

## Student Worksheet

### Achoo! Pollen does more than make us sneeze.

**Introduction:** Do you know what pollen is? We all think of it as the stuff that makes us sneeze in the fall and spring. Pollen is the male fertilizing agent of flowering plants, trees, grasses and weeds. It is very important in plant reproduction and, in turn, our agriculture. Pollen grains are very small from 5 to about 200 micrometers or microns ( $1 \times 10^{-6}$  m). Do you know how small that is? If you look at a meter stick there will be 100 millimeters ( $1 \times 10^{-3}$  m) in one meter or the smallest divisions on the meter stick. 100 mm make up one centimeter (1 inch = 2.54 cm). If we put the pollen size in inches it would range from .000197 inches to .00787 inches. Pretty small, right? The other word you will hear in the activity is nanometer or  $1 \times 10^{-9}$  m. If you put the pollen size into nanometers, it will be 5000 nm to 200,000 nm. A nanometer is really small.

You will learn about a high technology microscope called a scanning electron microscope (SEM) which allows us to see very small things like pollen as well as the details of the pollen surface. The surface of pollen plays an important role in fertilization and allergies. Scientist need to know what the size of the pollen is and you will learn how to do this from images of pollen.



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image from Purdue author.

#### Directions for the Activity:

**Part 1.A.** Scale in microscope images.



When looking at images from a microscope, how do you tell how big something is?

When scientists take pictures with a microscope, they put something called a scale bar on the picture. This is a line showing the scale of the picture. The length of the line is shown in the picture.

For example, the head of the worm looks like something out of Star Wars, like it could eat you whole.

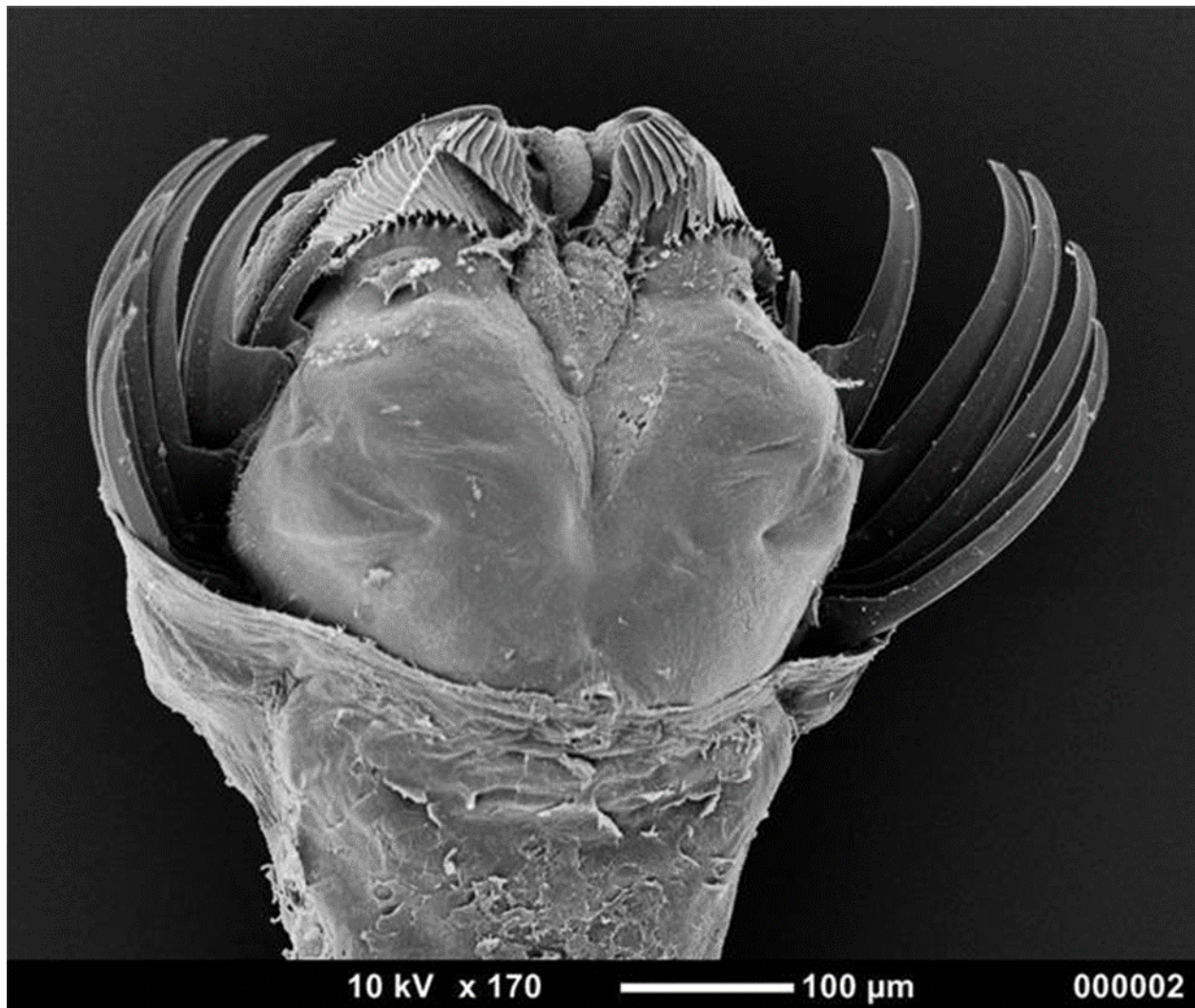
Can you use the scale bar to figure out how big across the head of this worm is?  
Measure how big across the worm head is with a ruler in inches.  
Measure how big the scale bar is in inches.

Use the following formula to calculate how big the worm head is:

Size of scale bar (in  $\mu\text{m}$ ) \* size of worm head (in inches)/size of scale bar (in inches) = size of worm head (in  $\mu\text{m}$ )

Bonus info: These worms are chaetognaths. They are tiny worms that live in the ocean.

<https://en.wikipedia.org/wiki/Chaetognatha>



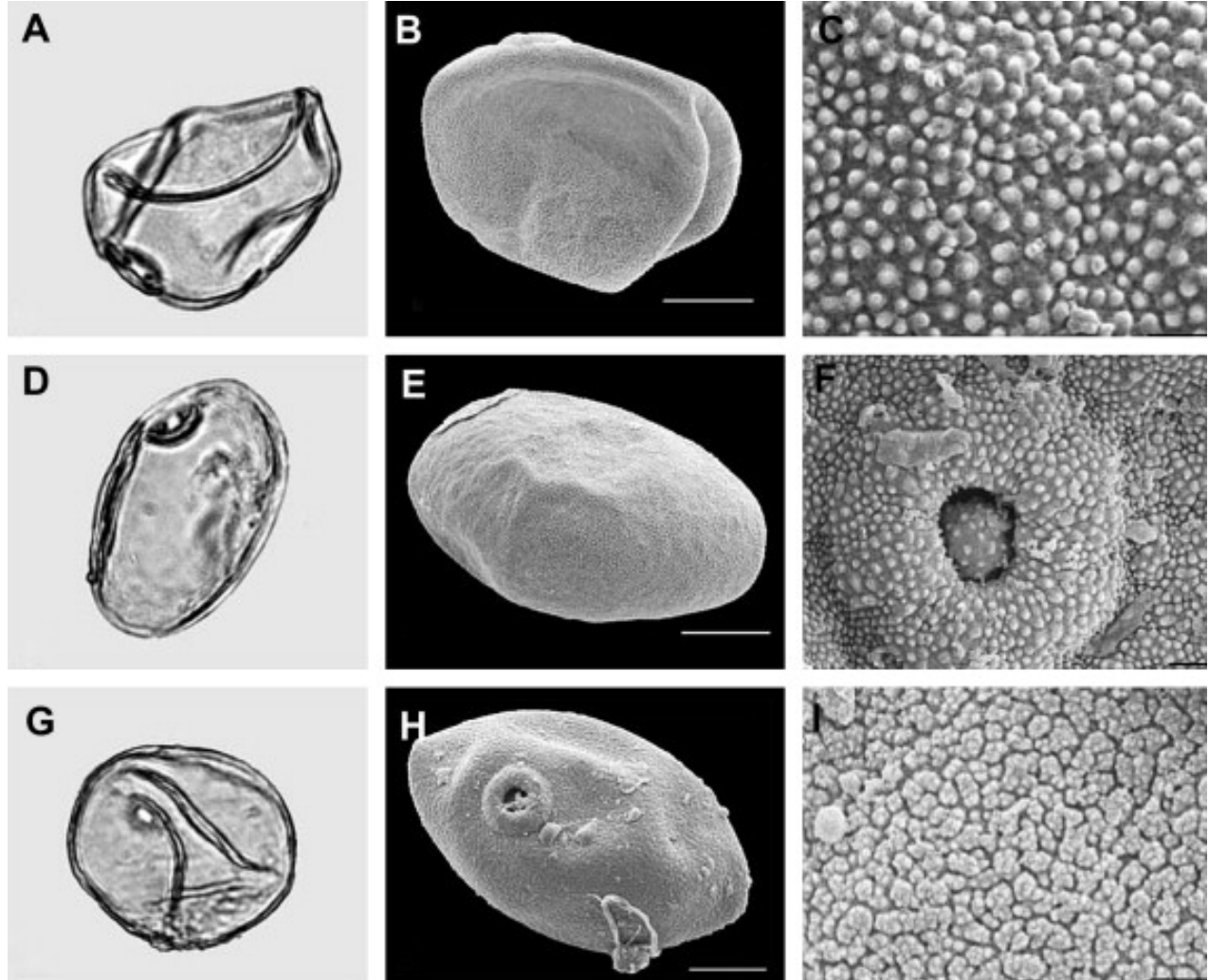
**Part 1.B** What kind of microscope is good for looking at pollen?

Here are some images of pollen grains taken with a light microscope and with a scanning electron microscope (SEM).

Light Microscope

SEM -whole grain

SEM -zoom in



<http://dx.doi.org/10.1016/j.quascirev.2008.12.025>

**Which microscope would you choose? Why? Why do you think they are different?**

Below you can see the parts of the SEM and the resolving power of microscopes. This information should help you decide on what microscope you would choose.



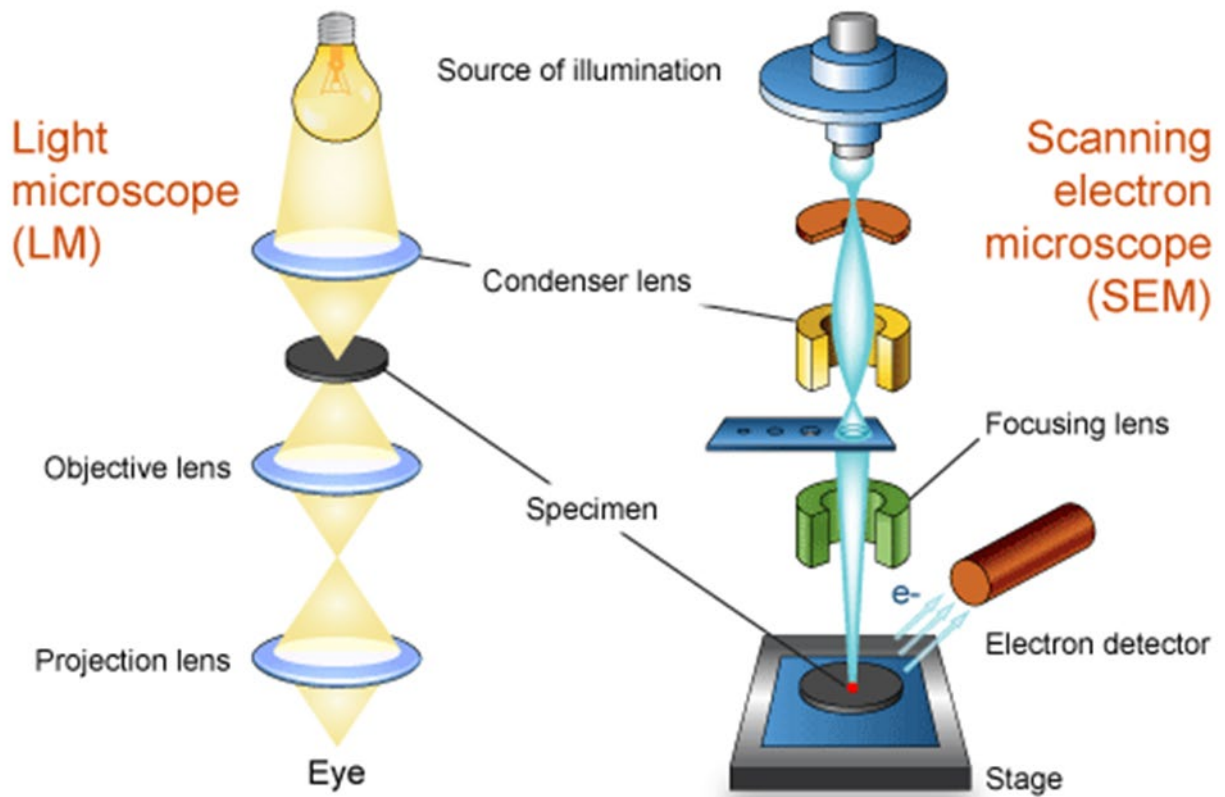
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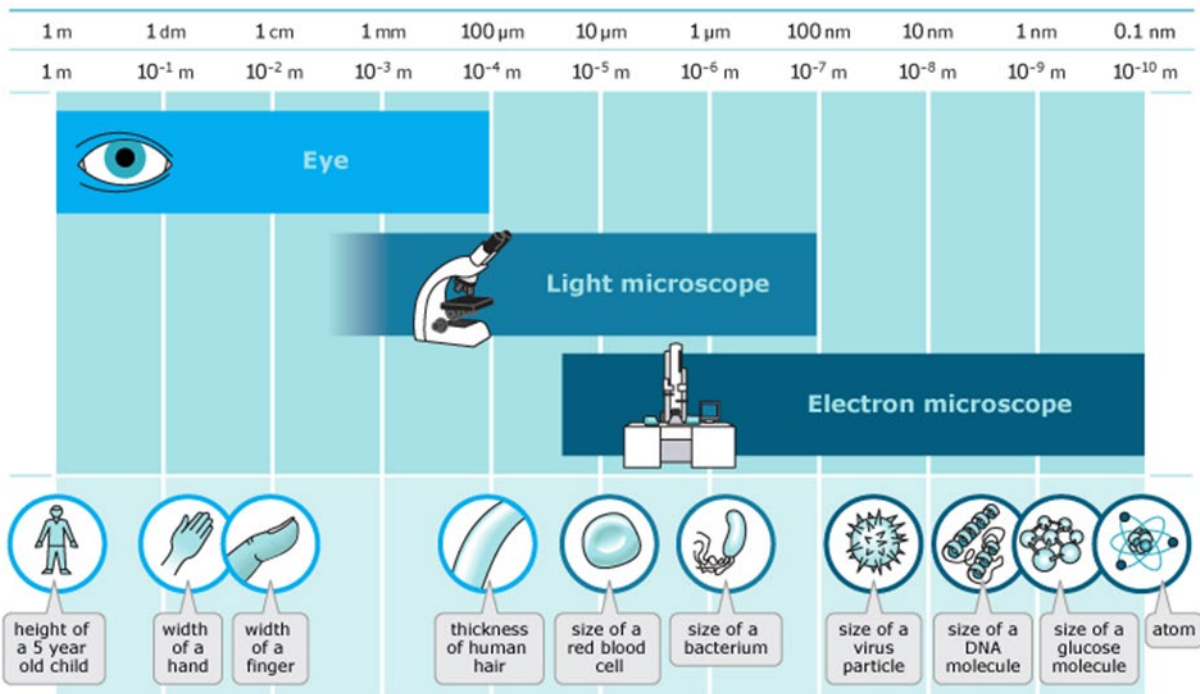
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## Resolving power of microscopes



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## Part 2. Pollen Diversity

Pollen diversity:

Pollen comes in many shapes and sizes.

Largest pollen is from squash: 200um

-twice the thickness of a human hair (100um)

Smallest pollen is from forget-me-not flowers: 5um

-about the size of a bacteria (1-10um)

See an image of this diversity here: <http://www.micronaut.ch/wp-content/uploads/2012/12/%C2%A9-Micronaut-Pollen-Morphology-white.jpg>

**Why do you think pollen might come in so many different shapes and sizes?**

**For many people pollen causes allergies.**

*“The average grain of pine pollen is about 60-90 micrometers in diameter. This is too big to get very far up your nose. Oak pollen is much less visible. Even though there is about as much oak pollen in the air in my neighborhood as pine pollen, you don’t see the oak pollen unless you shake it on to a dark surface. Oak pollen is tiny, 24-38 micrometers, or less than half the size of pine pollen. You may not notice oak pollen, but your nose does.”*

<http://www.planetexperts.com/allergic-to-pollen-its-getting-worse/>

What are some symptoms of a pollen allergy? Write down what pollen allergy symptoms most often include:

What factors influence how likely a particular pollen is to cause an allergy?

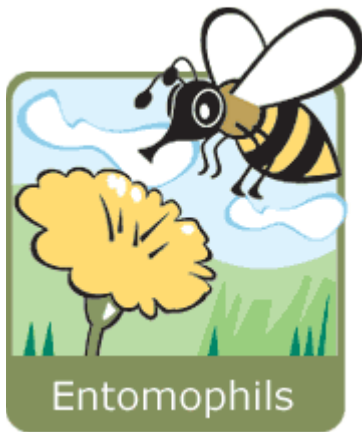


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- **Entomophils** (from the Greek Entomos= insect) → these plants reproduce themselves by means of insects. These usually have very eye-catching and beautiful flowers in order to attract insects, and so their pollen is normally quite sticky. When an insect alights on a flower to suck the nectar, pollen sticks to the hair on its legs. Then, when the insect goes to another flower, some of this pollen sticks and thus fertilizes the plant.



- **Anemophils** (from the Greek Anemos = wind) → these plants reproduce themselves by means of the wind. They do not have beautiful flowers, because they do not need to attract insects. So, they usually have small pollen, that comes off very easily and in great quantities when the wind blows, and is carried by the wind great distances ("aero-roaming"), thus permitting the fertilization of other plants of the same species.

For each of the pollen grain images, fill out the table:

Plant	Scale bar size (uM)	Pollen Size (cm)	Pollen Size (uM)	Shape	Method of dispersal	Sneeze?



### **Part 3. Outdoor activity**

Collect your own pollen samples. Look for blooming flowers and try to scrape some pollen off of the stamen. Look for the less obvious flowers of the wind pollinated plants (like grasses and trees). Take notes about where your pollen came from and label your sample holder.

If you have light microscopes in your classroom, look at your pollen with the light microscope. Draw what you can see.

Your teacher will send the pollen you have collected to a university laboratory, which will image your samples with a scanning electron microscope. You will get SEM images of the pollen showing the size and shape. Look up information about your pollen, the plant it came from, and write the story of your pollen.

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