioned in the Module 1 notes are of value here too.

Bennett, M. (2003). *Pulmonarias and the Borage Family*. Batsford, London. Although written primarily from a horticultural point of view, there is a lot of solid botanical information here about the many cultivated plants in the family.

Cullen, J. et al. (2011). *The European Garden Flora* edn. 2, vols 4-5. Cambridge University Press, Cambridge. (For species accounts for many garden plants outside the standard guides and Floras that may occur as garden throw-outs.)

Lansdown, R.V. (2008). *Water-starworts (Callitriche) of Europe*, BSBI Handbook 11, London. This book will teach you, if nothing else, not to be sloppy about *Callitriche* identification.

Metherell, C. & Rumsey, F.J. (2018). *Eyebrights (Euphrasia) of the UK and Ireland*. BSBI Handbook 18, Bristol. A superbly detailed account of this difficult group.

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Sell, P.D. & Murrell, G. (2006, 2014, 2009). *Flora of Great Britain and Ireland*, vols. 2-4. Cambridge University Press, Cambridge. For detailed species accounts.

Stace, C.A. (2010, 2019). *New Flora of the British Isles*, 3rd / 4th editions, Cambridge University Press / C&M Floristics.

Thorogood, C.M. & Rumsey, F.J. (2021). *Broomrapes of Britain and Ireland*. BSBI Handbook 22, Durham. Covers all the full parasite members of Orobanchaceae, with superb colour photos.

Tutin, T.G. (1980). *Umbellifers of the British Isles*. BSBI Handbook 2, London. Mercifully taxonomic change has been limited in this important family, other than the segregation of Hydrocotylaceae (which not everyone agrees with). It fits easily into a pocket, with good line illustrations and species accounts. Essential if you want to learn the family thoroughly in the field.