Sample 1 (Carboniferous, Scotland)

https://www.virtualmicroscope.org/content/carbonate-cemented-conglomerate
Microscope and hand sample linked from that page

What is the nature of intragranular space in this sample? Is it a fine-grained matrix, silica cement, calcite cement, or open pore space?

Sample 2: Penrith Sandstone (Permian, England)

https://www.virtualmicroscope.org/content/leeds-08-penrith-sandstone

The cement in this sample is *syntaxial*, which means that it formed with the same crystallographic orientation as the grain that it grew on. Syntaxial cements can be identified because the cement has the same extinction as the grain.

What type of cement does this sample contain? What is another feature of the intergranular space?

Plot the composition of this sandstone on the QFL diagram. It is easier to assess the abundance of grain types in thin section, so people often give more precise petrological names. In hand sample, it's typical just to use quartz or feldspathic or lithic, but in thin section it's easier to separate sublithic, subfeldspathic, etc. There are several different classification schemes; for this lab we'll use the one at: https://people.ucsc.edu/~mclapham/eart120/QFL_thin_sec.png.

Give a complete name to this sample, including rounding, sorting, grain size, composition, and amount of matrix (arenite or wacke).

Describe the textural maturity of this sample. Describe the compositional maturity. Explain how you came to each conclusion.

Sample 3 (Penrith Sandstone, Permian, England)

This is a different sample from the Penrith Sandstone.
https://www.virtualmicroscope.org/content/s03-sandstone-aeolian-cumbria

Note the variable porosity, which is higher in better-sorted laminations and lower in poorly-sorted laminations where pore space is infilled by fine grains.

This sample contains a lot of quartz, most of which is monocrystalline. But there are polycrystalline quartz grains as well. Find one and use the "share" button to get a link; copy and paste that link here. (Make sure you've found a polycrystalline quartz grain and not a rock fragment.)

Sample 4 (Silurian, Ireland)

https://www.virtualmicroscope.org/content/s02-sandstone-turbidite

Plot the composition of this sandstone on the QFL diagram.

Give a complete name to this sample, including rounding, sorting, grain size, composition, and amount of matrix (arenite or wacke).

There are elongated and thin grains with bright colors in crossed polars. What mineral is this?

Describe the textural maturity of this sample. Describe the compositional maturity. Explain how you came to each conclusion.

Sample 5
https://www.virtualmicroscope.org/content/s04-sandstone-aeolian-exeter

Describe the nature of the intergranular space in this sample: the amount and nature of matrix, cement, and porosity.

Plot the composition of this sandstone on the QFL diagram.

Give a complete name to this sample, including rounding, sorting, grain size, composition, and amount of matrix (arenite or wacke).

Describe the textural maturity of this sample. Describe the compositional maturity. Explain how you came to each conclusion.

Sample 6
https://www.virtualmicroscope.org/content/s07-sandstone-rockall-basin

Plot the composition of this sandstone on the QFL diagram.

Give a complete name to this sample, including rounding, sorting, grain size, composition, and amount of matrix (arenite or wacke).

What type of feldspar is most common: plagioclase or K-feldspar (orthoclase and microcline)?

Describe the textural maturity of this sample. Describe the compositional maturity. Explain how you came to each conclusion.

Sample 7 (Triassic, Ireland)
https://www.virtualmicroscope.org/content/s06-sandstone-subarkose

Plot the composition of this sandstone on the QFL diagram.

Give a complete name to this sample, including rounding, sorting, grain size, composition, and amount of matrix (arenite or wacke).

Describe the textural maturity of this sample. Describe the compositional maturity. Explain how you came to each conclusion.

Sample 8
https://www.virtualmicroscope.org/content/leeds-05-calcareous-sandstone

Describe the nature of the intergranular space in this sample: the amount and nature of matrix, cement, and porosity.

Plot the composition of this sandstone on the QFL diagram.
This sample contains a few fragments of fossil shells (see circle 2, for one of them). Carbonate shells of fossils will often have a dirty brown appearance in plane polars. When making a QFL plot, carbonates are sometimes included as lithics and sometimes excluded from the count. Because these are fossil shells, we'll exclude them from the count.

Give a complete name to this sample, including rounding, sorting, grain size, composition, and amount of matrix (arenite or wacke).

Describe the textural maturity of this sample. Describe the compositional maturity. Explain how you came to each conclusion.

Sample 9
https://www.virtualmicroscope.org/content/s08-sandstone-fluvial
Compare the maturity (compositional and textural) of the large grains to the maturity of the matrix. What do you think could cause that discrepancy?

Sample 10
https://www.virtualmicroscope.org/content/s05-sandstone-arkose-corrib-gas-field
This sample contains an unusual cement mineral - anhydrite. Anhydrite is an evaporite mineral ($CaSO_4$, the anhydrous version of gypsum). Find the areas with anhydrite cement and describe its appearance under plane polars and under crossed polars.

Some layers are tightly cemented with anhydrite, while others have some open porosity (although not a lot). Sedimentologists care a lot about porosity because it's important when you are exploring for fluids (water, oil/gas) or trying to find a place to store fluids (carbon capture by CO_2 sequestration).

The grains seem pretty similar between cemented and uncemented layers, in terms of size and sorting. What might cause some layers to lack anhydrite cement?

(As a hint, remember that anhydrite is an evaporite mineral, like gypsum and salt, so think about what happens to evaporites in the presence of water.)