Teacher's Answer Sheet
(answers here for B1 and B2, the videos, as well as A1 the main activity)

B1: How to Use the SEM

Questions:

1. Why do you want to avoid having air molecules inside the specimen chamber? The electrons could collide with the air molecules and send them off course, creating a fuzzy or incorrect image.

2. Where are the primary electrons coming from in the SEM? The primary electrons are from the electron beam at the top of the pole piece. They are beamed at the specimen.

3. Where are the secondary electrons coming from in the SEM? The secondary electrons are bounced off or ejected from the surface of the sample.

4. How does the SEM convert the electron beam pattern into a picture on the computer screen? The analog signal from the SED is converted to digital through an analog to digital converter. The computer then converts the digital signal into grayscale pixels.

5. Explain how magnification of the compound light microscope and the SEM are different. The compound light microscope uses lenses of varying magnification to enlarge the image of the specimen. The SEM magnifies by making the field of view over which the electron beam travels smaller. (Example: a 1 micron wide scan area will magnify the image 10 times more than a scan area of 10 microns wide)

B2: How to prepare SEM samples

Questions:

1. Josie applies double carbon tape to the stub. What are 2 reasons for doing this? It keeps the specimen firmly planted to the stub and provides a conductive contact between the sample and the stub.

2. What 2 alloys do they use to coat the specimens? Gold and Palladium

3.What is the gas in the sputter coater chamber that glows bluish purple? Argon

4. Why do they rotate the specimen in the sputter coater chamber? In order to deposit the gold and palladium evenly over the surface of the sample.

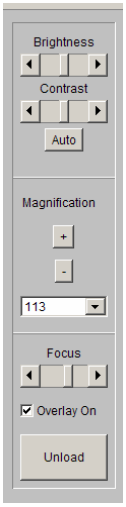
5. After your specimen of the sap beetle goes through the sputter coater, what steps would you have to follow in order to load it into the SEM? 1. Vent the

specimen chamber. 2. Switch on the CCD camera. 3. Open the door. 4. Place the sample stub on the specimen holder and screw in place. 5. Close the door and turn on the pump. 6. Turn on the electron beam.

A1: Run the SEM

Part I: Measuring your specimen

1. Click on the magnification box on the right hand side of the screen and select a magnification of **14**.



2. Move the scale bar so that one end is at the posterior of the beetle and the other end is at the anterior. If placed correctly the bar will be showing the length of the sap beetle.
3. What is the length of the sap beetle at a magnification of 14? (Remember your units!) Approximately 4.3 mm
4. Change the magnification to 113 and once again center the bar to measure the length of the sap beetle.
5. What is the length of the sap beetle at a magnification of 113? (Remember your units!) Approximately 4.3 mm
6. Has the length of the sap beetle changed with a change in magnification? **Why or Why not**? The length of the beetle has not changed because the SEM changes the field of view to smaller or larger but retains the actual measurement of the specimen.
7. What units are you measuring the sap beetles length with? millimeters
8. Measure the width of the sap beetles body in the thorax region.
9. What is the width of the thorax? (Remember your units!)Approximately 1.7 mm

10. Does the length of your specimen fall into the range that is noted on the sap beetle information sheet? Yes

Part 2: Comparison of Appendages

11. On the information that you found at the library it stated that the antennas had 11 segments with the last three forming a club. You now need to compare this data with your specimen.
12. At the anterior end of the sap beetle locate the antenna that is towards the top of your screen.
13. Increase the magnification to 225.
14. How many segments make up the antennae of the sap beetle? 11

15. Does your answer to #14 compare with the information given on the sap beetle information sheet? Yes, the segments are the same.
16. Do the last 3 segments form a club at the end of the antenna? yes

17. Use the measurement bar to measure the length of the club portion (last 3 segments) of the antennae.
18. Length of the club portion: Approximately 3.3 micrometers

19. What units did you just use to measure the length of the club of the antennae? micrometers

20. How many micrometers is equal to 1 millimeter? 1000

21. Using the length of the club portion, convert the length to millimeters. Show your work in the box.

$$\frac{3.3\ \mu m}{x} = \frac{1000\mu m}{1\ mm}$$

$1000x = 3.3$
$x = 3.3/1000$
$x = .0033\ mm$

22. What is the scientific notation for this number? 3.3×10^{-3} mm

23. What is the abbreviation for micrometers? µm

24. Measure the length of one other appendage on the sap beetle.
What appendage did you measure? Answer will vary

What was the length of this appendage? Answers will vary

Part 3: Scientific Inquiry

You decide to use the SEM to answer the following question: “Are the hairs on the sap beetles body the same length?”

25. Before you begin to observe the hairs: What is your prediction to this question? Answers will vary

26. Explain a procedure for determining the size of the hairs on the sap beetle. (List your procedure in steps). Answers will vary

27. Construct a data table for your raw data.

28. Follow your procedure to collect your data and place it in the data table above.
29. What is the range of measurements that you collected in the data table? Answers will vary.
30. Calculate the average length of the hairs in your data table.
    Average Length (don’t forget the units!): Answers will vary
31. Based on the data that you collected was your prediction supported or not supported?
    Why? Answers will vary but should include valid reasoning based on data collection.

Part 4: Conclusion

32. If you were to measure a specimen of a sap beetle in your classroom, what metric unit would you use? Millimeters

33. Would you use the same metric unit to measure an appendage on the sap beetle? Why or why not? No, appendages are much smaller than the entire body and you need to use a smaller metric unit

34. Explain why the use of metric units smaller than a millimeter are necessary for scientific study? Possible answers could include measuring microscopic structures such as cells, cell organelles, protists, etc.

35. What conclusion can you provide for your grandmother about her strawberries? Support your answer with information that you gathered and learned in the lab. Answers will vary but should have support from the lab.

36. Should your Grandmother use insecticides or chemicals to kill the beetle? Why or why not? Answers will vary but a common solution is to get rid of the rotting fruit and the beetle goes way. If you poison the beetles, more still fly over from other areas, attracted to the rotting fruit.