Figure 1
ELL strategies in the science classroom (Carr, Sexton, and Lagunoff 2002)

ELL strategy	**Sample procedures**
Paired/cooperative groups	• Pair by same language: same level for workstations, with stronger English speaker for lessons, labs, and investigations • Pair ELL student with native speaker in regular classes • Group beginner ELL students with advanced ELL students • Be flexible, depending on the activity: can use native language, level for remedial work, select own partner
Background/prior knowledge	• Pictures of setting for lesson content • Whole-class discussion and visual prompts using a PowerPoint • Verbal/written surveys to determine what is known about the topic • Questioning strategies eliciting knowledge of related topics
Visual references	• Photos • Illustrations • Actual samples • Picture books and dictionaries, both trade and student created • PowerPoint slides • Use of actual samples of fossil, minerals, rocks, etc.

Demonstrating	• Demonstrate lab techniques such as measurement, equipment use, fossil and rock identification, and so on, as follows:
	  ○ Can perform classroom demonstration in front of room
	  ○ Can demonstrate in front of student groups while others perform activities
	• Use Elmo equipment to magnify and project to a large group
	• Create PowerPoint slideshow showing step-by-step activities
	• Train several student "experts," have them demonstrate for student groups
	• Demonstrate writing, data entry, and graphing by talking through analysis, typing and projecting responses with overhead or laptop and projector

Words: language prompts	• Posters • Interactive word wall • Reference glossary • Sentence starters

	• Word banks • Simple science readings and student-created writings as models
Hands-on activity	• Practice using science equipment such as beakers, calipers, and balances • Incorporation of science skills such as measurement, observation, and identification • Passing around samples relevant to science lesson, such as rocks, shells, leaves, minerals, etc.

Figure 2

Fossil picture reference sheet

Figure 3
Fossil investigation lab report

Fossil Finders Investigation	Name _____Group #_____ Class_____Date
1. Question	How can fossils be used to provide evidence of environmental change?
2. Hypothesis	*If* marine fossils such as clams are found on top of a hill in upstate New York, *then* upstate New York must have once been covered by water because clams are found living in water today.
3. Materials	Hand lens; marine fossil samples in zipping bags labeled with the sample number; extra zipping bag for examined fossils labeled "finished"; newspapers to protect the desks; colored pencils for graph; fossil picture reference sheet, and fossil language reference sheet
4. Procedures	1. Record the sample number of the bag your group received on the data table. 2. Remove rocks and fossils from your assigned bag. 3. Examine each rock for the presence of a fossil(s). Allow each person in the group to examine several rocks.

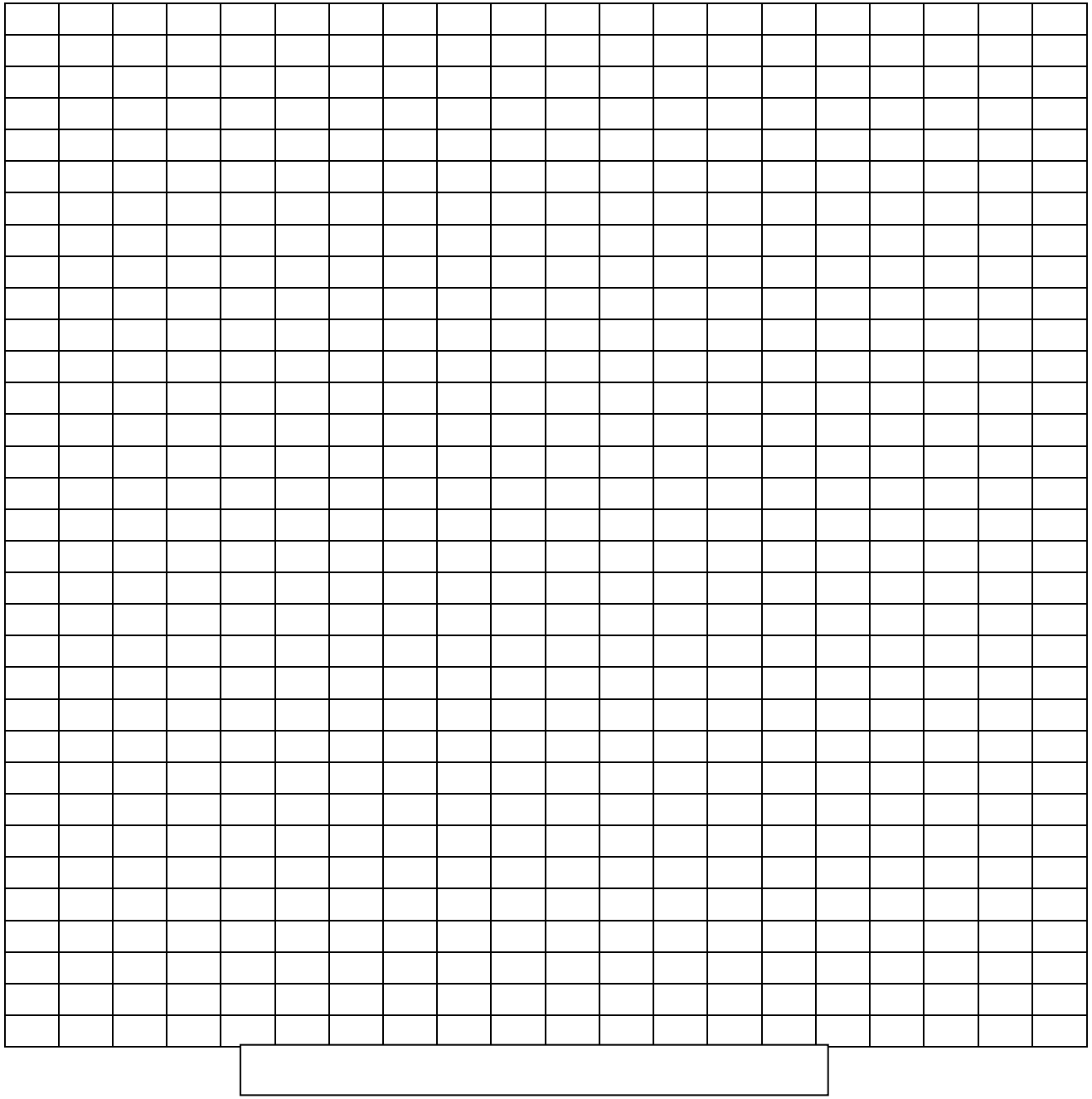
	4. Identity each fossil you find using the reference sheets if necessary. 5. Place the examined rocks into the other bag labeled "finished." 6. Put a tally mark in the correct cell of the data table; total up your tallies. 7. Add everyone's totals from your group and write it in the "Your Group Total" column. Everyone at your table should have the same numbers in this column.

Bag number: **Fossil tally table**

Fossil type	**Your tally**	**Your total**	**Your group total**	**Class total**
Brachiopods				
Clams				
Trilobites				
Snails				
Cephalopods				
Bryozoans				
Corals				

5. Data	1. Create a graph to display our total class data 2. Include a title, labels for the *x* axis and *y* axis, and use an appropriate scale and key

Title:



Fossil type	Total	Key	Fossil type	Total	Key
Brachiopods			Cephalopods		

Clams			Bryozoans		
Trilobites			Corals		
Gastropods			Crinoids		

	Answer questions 6 and 7 in complete sentences. Continue and attach a separate piece of lined paper if needed
6. Analysis	1. What type of fossil do we have the largest number of? 2. How does this compare to your amount? 3. How do the fossils you found prove that the environment of New York state has changed over time?

7. Reflection	1. Why is it important to study fossils? 2. How did you feel doing a real scientific investigation?

_____
_____
_____
_____
_____

Figure 4

Fossil names

	Fossil names
1.	Trilobites
2.	Brachiopods
3.	Clams
4.	Snails
5.	Crinoids
6.	Corals
7.	Bryozoans

Figure 5

Science function words and phrases (Carr, Sexton, and Lagunoff 2002)

Function	**Words**	**phrases**	**Sentence starter example**
Define	means	Is the same as	Extinct ***means***_____
Giving examples	Including; include	For example; such as	Marine fossils ***include*** trilobites, _____
Adding ideas	Also; another	I would like to add	***Another*** way to identify brachiopods is _____
Showing order	First, second, next, finally; before; after		***First***, we learned to identify _____

Showing cause and effect	Because; therefore; since	As a result of; If…then	***If*** marine fossils such as clams are found on top of a hill in upstate New York, ***then*** the upstate New York must have once been covered by water because clams are found living in water today. ***Because*** we all worked together in our group_____
Comparing	like	Just like; same as	Brachiopods were marine animals ***like*** _____ Gastropods have shells ***just like*** _____
Contrasting	But; however	Different from; instead of	Brachiopods are symmetrical, ***however***, _____
Concluding	Finally	I learned; I discovered; I think; I concluded	After our investigation***, I concluded*** that_____ After looking at the fossils, ***I learned*** that _____

Figure 6

Fossil Finder power words

Fossil Finder power words	
Word	**Meaning**
Asymmetrical	Having two halves that are not the same
Coil	A loop or curl
Concentric	Curved lines circling a common center
Environment	The surroundings where organisms live
Extinct	No longer in existence
Fossil	Preserved remains of prehistoric organisms
Hypothesis	An educated explanation that you test
Marine	Found in the sea
Organism	A living thing
Paleontologist	Scientist who studies fossils
Radial	Lines spreading out from a common center
Symmetrical	Having two halves that are the same

Figure 7

Fossil investigation rubric

Criteria:	**4 Exceeding expectations**	**3 Meeting expectations**	**2 Approaching expectations**	**1 Below standards**	**Points**
Fossil identification (25 points)	Identifications are complete and accurate	Identifications are complete, but have a few inaccuracies	Less than half the identifications are present or correct	Identifications are missing or inaccurate	
Data collection and graphing (25 points)	All data are accurately recorded and graphed	All data are recorded and graphed; some errors such as labeling	Less than half of the data are recorded, graphed, or correct	Data are missing from table and graph	
Analysis (25 points)	Analysis and explanation follows from the data and observations in investigation	Analysis and explanation present, but incomplete	Either analysis or explanation missing, or only partially support observations	Analysis and explanation are missing, or do not relate to the investigation	
Reflection (20 points)	Reflection is thoughtful, relevant, and shows insight into the investigation	Reflection shows some insight into the investigation	Reflection shows little insight into the investigation	Reflection is missing, or shows no insight or relevance to the investigation	

Writing conventions (5 points)	No more than two misspellings or grammatical errors	A few misspellings or grammatical errors (3–7)	Several misspellings or grammatical errors (8–12)	Many grammatical errors; illegible writing is difficult to read	

Fossil Finders Investigation: Task

Earth's environment has changed many times throughout its history. Geologists and paleontologists study rocks and the fossil record to piece together this history of change. Fossils are clues to Earth's past, and can tell us when life first appeared, as well as how the environment of Earth has changed. This investigation allowed students to examine a group of fossils from a specific period in time (Devonian) and explain how the marine fossils found during that time provide evidence of environmental change.

I showed students a PowerPoint to introduce fossils and how they help scientists piece together Earth's history. Students were shown vocabulary words that were necessary to understand the activity, as well as the fossil names, which we practiced pronouncing. Students were then shown representative photos of the fossils they could expect to find during the investigation. I pointed out any distinguishing characteristics to help identify specific fossils.

I had selected students in the class who served as group leaders based on their English speaking ability and their native language. Students in my class speak Spanish, Bengali, Tibetan, Hindi, and Urdu, among others, so I tried to select leaders from each of these language groups. The leaders met with me several times before the investigation during our lunch period, and become "experts" by looking at sample fossils and practicing their pronunciation and identification. These leaders carried fossil samples around the room after students had seen them on the slides, and let students examine them. I followed up with a PowerPoint quiz to reinforce fossil types and pronunciation.

Students were given a lab sheet, which we went over together. We discussed the question, and how you create a hypothesis based on the question. We also reviewed the supplies and processes that were involved in the investigation. The lab sheet also included a data table to record fossil data, a blank graph, and spaces to write analyses and reflections.

1. I assigned students into groups (4–6 students) based on common languages with a leader. The leader was to be the fossil expert and directed the group to work together to identify the fossils.

2. Each group's table had the following supplies: newspapers, hand lenses, empty gallon-sized sealed plastic bag labeled "finished," a picture reference sheet of each fossil students might have encountered during the investigation, and a language sheet with fossil names, important vocabulary words, and function words and phrases.

3. Each group of students received a bag of fossils labeled with a sample number such as 1, 2, 3 etc.

4. Students spread newspaper on their table. They poured the fossils onto the table. If the fossils are not from an actual site, sediments such as small rocks or sand can be added to the bags for authenticity.

5. Students examined the fossils, and identified them by comparing them to the pictures on the reference sheet. They worked in pairs within the group: one identified the fossil, while another added a tally mark to the data table. After the fossils were identified, they were placed in the "finished" plastic bags so they couldn't be reexamined. After all the fossils in the bag were identified, everyone in the group shared their tally numbers so they all had the same group total for each type of fossil.

6. The group leaders then brought me their copy of the lab sheet. I input this data onto the Class Fossil Tally Total table on my PowerPoint. I projected my PowerPoint onto a whiteboard, so I wrote the data totals directly on the board. This can also be done with a Smart Board. If neither of these are available, data can be typed onto the computer. Students can then copy the projected data onto their own tables.

7. I projected the graph onto the board and reviewed graphing basics. We had a whole-group discussion and created a title, labeled the *x* and *y* axes, and determined the scale. We discussed creating a key to distinguish the different types of fossils that were to be graphed. Students then created a bar graph on the blank graph on their lab sheet from the data.

8. I allowed students class time to complete the remainder of the lab in case they needed assistance. When I do this with a native English-speaking class, I let them take the lab home to complete. In my ELL classes, students worked in groups to complete the analysis portion of the lab. They then completed the reflections in class, but individually.

9. As a closing, I asked if anyone wanted to share their reflections. Several students shared what they thought about the lab and their experience as "scientists." This discussion helped me assess whether students had truly understood the entire investigation. I also collected the completed lab sheets, which I graded with a rubric for accuracy.

In terms of timing, I would allow two or three periods (40 minutes each) to introduce the concept of fossils, show the fossils we were looking for, and review the lab sheet and investigation. The actual investigation can be completed in one period if students work cooperatively. In the event that students don't finish their entire sample bag, students were asked to write the sample number on their lab sheet. This bag can be returned to the original group to complete. Two further periods should be allotted to complete the graph, the analysis, and the reflection.