Slides to connect lab data to data from other sources:

Slide 2 – Asks the question...How will you know what your lab results mean? Students will receive population and phenotype data, so they can support or refute their narrow hypothesis. What is important for this lesson is that they know this is not where an experiment ends.

° Prompt: Once you have supported/refuted your hypothesis – what is next?
If the students say – "Do another experiment" – ask: how do you know your first experiment makes sense (what if your data is totally invalid)? How do you know what 'next experiment' to do? If students say "Repeat it", ask what happens if the data is the same….or different. Again, how do you know your first experiment makes sense (what if your data is totally invalid)?

° Get students to the idea that once an experiment is complete, scientists will then see how their data fits into the most current understanding of the organism. Some groups may even collaborate by comparing data and results.

Slide 3 – Asks, what did you measure? Answers should be: Color and Population Size
Ask, What are some things the data requires you to understand? (What is needed in order to make sense of the data?) This can go in many directions, but the teacher should remind students of what they know about color (caused by a pigment used in energy production) and cell division (requires energy).

Slide 4 – Asks, Can difference in color be due to genes? Ask students for examples. *Be sure you discuss not just gene variation which can lead to differences in color (like siblings having different hair color), but also the status of those genes (their regulation) can change the phenotype (remind them of the tan line or hydrangea example from Lesson 1 Intro).

° **Click** – a diagram pops up to show how, in the presence of a certain enzyme, a colorless compound is converted into a red pigment molecule – giving a pink flower. Remind students of how the proteins in an organism relate to its physical appearance and how a lot of this action is an indirect relationship. This is especially true of enzymes that allow biological reactions to occur. If students don't seem to understand, remind them that this DNA is in <u>every</u> other cell of the plant, so... Why are only parts of the petal turning pink and no other portions of the plant? Answer – in the red parts of the petal the gene making this enzyme is activated (turned on and actively transcribing), in other areas it is off. The "environment" of those cells flip on the enzyme making genes.
*POINT: homology data (scientists compare proteins of known pathways to see if the ones they are studying are similar) may help determine what is involved in gene expression resulting in a color change.

Next… What might help explain population growth?

Slide 5-7 - population (growth due to cell division) is connected to energy. Students should learn about current research on pathways of energy production (metabolism data) to help explain their data.
° During the jigsaw activity, students will look at an energy formation pathway (halo use bR to produce ATP using light energy in Halo which will allow them to get a better idea of whether their results "make sense".

Slide 8- shows the Great Salt Lake (GSL) with halo growing in high concentration and asks "what makes halo purple?" This is an opportunity to remind students that they are experimenting with both color and population growth so the jigsaw exercise will offer 3 different types of data that could help them answer confidently.

Slides 9 and 10 - shows a diagram of halo's membrane with purple protein embedded. Click and a box shows around 1 of the purple proteins. Click again and it enlarges.

Slide 11 - asks what the purple protein is actually made of.

Slide 12 - shows it is called bacteriorhodopsin (bR).

Slide 13 - shows retinal and bop inside the cell. Click and they move together to form bR.

Slide 14 - asks what purpose of bR. Allow students to answer.

Slides 15 and 16 - answer (converts light…). Click and light is added. Click again and box appears around 1 of the purple proteins. Click again and it enlarges. * Note that light does not become bR, light increases the amount of BR.

Slides 17 and 18 - click and 2 ATP are made.

Slide 19 - diagram compares ATP production when light is present and absent.

Slide 20 - point out halo in light (left side) has many more purple proteins in membrane than halo in the dark (right side).

Slide 21 - by now students may ask (hopefully) about why there would be more bR in the membrane when light is present. If they haven't arrived at this, the slide 20 asks it for them.

Slides 22 to 24 - illustrate the answer (increases gene expression..initiates transcription). Students will see this during the jigsaw exercise in more detail.

Slide 25 - the final slide states the guiding question for the lesson: "How do halobacterium cells change the amount of bR in response to light?" Explain to the students that they will be modeling what is done in science today (especially when studying a whole system). In setting up their lab they explored environmental influences on halo. In order to fit their research into what is understood about halo – they must look at data from other experiments/scientists. Most scientists tend to specialize (and other scientists will be working on related experiments) so they won't be producing all the data on an organism/system. During the jigsaw each of the 3 data groups will be acting as a separate lab group. When they get together to share their ideas, that will illustrate how scientists work together across many fields to complete the "picture" of a system (e.g. this data would have come from geneticists and biochemists).