**ACTIVITY: Which microscope is best?**

**Activity idea**

In this activity, students use the Which microscope? interactive to learn about various types of microscopes and answer questions to determine which microscope is best for a specific sample type.

By the end of this activity, students should be able to:

* use an interactive to learn about different types of microscopes
* use text and media to find facts and answer questions about various microscopes
* use the Science Learning Hub as a research tool.

**For teachers**

***Introduction/background***

Specialised microscopes allow us to view an object’s surface and its internal structures to build up 3D images from thin 2D slices and to look much more closely than we ever have before.

This activity guides students through the interactive [Which microscope?](https://www.sciencelearn.org.nz/image_maps/100-which-microscope) to explore the strengths and weaknesses of eight different types of microscopes.

Students then use their reading, viewing and comprehension skills and strategies to find facts and answer questions about various types of microscopes.

***What you need***

* Access to the interactive [Which microscope?](https://www.sciencelearn.org.nz/image_maps/100-which-microscope)
* Access to the articles [Light microscopes](https://www.sciencelearn.org.nz/resources/501-light-microscopes) and [Types of electron microscope](https://www.sciencelearn.org.nz/resources/502-types-of-electron-microscope)
* Copies of the student handout [Questions about microscopes](#bookmark=id.1fob9te)

***What to do***

1. Use the interactive to learn about the functions of the various microscopes and why scientists have chosen to use a particular type of microscope in their research.
2. Hand out copies of the student handout [Questions about microscopes](#bookmark=id.1fob9te) and discuss.
3. Ask students to use the information within the interactive to report on the functions, uses, advantages and disadvantages of the various microscopes. Refer students to the [Light microscopes](https://www.sciencelearn.org.nz/resources/501-light-microscopes) and [Types of electron microscope](https://www.sciencelearn.org.nz/embeds/12-which-microscope) articles to find specific examples of what scientists might view with this microscope.

***Extension idea***

The Science Learning Hub contains many images and videos that involve a variety of microscopes. Give students a 5-minute challenge to discover how many different types of microscopes are featured in Hub images and/or videos. Students do not need to view the videos. They can skim through the transcript found under each video clip. (Answers include electron, SEM, TEM, atomic force, confocal, microCT scanner, dissection, optical, scanning tunnelling microscopes.)

**For students**

***Questions about microscopes***

Use the [Which microscope?](https://www.sciencelearn.org.nz/image_maps/100-which-microscope) interactive and articles [Light microscopes](https://www.sciencelearn.org.nz/resources/501-light-microscopes) and [Types of electron microscope](https://www.sciencelearn.org.nz/resources/502-types-of-electron-microscope) to complete this table.

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| --- | --- | --- | --- | --- |
| **Microscope type** | **Function** | **Disadvantage** | **Useful for looking at** | **Watch the videos to answer these questions** |
| Stereomicroscope (light) |  |  |  | When does resolution start to run out when using a light microscope?  |
|  |
| Compound microscope (light) |  |  |  | The compound microscope shines light through what part of the sample? |
|  |
| Confocal laser scanning microscope |  |  |  | What example does Rebecca Campbell use to explain how the confocal technique works? |
|  |
| Scanning electron microscope (SEM) |  |  |  | When using a SEM, what gets knocked off the surface of the sample and then picked up by a detector? |
|  |
| CryoSEM |  |  |  | What substance is used to prepare samples for the cryoSEM microscope? |
|  |
| Electron tomography |  |  |  | Does electron tomography use thinner or thicker sections than normal electron microscopy? |
|  |
| Transmission electron microscope (TEM) |  |  |  | What is the TEM’s main advantage? |
|  |

***Questions about microscopes – sample answers***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Microscope type** | **Function** | **Disadvantage** | **Useful for looking at** | **Watch the videos to answer these questions** |
| Stereomicroscope (light) | *Uses light to illuminate the surface of a sample.* | *Usually lower resolution than the compound light microscope.* | *A living thing like an insect or earthworm.* | When does resolution start to run out when using a light microscope?  |
| *2000x magnification* |
| Compound microscope (light) | *Uses visible light to illuminate a thin section of sample.* | *Low resolution compared to electron microscope.* | *Thin cross-sections of a living thing.* | The compound microscope shines light through what part of the sample? |
| *Slice* |
| Confocal laser scanning microscope | *Lets you look at thin slices in a sample while keeping sample intact; look at parts of a cell.* | *Low resolution compared to SEM; see only fluorescent objects; can cause artefacts.* | *Movement of mitochondria around cells, mitosis, primary cilia.* | What example does Rebecca Campbell use to explain how the confocal technique works? |
| *Pancakes* |
| Scanning electron microscope (SEM) | *Lets you look at the surface of objects at high resolution.* | *Resolution not as high as TEM; can’t use living things – need to dry and coat with metal; costly.* | *And generating 3D images of lice, flies, snowflakes.* | When using a SEM, what gets knocked off the surface of the sample and then picked up by a detector? |
| *Electrons* |
| CryoSEM | *Lets you look at the surface of objects that contain liquid (easier sample prep).* | *Resolution not as high as TEM; can’t use living things – need to freeze sample; costly.* | *Things that contain moisture such as plants or food.* | What substance is used to prepare samples for the cryoSEM microscope? |
| *Liquid nitrogen* |
| Electron tomography | *Lets you build up a 3D model from a sample from TEM data.* | *Can’t be used with living samples –extensive prep required; costly.* | *3D view of a cell or tissue.* | Does electron tomography use thinner or thicker sections than normal electron microscopy? |
| *Thicker* |
| Transmission electron microscope (TEM) | *Lets you look at a very thin cross-section of an object.*  | *Can’t be used with living samples –extensive prep required; costly.* | *How components inside a cell (organelles) are structured.* | What is the TEM’s main advantage? |
| *High resolution* |