



# What's the Big Idea?

A Publication of the K-12 Alliance: A WestEd Program

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## Scaffolding for Learning: Summary Statements

*Editor's note: Here, we continue our series on sense-making notebooks that we began last year. Overall, we recognize notebooks are an important place where students can gather data, communicate their understanding, and reflect on what they learned. For teachers, student notebook entries are windows into student thinking, providing valuable information about what they know and don't know.*

We delve deeper into this series with an emphasis on how student notebooks can be used as an important instructional tool, particularly when entries are student-driven, rather than teacher-directed. This article focuses on the role of summary statements as a way to synthesize data recorded from the experiment/investigation. Summary statements explain patterns in data and form the basis for generalizations and conclusions.

### Conclusions are more than a statement about "most" of the results!

During a recent science grade five Teaching Learning Collaborative (TLC), teachers planned a lesson in which students would write summary statements about living and non-living things based on observations of a wide range of specimens. The intent of the lesson was to have students recognize that cells are a characteristic of living things.

The idea for the lesson evolved from looking at student work from a previous lesson -- students had been asked to individually generate a list of cell structures as well as characteristics for living and nonliving things. (Sample 1 is typical of what the students were able to do.) Students were facile with listing some features of cells, however, they were less clear about the characteristics of living and nonliving things. None of the students listed cells as a characteristic of living things.

The TLC team decided to address the students' lack of knowledge – revealed in their notebooks – that cells are a characteristic of living things. The focus of this TLC lesson was to use a microscope to view living and nonliving items in order for the students to generalize that living things have cells.

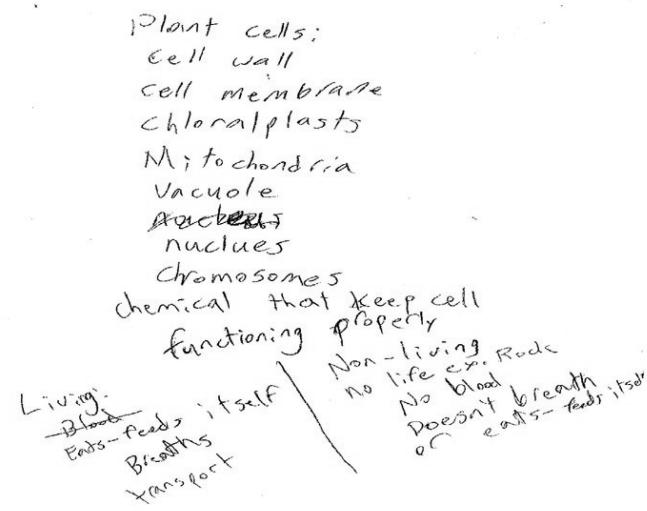
Students were asked to answer the question, "How do living things look different from nonliving things in a microscope?" For the lesson, students were given slides of different "things" (sand, salt, sugar, elodea, onion, blood,

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brain and skin cells), asked to observe each item using a microscope, and then record and draw their observations. (The teacher had a projecting microscope to assist in clarifying student observations.) Students were then asked to review their observations and identify any patterns.

### Sample 1: Cell Parts and Living/Non-living Characteristics



In Sample 2 (see page 8), the student first draws his observation of the different specimens; notice how he uses words to help identify the drawings. Additionally, the student seems to observe some type of organization in the living specimens, and less order in the nonliving specimens. The observations appear to be free from inferences, indicating that the student has an understanding of what makes a quality observation.

**SEE SCAFFOLDING, PAGE 8**

# Spring Cleaning: What's in Your Desk?

By Kathy DiRanna

I was up late the other night, working on yet another grant deadline. I needed to photocopy some graphs, and was looking for that one \$\$#!@\* whiteout bottle that hadn't become clogged and gooey.

While thrashing around, tossing Post-its, staples, pens, scratch paper, chewing gum and Kleenex, I came across a handwritten note. I immediately recognized it as from my mother. As many of you know, she passed away last year, and I wondered what piece of sentiment I had carelessly thrown in the drawer.

I carefully unfolded the paper. She had written a note to her ninth grade graduating class from Audubon Junior High reminding them that their destiny was theirs to create. She ended with a quote from Robert Kennedy from his 1966 speech to South African students. As I read those words, I thought how apropos these ideas still are especially in today's (still) difficult times.

Our national education agenda is in danger of political bickering that seeks to win rather than to solve problems. Here, I share Kennedy's words and encourage you to think about how you stand up for the whole child, for deep learning for all students and for quality education in science, arts, reading, mathematics, physical health, history, civics, language, etc. etc. etc.

## Excerpts from Robert Kennedy's "Day of Affirmation" Speech, June 6, 1966 to students at the University of Capetown, South Africa

*Each time*

*A man stands up for an ideal  
Or acts to improve the lot of others  
Or strikes out against injustice  
He sends forth a tiny ripple of hope.*

*And crossing each other  
From a million different centers  
Of energy and daring  
These ripples build a current  
That can sweep down  
The MIGHTIEST walls  
Of oppression and resistance...*

*Moral courage  
Is a rarer commodity  
Than bravery in battle  
Or great intelligence*

*Yet it is the one essential vital quality for  
Those who seek to change a world  
Which yields most painfully to change.*

*Aristotle tells us: "At the Olympic Games it is not the finest or the strongest men who are crowned, but those who enter the lists. ...  
So too in the life of the honorable and the good it is they who act rightly who win the prize."*

*I believe that in this generation those with the courage to enter the conflict will find themselves with companions in every corner of the world.*

Our companions are you, teachers, educators and lovers of science and math, you who continue to daily inspire not only me, but each other as we continue to fight the good fight to change the world and never, ever, ever back down. ■



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# The Learning Journey

By Richard Pimental

**"I decided to become an administrator to ensure that science is paramount and that we use true and tried methods for teaching and learning."**



Richard Pimental

I was lucky to have the K-12 Alliance save me from the clutches of handouts and lectures in 2001, a mere two weeks after I was hired as a biology teacher with an emergency credential at Coachella Valley High School. Although I was “volunteered” to be a part of the K-12 Alliance Pathway Grant (and literally thrown into the 5E cauldron), I quickly found my niche with a group of sensible people. This grant focused on improving teacher content and pedagogy; it also had a component to encourage and support high school students who wanted to become teachers as they continued through their college training.

I was excited to be part of a program that was examining how people learn and then putting that knowledge into practical applications. Just the way to go when it comes to education, I say!

The concept of a Teaching Learning Collaborative (TLC) fascinated me; I fell in love immediately with the fact that professionals could cooperate in lesson study and design, share presentation pointers and evaluate student work using rubrics.

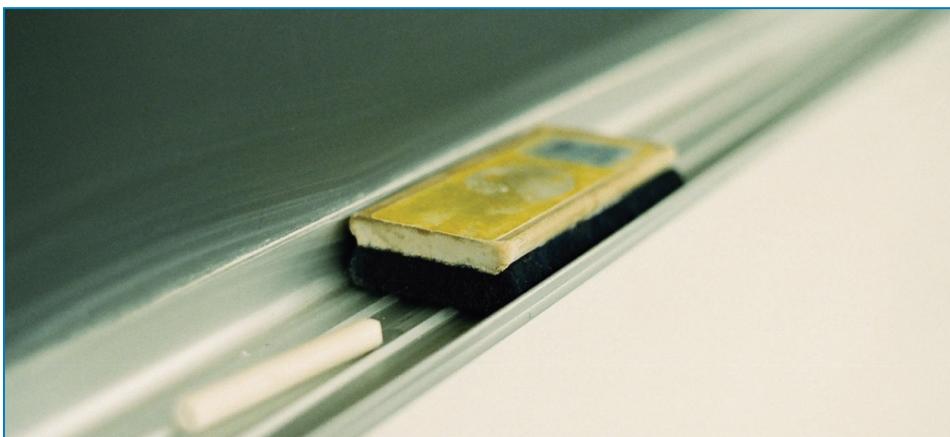
Sadly, our Pathways grant finished and the TLC process went wayward for a while. Then our district, under the District Assistance and Intervention Team (DAIT) mandate, decided to bring an expert to introduce the concept of a Professional Learning Community (PLC), which targeted student thinking as its top priority. This was good and wonderful until I heard the price tag: more than \$2 million dollars a year!

I was not thrilled to hear that our district was spending such a large sum of money and I was disappointed about opportunities the district had missed in the past, especially with the K-12 Alliance. This was the turning point for me. Never again did I want to see science sidelined in our district. I decided to become an administrator to ensure that science is paramount and that we use true and tried methods for teaching and learning.

Currently, I am a student facilitator at Oasis Elementary in Thermal, the first school to use a new grant to teach science to the entire staff. The grant was funded by the California Post Secondary Education Commission (CPEC) and it is a collaborative effort between Oasis, CSU San Bernardino and the K-12 Alliance. Our goal is to use science as a vehicle to improve student writing and we link literacy through authentic experiences in science. As part of the grant, we also are organizing an upcoming family science night, which will extend our science reach to include parents, neighbors and our local community.

I am thrilled that I get to share my passion for science to not only students, but everyone connected to the education process! I plan to be a constant science advocate, using the lessons that the K-12 instilled in me and always holding true to the Alliance's number one principle: Never stop learning! ■

*Richard Pimental is a student facilitator at Oasis Elementary in Thermal, CA.*





# Science Connections with Literature Circles

By William Straits

I used to be an elementary and middle school teacher, however, a few years ago, I took a position at California State University in Long Beach. I still get into the classroom every now and then, and although there is much there that I miss, one of the benefits of my new job is that I have time to really think about teaching and to tinker with specific teaching strategies. I enjoy sharing these ideas with real teachers like you who can put these theories into practical use in your classrooms.

One successful strategy involves literature circles – using historical non-fiction texts to help students make personal connections to science and come to understand science as a human endeavor interdependent with culture, society and history. For example, in the book Double Helix, author James Watson tells of the trials, tribulations, competition and serendipity involved in discovering DNA.

In a nutshell, literature circles are student discussion groups, similar to your monthly book club meetings, but have the added support of providing students with prompts or roles to respond to as they read (Daniels, 1994). The purpose of literature circle roles is to guide students to develop understandings of particular concepts as they explore the text. As students read they perform specific roles; these typically involve recording written notes. In reading a recent blog posting about NASA's decision to send a man to Mars, students can take on the roles of scientists, skeptics, biographers, among others. These notes then support students during meaningfully participation in small-group discussions.

Researcher Harvey Daniels offered several general-purpose roles appropriate for students reading books. In addition, I've designed roles specifically to focus students' attention to issues of the nature of science and to promote students' connection with science as they read historical non-fiction. (For full descriptions of these roles and their use in various grade levels, see Straits & Nichols 2006; Straits 2007; and Straits, Gomez Zwiep, & Wilke 2011.)

## Literature Circle Roles

Generic-roles developed by Daniels	Science-specific roles developed by Straits
Questioner	Everyday-life Connector
Literary Luminary	Science Skeptic
Illustrator	Science Translator
Summarizer	Science Biographer
Researcher	Power Investigator
Word Wizard	Science and Culture Connector
Scene Setter	Nature of Science Investigator

While reading, each student performs a different role and discovers important contributions to make during their discussion group meetings. Conversations should not be limited to simply reporting information; roles should enrich conversations, not delineate them. (See example below).

Make explicit to your students that, "group meetings aim to be open, natural conversations about books, so personal connections, digressions, and open-ended questions are welcome" (Daniels, 1994). During discussions, students should use information gathered via roles to help clarify meaning, draw parallels to other situations, offer additional information, connect the text to the nature of science and investigative skills learned in class and, importantly, articulate related personal experience. These personal connections can help students see the relevance of science in their own lives and motivate them to continue their science learning.

For example, while discussing a book about inventions or discoveries of the past, students' connections may be reflected by sharing their own or a family member's personal experience; these discussions may then spark any number of current event connections that could range from the lives of professional athletes to the Gulf oil spill. The sky is the limit!

Overall, these personal connections can make a world of difference to your students. Using modified literature circles roles, reading and discussing historical non-fiction texts can bring a new light to how science is a part of everyone's daily existence. It's been a productive strategy for me and I hope you will try this method with great success! ■

William Straits is an associate professor in the Department of Science Education at California State University Long Beach in Long Beach. Contact him at [wstraits@csulb.edu](mailto:wstraits@csulb.edu).

## COLLABORATION



# Where Do We Go From Here?

Data is just data. You have to analyze, interpret and act on it for data to mean anything – otherwise, it's just a bunch of seemingly random numbers, facts and figures on a spreadsheet.

But what if data meant that more students could reach their potential? What if these series of numbers helped at-risk kids graduate and get into college? What if data shed light on how teachers could effectively plan lessons?

The K-12 Alliance and Temecula Valley USD (TVUSD) have extended their science education partnership into a new arena involving data that promises to sparkle up the blandest of data into a meaningful, practical and accessible resource.

Digital Assessments, Tools And Strategies That Enhance Proficiency (DATASTEP) is a new project funded under the ARRA EETT-C grant that seeks to:

- Enhance college and career readiness programs and/or to improve high school graduation rates;
- Improve student achievement, that can be widely implemented as best practices by State Educational Agencies and LEAs ; and,
- Provide professional development as an important part of the comprehensive education technology program.

DATASTEP is directed by Karen Vogt, a Teacher on Special Assignment who has also spear-headed partnerships with the K-12 Alliance incorporating TLCs with technology for fourth to seventh grade teachers in math and science.

In an effort to improve the number of students who are classified as “college ready,” TVUSD has selected to collect, manage and analyze algebra data at the eighth and ninth grade level to identify students who are at-risk. TVUSD will also recommend ways teachers can modify instruction, which would ultimately improve graduation rates as well as college and career readiness for these students.

Through DATASTEP, classrooms across secondary sites will be transformed into Algebraic Proficiency and Mathematics Assessment Centers where technology tools will become the common thread that ties together data, professional development, assessment, curriculum and instruction. In addition to equipment to expand the current data management, DATASTEP will offer the district mobile netbook carts so students can have access to digital curriculum and various assessments.

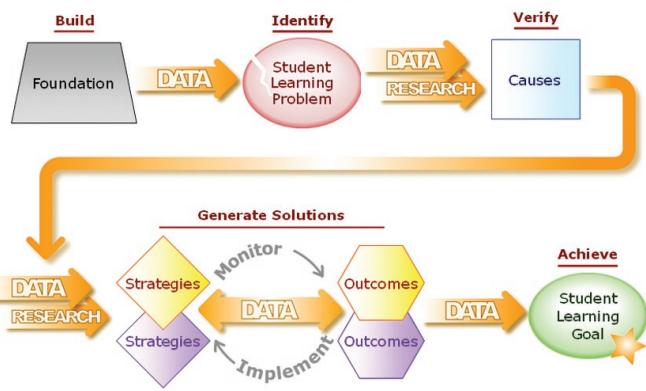
The Apex Student Learning System, an online algebra program, will provide individualized, instruction for students. An assessment component will provide timely and targeted data to teachers so they can effectively track how their students are progressing as well as offer interventions suggestions.

The K-12 Alliance will provide professional development in how to gather, sort and effectively use this data. Mathematics teachers from grades 7-9 will participate in six days of training; they will establish goals for learning and analyze student data from a variety of sources to identify student learning problems. Teachers will then research probable causes for these learning problems which might include strategies like student pull-out programs, inconsistent instructional strategies, or use of different instructional materials.

Teacher participants will then identify behavior and academic patterns of these at-risk students. Once core causes are verified, teachers will finally create logic model design programs and interventions so they can properly identify students at-risk and assess college and career readiness.

The K-12 Alliance is pleased to be a part of DATASTEP; keeping students and teachers on the mathematical track with easy-to-use technology and practical solutions meshes with our philosophy of supporting education on all levels to all levels. This is data that can change and inspire lives! ■

### The Using Data Process



# Ask a Cadre: What About Decomposers?

**Dear Dave:**

**All fourth graders know that food chains and webs have producers, consumers and decomposers. Yet, none of these visual drawings ever seem to include the decomposers. Why is that?**

**Signed,**

**Wondering About Worms and Such**

Dear Order Seeker:

My best guess at the reason those chains and pyramids don't show decomposers is that decomposers aren't easily put into nice neat chains and pyramids. The whole idea of trophic levels – and movement of energy and matter through them – is really a lot messier than any diagrams would suggest. If you are following a single molecule, it's pretty easy to imagine: it always starts with plants (or some kind of autotroph), then goes to something that eats plants, then to something that eats something that eats plants, etc., etc., etc. That's easy.

But when you try to put concrete names on those "somethings," envisioning the whole array of species in some sort of organized set of trophic levels, it gets very messy very quickly, mainly because there is NOT any real organizing force out there.

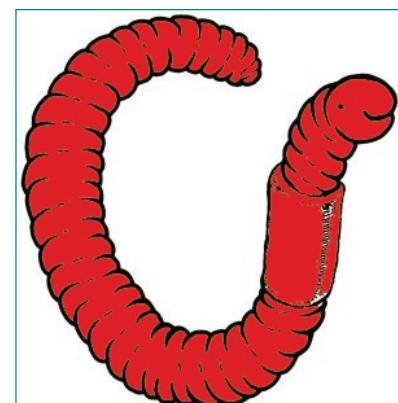
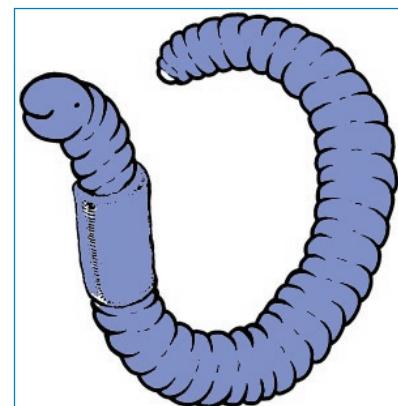
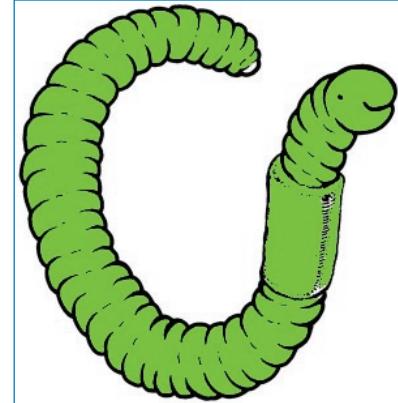
For example, let's imagine a bug eating plant leaves. Should you put the bug in the "primary consumer" trophic level or the "decomposer" trophic level? It's sometimes an easy call, like when the bug is sitting on the living plant chomping on the leaf (we'd usually call the bug a primary consumer). But what if that bug is crawling on the ground, eating a leaf which just fell off the plant? Or, what if that leaf had fallen off a week ago and has some fungal growth already? Or a month ago, and was almost totally "eaten" by bacteria and fungus already (which most people would easily now put in the "decomposer" level). It's always just "a bug eating a leaf," but where to put it is very fuzzy.

Take that one step further: what do you call a nematode now eating that bug? If you call the bug a "primary consumer" the first time, then you would probably call the nematode a "secondary consumer," especially if the nematode was eating the bug while it was still alive. However, if you call the bug a "decomposer" in the first place, or if the bug had died before the nematode started eating it, you would probably feel compelled to call the nematode a "decomposer" instead.

And it goes on. Most people are OK with calling a nematode a decomposer, but what if a lizard ate the bug instead? Lizards aren't usually viewed as decomposers, so one would usually be tempted to always call it a "secondary consumer." However, if you had previously decided that the bug was a decomposer, now you are in a quandary because there are usually NO arrows going FROM decomposer TO consumer trophic levels. Matter and energy are moving in the wrong direction! And it just gets messier and messier the more you think about real world predator/prey and host/parasite interactions.

The bottom line is that our nice neat little boxes and tidy arrows just don't work in the real world. The reality is that the "decomposer" food chain is really just a bunch of consumers. It's just convenient to lump them all in a neat little box and label them "decomposers" if you want to avoid looking at the detail once "the big things" have finished eating. But the reality is that decomposers don't act any differently than all the other consumers – energy is still flowing, matter is still cycling in the same way as all the other consumer levels. And in many cases, it's bouncing back and forth between "consumers" and "decomposers."

Now, what do you do at the K-12 level, where all this messiness doesn't make much sense? Just go with uncomplicated diagrams which try to simplify extreme complex phenomena, and doesn't show all the details.



# Who Wants More Science? BGE Does!

Based on the overwhelming success of its first science fair in 2010, Bell Gardens Elementary (BGE) held its Second Annual Science Fair on February 23. Once again hundreds of students, parents and dignitaries came to see how students are learning about the wide and wild world of science.

The campus cafeteria was the cozy setting where guests engaged in science experiments, listened to excellent student presentations, and learned interesting facts about the fascinating world of science.

To accommodate everyone interested in attending the event, BGE created one day devoted to its science fair; students attended during the school day and families after school.

While participation in the science fair is voluntary for teachers and classrooms at BGE, all classrooms took time to visit the fair during the school day in a well-orchestrated rotation.

Upon approaching the fair, students and guests were greeted with a "Bubbleology" exhibit in the school patio where everyone could experiment with bubbles of all shapes and sizes. Some bubbles were large enough to hold a student!

Once entering the fair, attendees encountered student projects that included investigation of variables, "how it works" exhibits, reports and demonstrations on a wide range of science phenomena. Projects included: composting with worms, recycling, cleaning up oil spills, and even experimenting with finding out whether hair gel or hair spray holds hair together the longest in a windstorm!

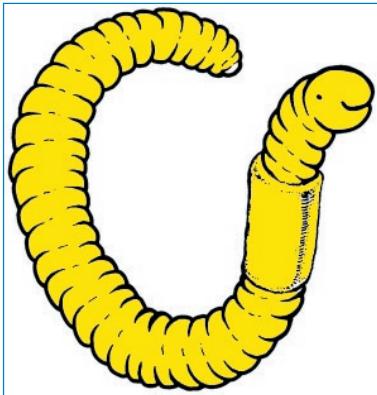
The Discovery Science Center got into the action as well and provided many opportunities for more hands-on science fun.

Oral language and communication of science thinking and learning were evident in every project. Students had rehearsed their presentations and were excited to share their new science knowledge.

Thanks to the emphasis on English language development during science instruction, BGE students are able to use academic content language in an authentic setting. BGE is truly becoming a science-centered school...and everyone is looking forward to the Third Annual Science Fair! ■



## ASK A CADRE (CONTINUED FROM PAGE 6)



But if you want to keep pondering, try this one out. A single organism might (and almost always does) fit into multiple "trophic levels" with each meal. For example, look at a cow. Cows are almost universally considered "primary consumers" or "herbivores." But I don't see cows spitting out bugs, which might be on the plants they are eating. So "cow eating bug" equals "secondary consumer." What about the fungus and bacteria on the bug? "Cow eating fungus eating bug" equals "tertiary consumer." And the story repeats. MOST of the matter and energy in a cow's diet come in at the level of "primary consumer," but SOME of the matter and energy come in at the second, third and higher consumer levels IN THE SAME BITE OF FOOD.

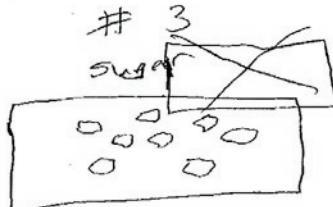
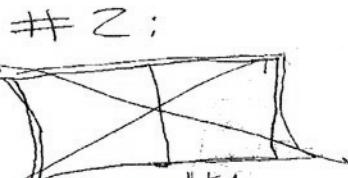
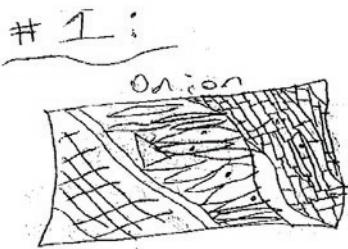
So classifying a single organism (primary consumer, secondary consumer, etc.) isn't really what the food chain is about. Rather, it is about following the path of matter and energy through the various organic components they pass through.

Now that is food for thought!

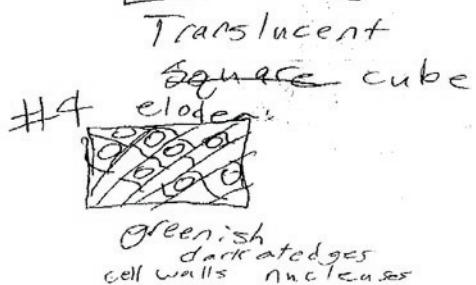
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**SCAFFOLDING (CONTINUED FROM PAGE 1)**

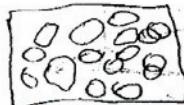
**Sample 2:  
Cell Parts and Living/Non-living Characteristics**



chunky  
Translucent  
uneven



#5  
Blood:



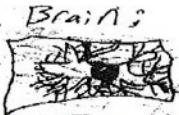
Pink  
roundish

#6



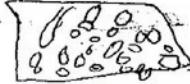
skin:  
fine lines  
nucleas

#7



Brains:  
Tree-like  
designs  
Nucleas

#8  
Sand



Rocks

After making the observations, the student writes a conclusion statement as shown below:

Conclusion:  
All things in the micro-scope are  
tiny. Some are living some are not.

While the conclusion summarizes the task, it does not identify and generalize the pattern (characteristics) that distinguish between living and nonliving items in a microscope.

After reviewing all the student work, the TLC team realized this student's response was typical of many responses throughout the class. While students were capable of independent work in making and recording observations and displaying data, they did not know how to use summary statements to isolate patterns in the data. When students were asked why they went straight to a conclusion without summary statement, the students replied they were only following their Science Fair template.

**SEE SCAFFOLDING, PAGE 9**

### Taking the right steps...at the right time

The team immediately recognized their Science Fair template skipped an important step before a conclusion is produced. Adult scientists analyze data, looking for patterns and generalizations before writing a conclusion. While this step is often not visible on the final science report or template, it's important scaffold thinking about a valid conclusion.

The TLC teachers decided to revise the second lesson to include "think alouds" to model how to analyze the data and write summary statements prior to synthesizing a conclusion. The team was aware of the instructional matrices developed by K-12 Alliance teachers to indicate how strategic planning of scaffolds can move from teacher-directed to student-directed thinking. The team reviewed the matrices on summary statements (See Table 1) and discussed the major differences between each row from Column A (total teacher-directed) through Column D (total student-directed).

**Table 1**  
**Criteria for Summary Statements**

<b>Criteria</b>	<b>Teacher-Driven Learning</b>		<b>Scaffolds to</b>		<b>Student-Driven Learning</b>
	<b>Column A</b>	<b>Column B</b>	<b>Column C</b>	<b>Column D</b>	
1. Answers the testable questions with data.	Teacher leads discussion—How to answer question using data, using a pre-designed format.	Teacher models "think aloud" for making a summary. Students try using format teacher used.	Students work in partners to make summary statement with data using previous format or one of their own.	Students write their own summary statements. They will design own format, but may use prior criteria format.	
2. Summarizes what was done in the experiment.	Teacher leads discussion on how to summarize the experiment. Introduces criteria for a summary and provides an example. Criteria is posted for use as reference.	Teacher "thinks aloud" what was done in the experiment. Teacher completes most steps of the summary and asks partners or small groups to complete the summary.	Students work with partners to create a summary of what was done in the experiment. Student may use previous example if criteria is not internalized.	Students write their own summaries of what was done in the experiment. Student may use criteria as a reference if not yet internalized.	
3. Provides the range of data for the highest and lowest values.	Teacher gives them the definition of range for highest and lowest.	Teacher models with different set of data. Students come up with range for high to low of presented data.	Students work in pairs to select which value is lowest and highest. They discuss what value the information has.	Students organize the data and justify the organization.	
4. Describes the shape of the line; tells about the change between data points.	Teacher leads a discussion on the shape of the line created by the data. Teacher gives details about the change between data points	Teacher models how to think about the shape of the line. Teacher, with student input, completes a description of a line from data.	Students work in pairs to describe the shape of lines using any prior (previously-introduced) format or design.	Student describes data points using a created design or format.	
5. Summarizes the relationship between the variables.	Teacher leads discussion using pre-determined criteria. Teacher provides a pre-determined recording sheet.	Teacher models thinking involved in summarizing relationships using a pre-determined record sheet. Students fill in beginning with teacher and finish on their own.	Students work in pairs summarizing relationships using a format of their choice (from prior lessons).	Students write their summaries using their own designs with possible references.	

**SEE SCAFFOLDING, PAGE 10**

## SCAFFOLDING (CONTINUED FROM PAGE 9)

The TLC team asked themselves:

- How is the teacher modeling thinking about summary statements and conclusions when using Science Fair templates?
- How is the teacher facilitating decision making about data patterns the students? (This may include data that is not conclusive at this point.)
- How are students individually measuring progress, including using criteria?

In planning the second lesson, the team focused on how to provide appropriate scaffolds that model thinking about summary statements, while still allowing students to maintain control over the appearance and detail of their summary statements. The team pondered using the sentence frame strategy and eventually rejected using these scaffolds since it appeared that students needed to know how to think about the process, not just find the correct words. The team thought frames might restrict student thinking.

The second lesson design also included posting criteria (See Table 2) for writing summary statements, which allowed students to measure their own progress. For the lesson, the TLC teachers planned to model the use of these criteria with a “think aloud” while analyzing a sample data sheet. The teachers thought these lesson revisions would help students write successful summary statements.

**Table 2 Summary Statement Criteria**

- Answers the testable question with data
- Summarizes what was done in the experiment
- Provides the range of data for highest and lowest values
- Describes the shape of the line; tells about the change between data points
- Summarizes the relationship between the variables

After the second teaching, the team came together to debrief the impact of their changes asking: What do students know about summarizing data after this lesson? What does the teacher know about student thinking about summarizing? What evidence promotes use or non-use of the “think aloud” scaffold?

The teachers analyzed the set of student work and noted that 75 percent of the students wrote summary statements of the data that met the basic criteria for summary statements. What an amazing difference!

While the student work in Sample 3 does not summarize what was done in the experiment (microscope observations), the student sorted the data based on characteristics and was able to synthesize how living things and nonliving things are alike. For example, the student noted which specimens had a nucleus and which did not. The student grouped together specimens that were angular from those that were more square-like; and he also sorted which had cell walls and which did not.

The student work also reveals that the student had made some classifications that are not related to his observation. For example, #5 does not have any traits the other specimens have in the cell category, yet it is placed there. A better summary statement would have explained this specimen is not following the pattern noted with others in the living category (i.e., nucleus, cell wall).

The TLC team ended the debrief session suggesting that the host teacher extend their students’ writing by introducing how to best write conclusions, based on the summary statements.

The next day, the teacher posted a criteria chart (see Table 3 on page 11) for writing conclusions, and discussed the criteria with his students. He reminded his students they did an observational investigation, not a controlled experiment. Students reviewed their problem question: “What are differences between living and non living things when viewed with a

**Sample 3**

Summary statements:  
1. #2 & #3 are translucent.  
2. #1, #4, #6, and #7 have ~~nucleus~~ no nucleus.  
3. #2 and #3 have angles.  
4. #2, #3, #5 have no nucleus. But ~~#5~~ #5 is round not cube or chunky.  
5. #5 is doughnut shaped.  
6. #4 has lots of nucleuses & cell walls.

<u>Cells:</u>	<u>non-cells:</u>
#1 Yes nucleus walls	#2 No X no nucleus or walls
#4 Yes nucleus walls	#3 No no nucleus or walls
#6 Nucleus carries oxygen has color/pink	#8 No no nucleus or walls random shapes
#7 Nucleus	

**SEE SCAFFOLDING, PAGE 11**

**Table 3**  
**Criteria for Conclusions**

- Based on summary statements
- Supports or refutes the cause and effect relationship between the variables
- Discusses any unresolved questions
- Includes error analysis of the data
- Answers the problem question or explains why it cannot be answered at this time

microscope?" The teacher once again reminded students that their conclusions should include summary statements and generalize the characteristics that make something living based on their observations.

In reviewing the student work, the teacher noted that 80 percent of his students used their summary statements—with data—to draw their conclusions. In Sample 4, the student indicated the importance of a nucleus and sometimes a wall (both indicators of cells), but did not use the word "cell" as a characteristic of living things.

#### Sample 4

##### Conclusions:

When I look in a micro-scope I will know its living if it has a nucleus color, and sometimes walls. I will know its non-living if it has no color sometimes, no nucleus or walls.

At the next grade level meeting, the host teacher shared his experience with having students construct conclusions. Together, the TLC team discussed how using "think alouds" as a thinking model shows students how to find patterns in the data. They also realized that fifth grade students' mental cognitive processes for summarizing and making conclusions may not be fully developed and that additional strategies are often needed to help students generalize for conclusions. The team also recognized why conclusions on Science Fair templates need to be supported by explicit work on summary statements. ■

*In our next article in this series, we will examine how to build student independence around developing experimental procedures for fair tests that include hypothesis generation, variables and controls. Until then, we hope you try scaffolding with the purpose of creating independent student learning. We'd love to hear how scaffolding has worked in your classroom! Please send your stories, experience and comments to [www.K12alliance.org](http://www.K12alliance.org).*