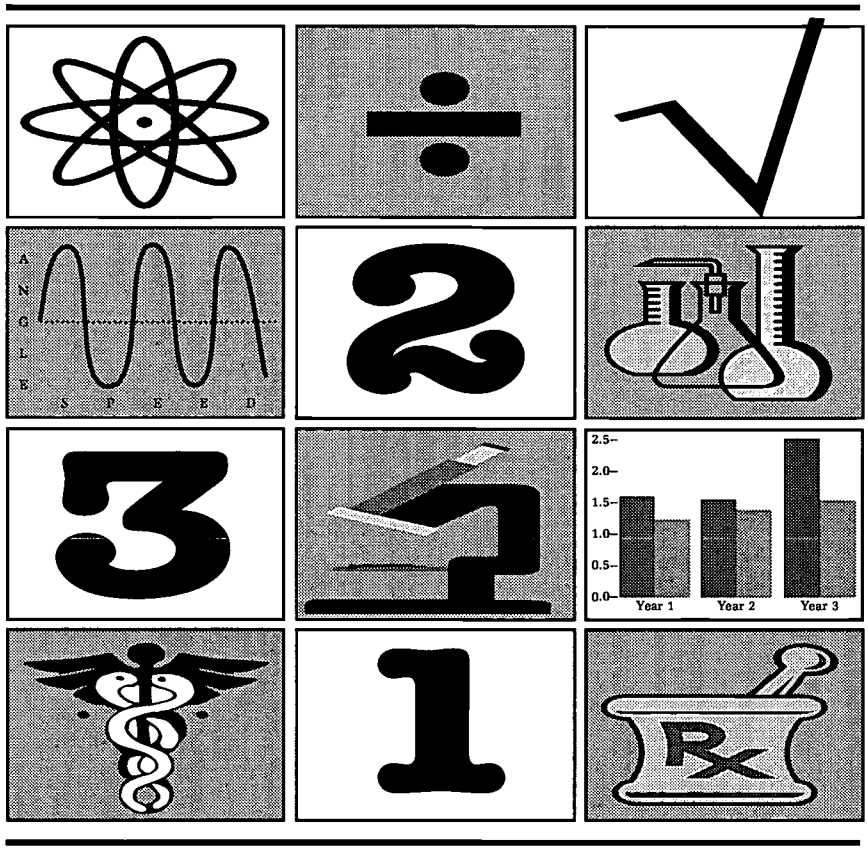
Guide to Scoring LEP Student Responses to Open-Ended Science Items



SCASS LEP Consortium Project

Authors

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Council of Chief State School Officers
1999

Council of Chief State School Officers

The Council of Chief State School Officers (CCSSO) is a nationwide, nonprofit organization composed of the public officials who head the departments of elementary and secondary education in the states, the District of Columbia, the Department of Defense Education Activity, and extra-state jurisdictions. CCSSO seeks its members, consensus on major educational issues and expresses their views to civic and professional organizations, federal agencies, to Congress, and to the public. Through its structure of standing committees and special committees, the Council responds to a broad range of concerns about education and provides leadership on major education issues.

Because the Council represents the chief education administrators, it has access to the educational and governmental establishment in each state and to the national influence that accompanies this unique position. CCSSO forms coalitions with many other education organizations and is able to provide leadership for a variety of policy concerns that affect elementary and secondary education. Thus, CCSSO members are able to act cooperatively on matters vital to the education of America's young people.

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In collaboration with state education agencies, the federal government, and national and international organizations, the Center contributes to a set of useful and valid measures of education geared, when appropriate, to education standards. The Center also supports efforts by states to use standards to improve instruction through collaborative activities of states and others within the education field.

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The consortium activities, including the development of this guide, were coordinated by CCSSO staff members, Julia Lara, and former Director of SCASS Projects, Edward Roeber. The text in this document is the product of a number of talented and dedicated practitioners working at the state and school levels, in particular, members of the scoring guide development and review committee listed in appendix A of this document. However, the document was principally written by Rebecca Kopriva, formerly Delaware Assessment Director and now a private consultant, and Ursula Sexton, national panelist, teaching consultant, and National Science Teacher 1998.

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List of Acronyms

BICS	Basic Interpersonal Communication Skills
CALP	Cognitive Academic Language Proficiency
CCSSO	Council of Chief State School Officers
DODEA	Department of Defense Education Activity
ELL	English Language Learner
IRT	Item Response Theory
LEP	Limited English Proficient
SCASS	State Collaborative on Assessment and Student Standards
SEA	State Education Agency

1.0 INTRODUCTION

1.1 The SCASS LEP Project

The State Collaborative on Assessment and Student Standards (SCASS) for Limited English Proficiency (LEP) is one of ten SCASS projects administered by the Council of Chief State School Officers (CCSSO). The SCASS LEP project is jointly administered by staff from the Council's State Education Assessment Center and its Resource Center on Educational Equity. The SCASS projects assist states in developing student standards and assessments by working with other states with similar interests. SCASS improves the quality of the student assessments that states are developing and using, reduces the time that it takes for innovations in assessment to be adopted on a wide-scale basis, and reduces the costs required to develop these assessments.

As its overall goal, the Assessing Limited-English Proficient Students SCASS consortium develops procedures and materials for more appropriate assessment of English language learning (ELL) students, including research on effective programs for English language learning students, language proficiency measures, and other materials related to measuring academic achievement.[1]

1.2 Development of the Guide to Scoring LEP Student Responses

Members of the SCASS LEP Consortium have developed this training guide to help scorers accurately measure the performance of LEP students on open-ended science performance items. This guide, as well as *The Guide to Scoring LEP Student Reponses to Open-Ended Mathematics Items,* which was published by CCSSO in 1997, was developed in response to scoring needs identified by member states. The science guide builds on its mathematics counterpart and input from a multistate work group of science educators convened by CCSSO in August 1997 and June 1998. (See Appendix A for a list of committee members.) These educators, from California, Florida, Wisconsin, and Pennsylvania, discussed at length the linguistic features that were apparent in the science responses of LEP students with whom they work. These features were determined to be the most salient features for monolingual scorers to be aware of in order to score LEP student papers. Hence, not all linguistic features that might be shown in LEP students' responses are reflected in the discussion contained in this guide.

Besides the guide for scoring mathematics responses, other products of the SCASS LEP Project include *Large-Scale Assessment Scoring Accessible For LEP Student,* a report analyzing the results of piloting the

[1] In this guide the term LEP and ELL will be used interchangeably.

linguistic training that took place January 1997 and *Ensuring Accuracy in Testing for LEP Students: A Practical Guide for Assessment Development.* The report documents the results of a study that sought to ascertain whether the scoring of LEP students' papers could be improved by training scorers to be sensitive to the linguistic features identified in the scoring guide. The guide outlines specific strategies to increase the validity of new and established tests for LEP students in terms of development, administration, scoring, reporting, use, and evaluation.

In responding to assessment items written in English, English language learners (ELLs) are required to read, interpret, devise a solution, write out their scientific rationale, and, very often, communicate their reasoning in writing. This present guide presents linguistic issues and identifies indicators that can be used in the training of monolingual English scorers of open-ended science problems from high-volume district or statewide achievement assessments. The information can also be used by teachers to aid them in accurately evaluating classroom work. The guide is arranged in such a way that it can and should be adapted to local training conditions, and to the needs of various large-scale and classroom endeavors.

This document contains linguistic training guidelines, a brief discussion of issues related to the accurate development of assessments for this population, and a glossary of terms.

1.3 Background Information about ELL Students

English language learners are students from homes where a language other than English is the principal means of communication. Some students were born and raised abroad, while others were born and are reared in the United States. The degree to which they were educated and are literate in their native language varies from very little to extensively, as does the amount of academic instruction they have received in English before test administration. Consequently, while all ELLs are in the process of acquiring English, they are typically at different stages of acquisition with respect to conversational English (basic interpersonal communication skills, or BICS) and to the use of academic language (cognitive academic language proficiency, or CALP) in the various content areas. Likewise, their English reading and writing levels tend to vary considerably.

1.4 Issues Related to the Development of Language Proficiency

Most states require ELLs to participate in districtwide and statewide tests after their second or third year of schooling in the United States and/or after having achieved an intermediate level of English language proficiency. The belief that level of language proficiency has little or no effect on the learning of science and, therefore, on the

assessment of scientific knowledge, may lead to erroneous decisions. ELLs who are in the process of acquiring a basic knowledge of English vocabulary, syntax, and semantic properties will most likely have problems in understanding and interpreting science assessment items that are language based. In addition, students who are in the process of learning English will develop a degree of proficiency in social language skills (survival English) before they develop any degree of academic language skills. Research indicates that the development of precise academic terms and ways to structure academic explanations and arguments actually takes anywhere from four to six years (Collier, 1987).

Between the time when ELLs begin to participate in district and/or statewide assessments and the time when their mastery of the English language is commensurate to that of their native English-speaking peers, it is crucial to be able to distinguish what students know in a subject area (e.g., science) and how well they can read and interpret what is required to successfully and clearly articulate their responses in English. Certain standard patterns of misunderstandings can be identified, which should be helpful to scorers as they attempt to evaluate what ELL students know. Examples of those are described in this guide.

1.5 Interpreting Science Assessment Items

ELLs will interpret and respond to science assessment items in English with differing degrees of success depending upon their science background, socio-cultural experience, and proficiency in handling the academic language of science in English. Some, because of poor backgrounds in science with or without adequate English proficiency, will respond not at all or incorrectly in most cases. Others who have good scientific backgrounds will comprehend science assessment items in English but will have limited proficiency for expressing themselves in English. They may calculate answers accurately but may not be able to articulate their reasoning in written form where assessment items require them to do so. Others may articulate their reasoning adequately but in ways that are difficult for the scorers to grasp, especially under the pressure of a rapid, high-volume scoring situation.

Some students, either because of their stage of English language proficiency at the time of assessment administration, their education abroad, or their cultural background, may interpret the items and problems in ways that may be unexpected or that appear atypical for a scorer. Such background characteristics may prompt students to focus on certain types of information over others or to emphasize aspects of a problem or its solution that would not be accorded a similar priority by the scorer. In any case, although the scorer may perceive certain interpretations of the meaning of the item, the responses of some ELL students may nevertheless be understandable and defensible, and the solution presented may be acceptable and consistent with the

interpretation and the scientific knowledge required by the assessment developers.

It is important for scorers to understand what ELL students are being asked to demonstrate on a science assessment item where students are asked to construct a response. Because it is typical for on-demand assessments to require written responses, the information we present in this guide gives readers information about the linguistic issues that can be confounding factors in assessing an ELL's responses. ELL students are asked to demonstrate not only scientific skills, but also reading and writing skills in a language that they have not yet fully acquired. This poses a challenge to both the student and the individual who scores the items, since they must differentiate between evaluating the student's knowledge of science with accuracy despite the hurdle of functioning in a second language.

2.0 EFFECTS OF ENGLISH LANGUAGE DEVELOPMENT ON ELL STUDENT RESPONSES

2.1 Linguistic Issues

Linguistics is the science concerned with a number of systems that constitute language and communication. As such, linguists study language at the level of sound (phonology), words (morphology), sentences (syntax), meaning (semantics), and use (pragmatics). Student responses to test items are products of these five systems working with the English writing system. They are also the products of the interaction between prior knowledge or experience and new knowledge.

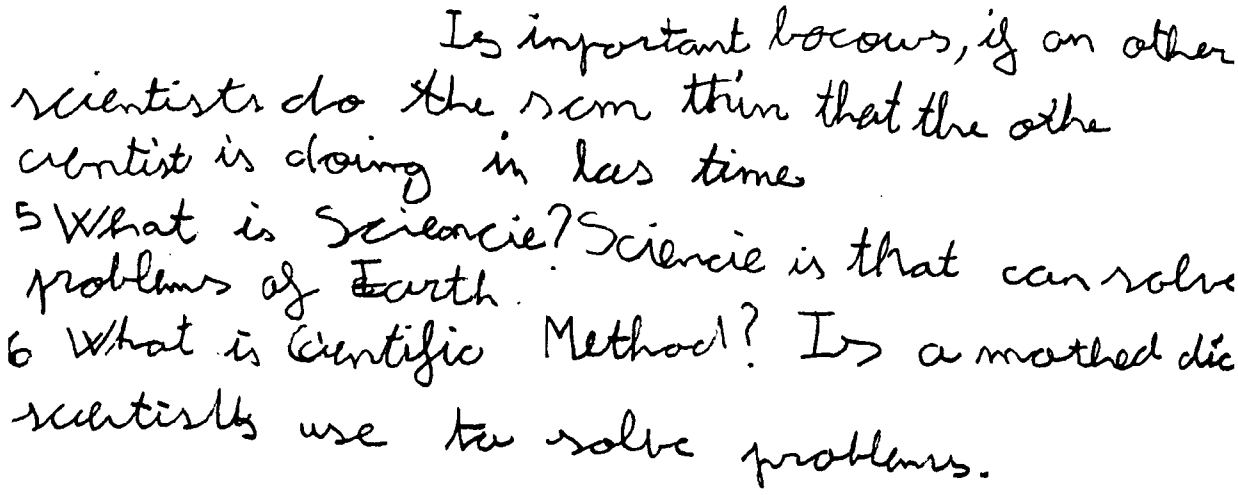
2.1.1 Native Language Influences - Interpretation of Sounds

Native language influences may appear in ELL student responses. How ELL students write may be influenced by sounds in their native language or dialect that differ from English sounds. In speaking or writing English, ELL students may omit some final consonant sounds, transpose certain sounds, substitute one sound for another, or reduce consonant clusters.

Final consonant sound omissions:	Sound transposition:	Sound substitutions:	Consonant cluster reduction:
sam vs. **same**	**sciencie** vs **science**	**becows** vs. **because**	**cientist** vs **scientist**
thin vs. **thing**		**mathed** vs. **method**	**cientific** vs **scientific**
othe vs. **other**			
las vs. **last**			

In **figure 2.1** the student identifies the importance of recorded and already existing scientific information as part of furthering the scientific process and as part of the strategies for problem solving. This student makes the mistakes shown in the table above. It exemplies the effect of the student's first language on his response in English.

Why do you think it is important for scientists to gather information before they begin work on a problem?



"Is important becows, if an other scientists do the sam thin that the othe cientist is doing in las time.

5. What is Sciencie? Sciencie is that can solve problems of Earth.

Science is a discipline which helps to solve problems of the Earth

6. What is Cientific Method? Is a mathed did scientists use to solve problems."

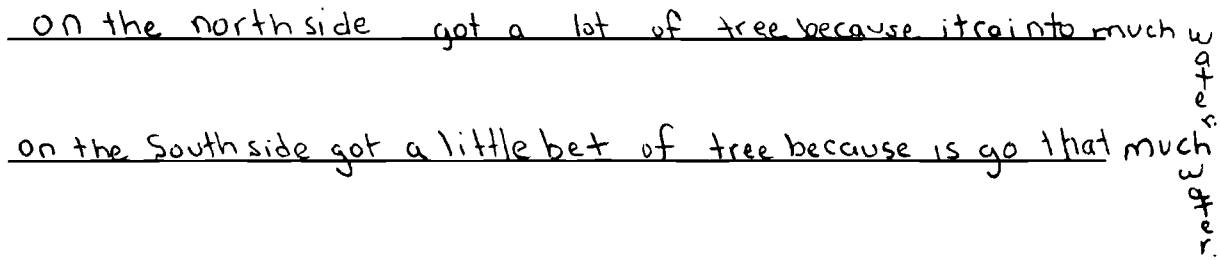
It is a method that scientists use to solve problems.

Intended meaning: It is important for scientists to gather information before they begin to work on a problem, because when other scientists try to do the same, they can replicate what the scientist did the last time (previously).

Figure 2.1-Spanish

Figure 2.2 illustrates a lack of use of a pronoun, correct practice in some languages. Confusion for the reader can also occur because many languages use articles, nouns, and pronouns that are gender specific. In this example, the student identifies water supply as the environmental limiting factor of vegetation growth in area A and compares it to another area.

What environmental factor might have caused the lack of any trees in area A?



"On the northside got a lot of tree because it rainto much water. On the southside got a littlebet of tree because is go that much water."

Intended Meaning: On the north side, there are a lot of trees, because there is more water from rain. On the southern side, there are fewer trees, due to limited amount of water.

Figure 2.2-Laotian

2.1.2 Omissions - Consonants, Vowels, and Pronouns

It is very common for LEP students to write words without their ending or middle sounds, either because of conventions in their native language or because the sounds are not easily discernible. These are some examples of omissions, including those found in Figure 2.3.

"boo" (book)	*"wri" (write)*	*"pully" (pulley)*
"fatha" (father)	*"teacha" (teacher)*	*"wedg" (wedge)*
"skoo" (school)	*"inclin" (incline)*	*"weel" (wheel)*

In **figure 2.3** the student identifies five of the simple machines with appropriate examples and adds more examples instead of other types of machines or explanations.

2. What are the six simple machines? Explain. Give one example of each.

1) lever : scissors
2) weel and axel = lock of doors.
3) inclin plane = ramp
4) polly
5) wedg and screw
6) hammer

Figure 2.3 - Spanish

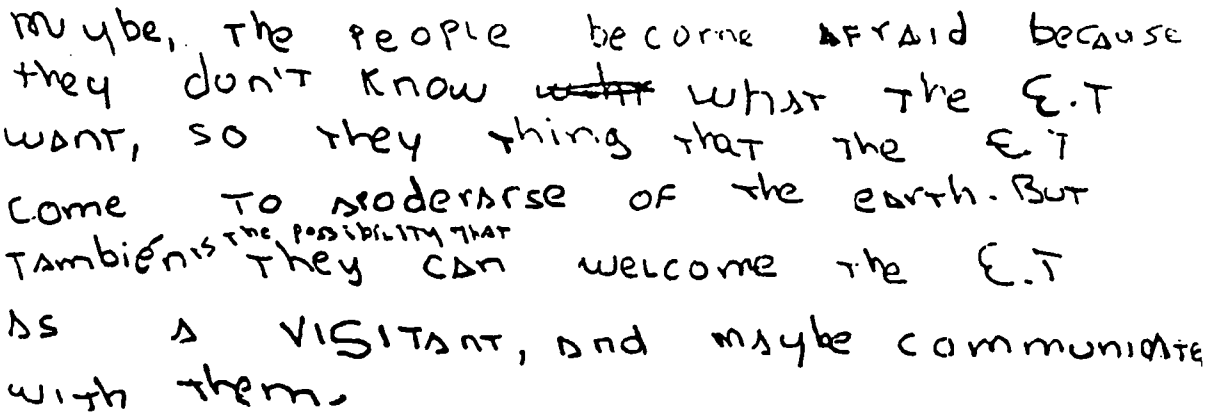
2.1.3 Code Switching

Code switching or code mixing of languages may appear in the oral or written samples of the second language user. Code switching is the alternate use of language where a sentence may contain elements from both the first language and the second language. Code switching may appear within and/or between sentence structures at the single word, phrase, clause, or sentence level. These influences should not detract from the essential message being conveyed by the respondent. For example:

Level of use	Example	Intended meaning
Word	"*... all of the offspring are pure and* ***semejantes***".	*... all of the offspring are pure and* **similar**.
Phrase	When the genes of two individuals se ***cruzan*** and they have a similar phenotype is probable they have ***hijos*** with one characteristic similar.	When the genes of two individuals **cross**, and they have a similar phenotype, it is probable that they have **offspring** with one similar characteristic.

In **figure 2.4,** the student uses "*apoderarse*" in lieu of to "*take over,*" "*también*" instead of "*also,*" and "*a visitant*" for "*a visitor.*" From a sociological stand point, the student's response is very appropriate. As a species, we are social beings with views and perceptions which vary from one individual to another. The way we respond to new circumstances is complex and based not only on scientific investigation, but also in the history, philosophy, literature and experiences that have shaped our humanity over time. We gain insight into human behavior while basing our predictions and responses on the experienced behaviors of our own species.

Predict people's reactions to a visit by living things from a distant planet.



"Maybe, the people become afraid because they don't know what the E.T want, so they thing that the ET come to **apoderarse** *of the earth. But* **también** *is the possibility that they can welcome the E.T as a* **visitant**, *and maybe communicate with them."*

Intended Meaning: Maybe people become afraid of an E.T., because they do not know if the E.T has come to take over the earth. However, it is also possible that the people might welcome the visitor, or that it might want tocommunicate with them.

Figure 2.4 - Spanish

2.1.4 Transposition, Substitution, and Reduction of Words

In addition to code switching, the second language learner may follow the rules of syntax or word order used in the home language. This occurs when students use knowledge of sentence structure from the home language, as in the following examples:

Transliteration	Translation	Original Syntax
"a rabbit black"	*"a black rabbit"*	Spanish: un conejo negro
" a garden vegetable"	*"a vegetable garden"*	French - "*un jardin potager*"

Sometimes ELLs substitute common words for precise scientific terms and concepts. For instance, the use of "*fattest*" for "*greatest,*" "*smallest*" for "*fewest,*" or "*plus*" for "*added*" are commonly found substitutions of quantitative terms. Depending on what the item is supposed to measure, the student's substitution may or may not be acceptable.

For example, in **figure 2.5** the student uses "small rain" instead of little rain to quantify and justify his response within the parameters of the complete task given.

What environmental factor might have caused the lack of pine trees in area B?

area B get small rain so don't have many tree

"area B get small rain so don't have many tree."

Intended Meaning: Area B receives less rain; therefore, there are not many trees in area B.

Figure 2.5-Hmong

Reduction of words is depicted in a student's reflective journal entry in **Figure 2.6.** In this instance the student uses "*inof*" for "*enough,*" "*solf*" for "*solved,*" and "*tim*" for "*team.*" The student's attempt to respond to the reflective prompt adequately conveys understanding, by communicating the limitations and strategies in the task analysis.

What was difficult about this project? Any problems or opportunities?

At first wi had
a problem for information
bot after wi faond
inof anformation

"At first wi had a problem for information bot after wi faond inof anformation."

What worked? How did you solve problems, if any?

wi solf problems as an
tim.

"wi solf problems as an tim."

Intended Meaning: At first, we had a problem finding information. Afterwards, we found the information. We solved problems as a team.

Figure 2.6 Czech

2.1.5 Phonetics and Spelling

Students bring together two things as they produce their test responses: a writing system and a linguistic system. The writing system in English is alphabetic, which means that a sound can be represented by a number of symbols. The English language has 38 phonemes and only 26 letters, which means that one letter can represent more than one sound.

It is not uncommon for some second language learners to use sounds from their native language while learning to differentiate between the sound systems of their native language and the unfamiliar sounds of their new language of English. Aside from appearing in their oral expression, these native language phonetic forms are also exhibited in written samples. The following chart shows examples of this phenomenon by native Spanish speakers.

Native Language Influence	Example
"*b*" for "*v*"	*"today was bery hot"*
"*y*" for "*ü*"	*"we can yuse the thermometer"*
"*ch*" for "*sh*"	*"the horsechoe crab has a long tail"*
"*d*" for "*th*"	*"de eard is tilted"*

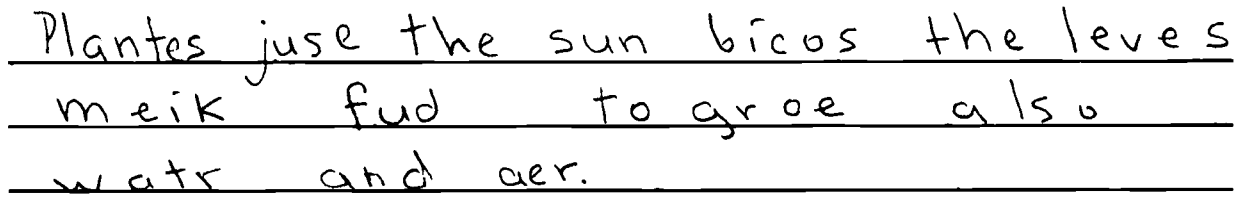
Also, students will sometimes use spelling conventions from their first language to write English words. For instance, in Spanish words beginning with "*s*" and followed by a consonant may be written as "*es*," as in "*eschool*" or "*escul*" (school). In other instances, there are phonetic influences from the English language, which affect their use. For example: "*juse*" is spelled phonetically, by substituting the sound of "*ü*" with the English sound of "*j.*"

Figure 2.7 shows the following phonetic spellings:

- "*meik*" for "*make*": silent e's are nonexistent in Spanish. The English language long sound of "*a*" is interpreted as the combination of the two Spanish vowel phonemes that represent it (ei).
- "*groe*" for "*grow*": "*w*" is rarely used in Spanish
- "*aer*" for "*air*": the sound of "*i*" in "*air*" is the sound of "*e*" in Spanish
- "*bicos*" for "*because*": the long sound of "*e*" is the Spanish sound for "*i.*"
- "*fud*" for "*food*": there are no double vowels in the spanish language and "*oo*" sounds like the Spanish "*u*" phoneme.

The content represents adequate understanding of the function of leaves and their interaction with the sun's energy at this level. The student also attempts to incorporate the role of water and air as components for plant food production.

How do plants get their food?



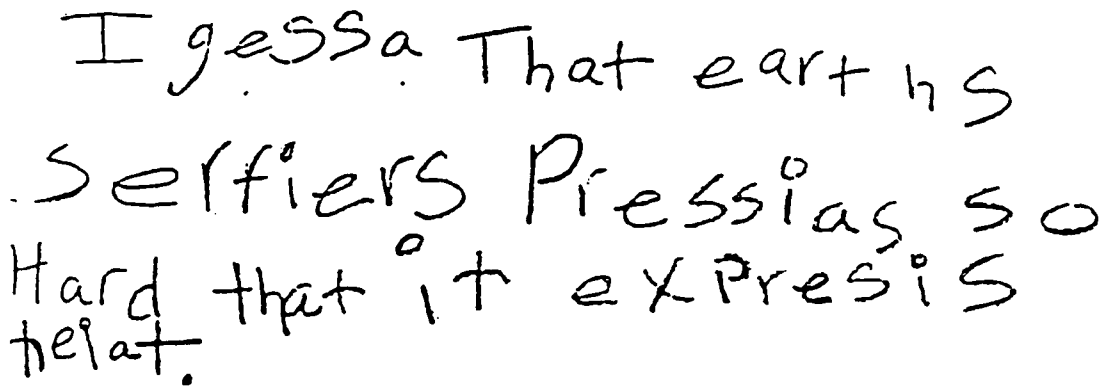
"Plantes juse the sun bicos the leves meik fud to groe; also watr and aer."

Intended Meaning: Plants use the sun, because the leaves make the food for the plants to grow. They also use water and air.

Figure 2.7 - Spanish

In the Spanish oral language tradition, the ending vowel sounds of one word are usually connected to the initial sound of the following word, making them sound as a "*run-on*" word. In **Figure 2.8** the student is connecting and interpreting phonemes: "*earths serfiers pressias so hard that it expresis heiat*" to "*represent earth's surface's pressure is so hard that it expels its heat.*" The student attempts to explain volcano formation by the interaction between the Earth's surface and the Earth's internal heat, in terms of pressure being released.

How are volcanoes formed?



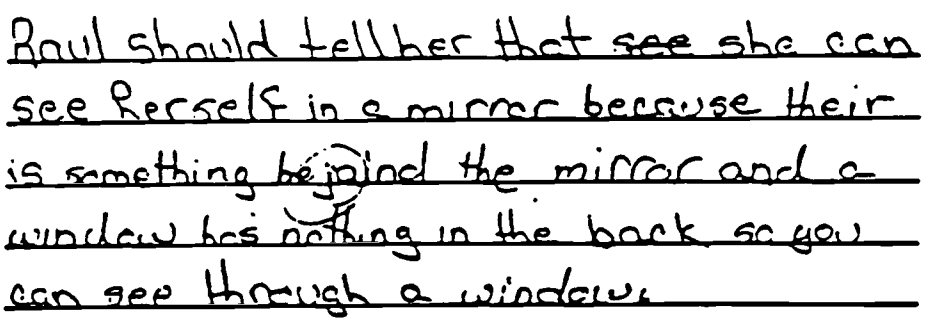
I gessa that earths serfiers pressias so hard that it expresis heiat

Meaning: I guess the Earth's surface's pressure is so hard that it expels its heat.

Figure 2.8 - Spanish

In **Figure 2.9** the student uses "*j*" in "*bejaind*" vs. "*behind,*" since there is no sound for "*h*" in Spanish. The letter "*h*" English sound is about the same as the letter "*j*" sound in Spanish. The student attempts to explain why mirrors reflect, by identifying the backing material in a mirror as the main difference between mirrors and windows.

Raul's little sister, Sarah, wants to know why she can see herself in a mirror, but she can see through a window. What should Raul tell his sister to explain the differences between mirrors and windows?



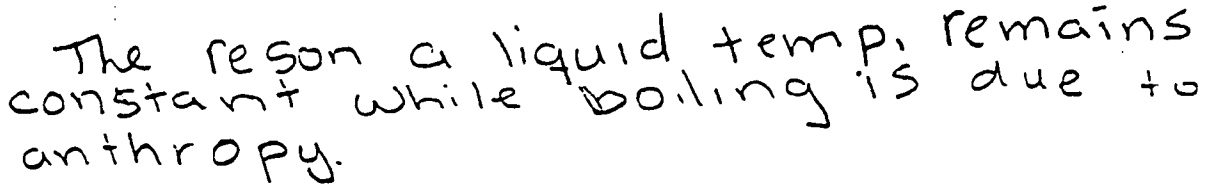
"Raul should tell her that see she can see herself in a mirror because their is something bejaind the mirror and a window has nothing in the back so you can see through a window."

Intended Meaning: Raul should tell her that she can see herself in a mirror, because there is something behind the mirror. A window does not have anything in the back, so you can see through a window.

Figure 2.9 - Spanish

In **Figure 2.10** the student uses the word "anthropy" for "entropy." The use of a prompt within the student's reponse is a technique taught to foreign students to ensure adequate grammatical structure in answering a question. The student's use of the word anthropy vs. entropy reflects phonemic spelling as limited explanation of the concept. Entropy relates to thermodynamic systems, dynamic equilibrium, and the rate at which energy exchanges occur between the system and its surroundings. Boiling a liquid represents a thermodynamic system. The response, although aiming at one of the principles that regulate thermodynamics, did not explain in detail why the temperature of the liquid portion of this system remained constant.

Explain in detail why the temperature of a liquid remains constant while it is boiling.



"The reson a liquid temp. remains constant while boiling is due to anthropy."

Figure 2.10 - Creole

2.1.6 Native Language Patterns

The scientific conventions used within a language may reflect the syntax used in that language. For example, chemical compound formulas are read from left to right in English and from right to left in Spanish as shown below:

Formula	English	Spanish
NaCl	Sodium chloride	cloruro de sodio
CaCO3	Calcium carbonate	carbonato de calcio
NaCO2	Sodium bicarbonate	bicarbonato de sodio

The students might be utilizing their native language syntax, and their response would be considered wrong, even though it would be correct. Another source of confusion for native Spanish speakers would be the use of suffixes in naming compounds, by having the vowel phonemes mixed, as the table below shows. Some students might think of *sulphide* or *sulphite* as *sulfato*, because in Spanish, *sulfato* is phonetically very similar to the English pronounciation of *sulphide* and *sulphite*.

As a chemical compound varies, so does its suffix and name. Students will have a tendency to mix phonemes, although the intended structure or formula is correct. Students with native Spanish language tend to substitute English sound of long "*a*" for "*e*" in Spanish and long sound of "*e*" for "*i*" in Spanish. This makes it dificult to name compounds appropriately.

English	Spanish
Nitrate	Nitrato
Sulphide (salt from hydrogen sulphide H2S)	Sulfuro
Sulphite (a salt from sulfurous acid H2SO3)	Sulfito
Sulphate (salt from sulfuric acid H2SO4)	Sulfato

2.1.7 English Phonetic Influences

ELL students also invent the spelling of English words, given their best estimate from what they know about phonetics in the English language. This is the same process that native English speakers go through when they are learning to write. It is developmentally appropriate, given ELL students' lack of experience with English, though often not grade-level appropriate in relation to native English speakers.

Examples of inventive spelling commonly seen in ELL responses:

"*ghuat*" (what)

"*ecwoles*" (equals)

"*yous*" or "*youd*" (use)

"*wen*" (when)

Figure 2.11 contains several examples of substitutions in letters and sounds, for instance, "*brake*" for "*break*," "*perant*" for "*parent*", "*here*" for "*hear*", "*neghbors*" for "*neighbors*", and "*eiseir*" for "*easier.*" In this example, the student attempts to show the effect certain materials have on the transmission of sound.

You are planning to use an empty garage as a studio for your band. Using what you know about sound, explain which materials you would use to help you set up the studio, so the music would sound good for recording, yet not disturb the neighbors and your friend's grandma, who lives in a room above the garage. List of materials: carpeting, ceramic tile, wood paneling, wallpaper, mirrors, cork paneling, wool blankets, plaster/gypsum boards, newspaper.

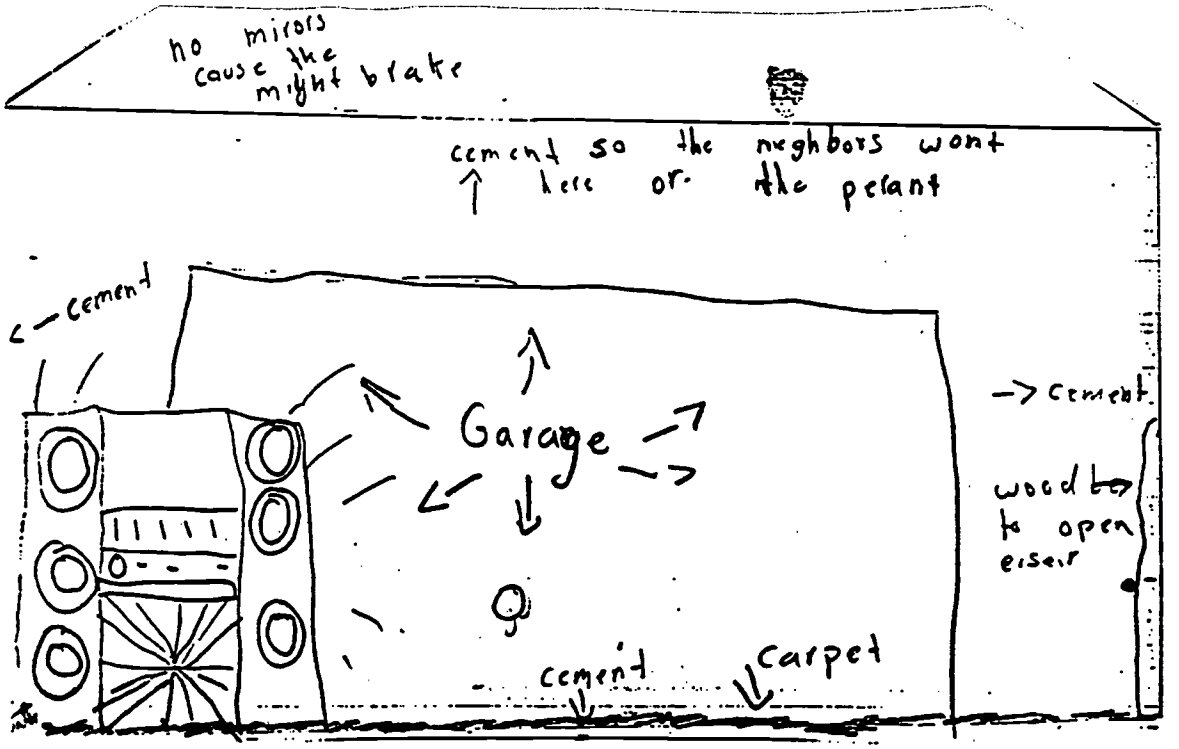
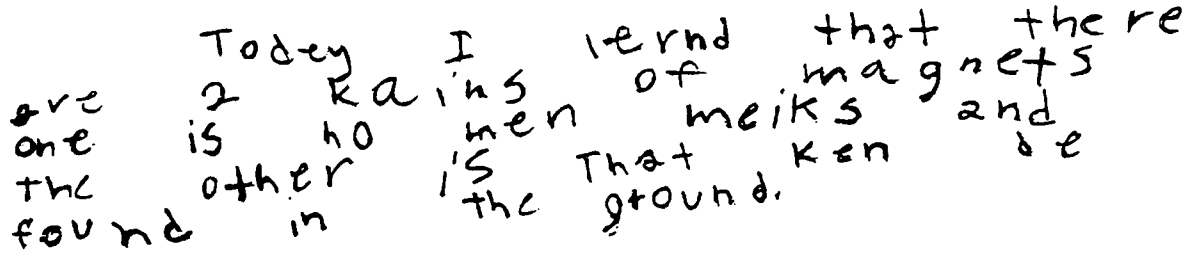


Figure 2.11

Figure 2.12 shows substitution of letters and sounds in the use of "*lernd*" vs. "*learned,*" "*kains/ken*" vs. "*kinds/kind,*" and "*ho*" vs. "*what.*" The response gives insight into the student's level of understanding, based on his reading about sources of magnetic materials, and into his ability to communicate it in his own words.

Upon having read some information about magnets, the student responded to the prompt in his journal "Today I learned..."



"Today I lernd that there are 2 kains of magnets one is ho men meiks and the other is that ken de found in the ground."

Intended meaning: Today I learned that there are two kinds of magnets. One is what man makes, and the other can be found in the ground.

Figure 2.12 – Czech

Sometimes, influences of both the native and the English language are evident in a student's writing sample, such as the example in Figure 2.13. The student uses the English phoneme "*dhe*" for "*the,*" as well as a combination of native phonemes with inventive spelling as follows:

Transliteration	Portuguese Inventive Syntax	Translation
"**en dhe pobulation dke es** produce **charateriste semejant** a la **mouch** species"	"en la **población de que es,** produce **caracteristicas semejantes** a la **majoria** de la especie."	"**the population from which** it is, produces **characteristics similar** to **much** of the species"

The student's attempt to respond to the prompt is limited, but demonstrates basic understanding that similar characteristics are being passed on when more homozygous individuals are produced. Use of "*mouch*" vs. "*majority,*" "*semejant*" vs. "*similar,*" "*dhe*" vs "*the*" are varied examples of native language and English influence. The Punnett square used helps the reader to identify some basic understanding of the concept in the prompt. Use of "*species*" vs. "*population*" is inappropriate.

Why does choosing a mate with a similar phenotype produce more homozygous individuals in a population?

en dhe pobulation dke es produce charateriste semejant a la mouch species

B=black
b=white
BY Bb

B	BB	Bb
b	Bb	bb

"en dhe pobulation dke es produce charateriste semejant a la mouch species"

Intended Meaning: In the population *from which it is**, produces characteristics similar to much of the species. (* the originating pool/population of the mate, referred to as "*it.*")

Figure 2.13 Portuguese

Fig 2.14 shows two students' responses to the same prompt. Their interpretation of English phonemes is evidenced by their inventive spelling. In this figure the students respond adequately, based on their observed results.

"**papertall**" vs. "**paper towel**"

"**theacker**" vs. "**thicker**"

"**proble**" vs. "**probably**"

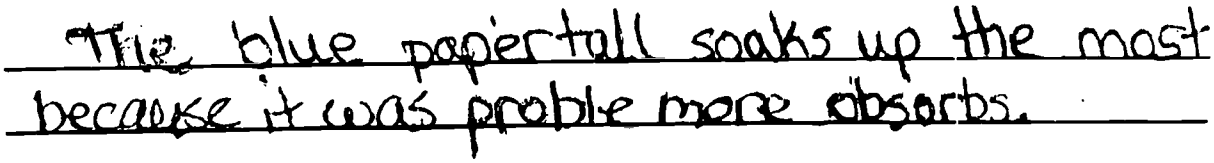
"**hevear**" vs. "**heavier**"

"**obsorbs**" vs. "**absorbs**"

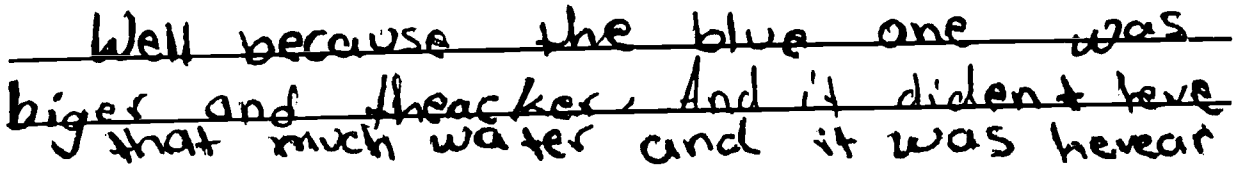
"**dident**" vs. "**didn't**"

How did you know from the experiment which paper towel holds, soaks up or absorbs the most water?

Student 1



Student 2



1. *"The blue papertall soaks up the most because it was proble more obsorbs."*
2. *"Well because the blue one was biger and theacker. And it dident have that much water and it was hevear."*

Intended Meaning:

1) The blue paper towel soaks up the most moisture, because it was probably more absorbent.
2) Well, because the blue one was bigger and thicker. It didn't have that much water in it and it was heavier.

Figure 2.14 - Spanish

Response 1) is an observational response, whereas response 2) attempts to include a comparative and quantitative approach to the task in the prompt.

2.1.8 Merging of Words

Closely related to innovative, phonetic spelling is the abbreviation of words and the condensing into one mega-word. Often, second language learners will create a phonetic word form based on their "*understanding*" of the spoken words. Specifically, second language learners will treat expressions with more than one word as a single word. This may entail phonetically re-creating and grouping various words as a single word. Difficulties may arise when the native language and the English language use different sounds, or use sounds that occur occasionally in the English language but pass unnoticed, because they are not phonemic (i.e.: "*ghuadayamean*" what do you mean?)

In **figure 2.15,** a journal entry about levers, the student writes "*longleverarm*" (for long lever arm), while in **figure 2.16** rough road is written as "*roughroad*".

When we put a Longleverarm

"When we put a longleverarm..."

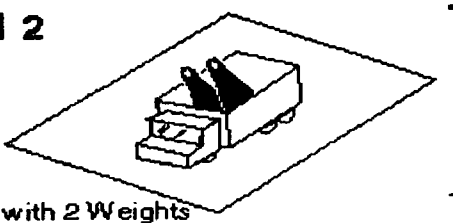
Intended Meaning: When we put a long lever arm...

Figure 2.15 - Spanish.

Compare your results for Trial 2 and Trial 4. Did it take more, fewer, or the same number of pennies in the cup to move the truck in Trial 4 than in Trial 2?

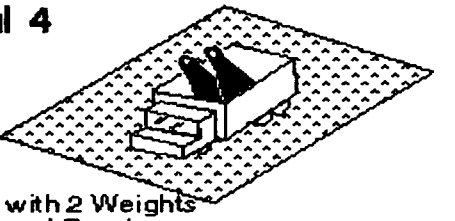
Explain your answer.

Trial 2



Truck with 2 Weights on Smooth Road

Trial 4



Truck with 2 Weights on Gravel Road

It took more pennies, because the truck was on the roughroad and it was hevey and in Trual 2 it to less or fewer because it was on a smooth surfice. The smother it is with less washers the easier and the faster it goes.

"the truck was on the roughroad and it was hevey and in Trial 2 it to less or fewer because it was on a smooth surfice. The smother it is with less washers the easier and faster it goes."

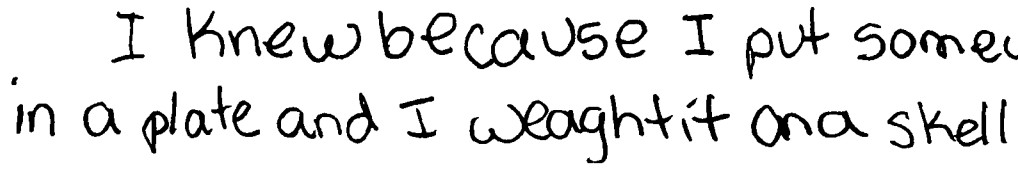
Intended Meaning: the truck on the rough road was heavy. In Trial 2, it took less or fewer pennies, because it was on a smooth surface. The smoother it is, the less pennies it needs, and the easier and faster it goes.

Figure 2.16

The student is able to make a comparison between the two road surfaces, and to identify the lesser amount of pennies needed to move the truck on the smooth surface. However, the understanding of principles of force/energy and friction is still limited, as is the use of weight as a control (not a variable) in this task.

In **Figure 2.17** the student merges and uses phonemic spelling by using "weaghtit" in lieu of "weighed it," "somewater" vs. "some water," and "ona" vs. "on a." The use of a scale (skell) is mentioned, but the response is limited in detail.

How did you know from the experiment which paper towel holds, soaks up or absorbs the most water?



"I knew because I put somewater in a plate and I weaghtit ona skell."

Intended Meaning: I knew, because I put some water in a plate and I weighed it on a scale.

Figure 2.17 - Spanish

2.1.9 Omissions and Misuse

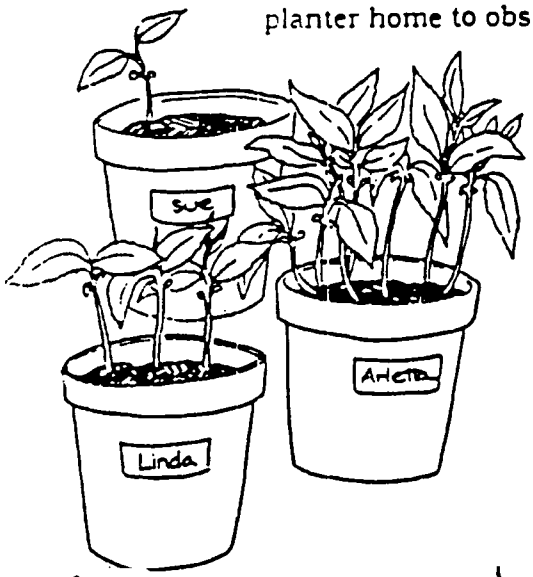
The omission and/or misuse of tense markers, punctuation, articles, plurals, pronouns, prepositions, or other words in students' written responses can be attributed to many sources, and are also seen in the responses of English dominant students. In the responses of second language learners, these omissions and misuses may occur because of a lack of understanding of English conventions or because there is no equivalent in the student's native language. In the following response of a LEP student **(figure 2.18),** the student omits prepositions, pronouns, plurals, capital letters, and punctuation: "*...not good [at] planting...only got one[.] [L]inda['s] [and] Arletta['s] plant[s] grow better....*"

Also the misuse of pronouns is evident: "*Sue is not good planting [her] plant... that['s] way [she] only got one.*"

28

1. List at least two ways that their results are different.

Three classmates. Sue. Linda. and Arletta. each got a planting container. some soil. and ten sunflower seeds. Each girl planted ten seeds and took her planter home to observe growth of the plants.



After ten days they brought their planting containers to school and compared the results. This is what they saw.

Sue is not good planting his plant that way he olny got one linda Arletta plant grow better because grow three bigger and seven plants.

"Sue is not good planting his plant that way he olny got one linda Arletta plant grow better because grow three bigger and seven plants."

Intended Meaning: Sue is not good at planting her plants. That is why she only got one. Linda's and Arletta's plants grow better because they grew three and seven bigger plants.

Figure 2.18 - Hmong

Poorly written responses of LEP students can make it difficult to appreciate what they intend to say. A scorer who has to read a high volume of responses might give a very low score to this type of response. However, a scorer that is aware of the linguistic factors that can distort the judgment of responses of LEP students can readily notice that the response makes more sense when the misuse of language or the missing words, letters, and punctuation marks are recognized. With a little "mental editing," this same response is read as shown below (the editing is in bold letters):

> Sue is not good **at** planting **her** plants. That **is** **why** **she** only got one. **Linda's** **and** Arletta's plants grow better because **they** grew three and seven **bigger** plants **respectively**.

Besides reflecting lack of familiarity with the English language, the mistakes observed in ELLs' responses are a reflection of the structure of their native languages. For example, the student in this example above did not write the word "*they*" because in her native language the pronouns can be omitted under certain circumstances. When scorers are aware of these linguistic influences, they can extract more meaning from the responses of LEP students. As a consequence, the scoring decisions about the science knowledge and science skills are not confounded with decisions about language skills.

In **Figure 2.19** the student means that radiation can be an example. The verb is misused in the infinitive form and "*n*" is omitted in the article. Though the response is limited in terms of the prompt's expectation and criteria, there is an attempt at responding with at least one of the three ways that heat can be transferred.

What are three ways heat can be transferred? Describe how each occurs.

Radiation can to be a example

"Radiation can to be a example"

Intended Meaning: Radiation can be an example.

Figure 2.19 - Spanish

2.2 Cultural Influences

The following points can be considered to be validity issues; that is, they should have been caught in bias review sessions during item development. However, as assessment developers are becoming more aware of the influence of culture, it is possible that items will be included which contain one or more of the points listed below. We have included the cases in this section because knowledge of these points could help the scorer understand a student response on science items, and subsequently, score the paper more accurately.

2.2.1 Symbols, Characters, Markings, and Accents

Learning a new language also involves relearning writing conventions and meanings of words, as well as symbol usage specific to the new culture. Although subtle, some of these new conventions may alter or even reverse the intended meaning. ELLs may accidentally express an idea that is totally different from the meaning they want to express.

The following table provides a sample difference in conventions and meanings that ELLs may need to relearn during their process of English language acquisition. The table is far from exhaustive.

Differences in Language Conventions

Type	Explanation Explanation/Examples
Algorithms	The algorithms taught and used to perform operations such as chemical equation balancing may vary by country. This may create the wrong impression that a student's response is incorrect whereas he/she may be using a different but correct approach to solve some problems.
Dates	In some countries, dates are not written in the same order a in English. For example, "*12/5/98*" may mean "*May 12, 1998*" rather than "*December 5, 1998*"
Meaning Systems	Many students from abroad are not familiar with the U.S. standard system. That may effect their understanding of prompts involving distance, volume, weight, and temperature units in the U.S. standard and monetary system.
Number reading	In some countries "*billion*" is interpreted as "*one million millions*" (1,000,000,000,000), not "*one thousand millions.*"
Punctuation	In some languages, the rules for punctuation are not necessarily the same as in English. That involves the use of commas, colons, semicolons, periods, quotation marks, m-dash, etc.
Number writing	In some countries, periods are used instead of commas to separate hundreds, thousands and so on. A student might read "*3.001*" as "*three thousand and one*" rather than "*three and one thousandth*". Also, in some countries, the decimal point is written as a midpoint between two numbers, not at the bottom (".") . "*3.5*" is read as "*three times five.*"
Computation symbols	Mathematical operations are indicated with different symbols in some countries. For example, the symbol for division (43/2) means 43 divided by 2.
Familiarity with animal and plants	Many animal and plant species that are very common in the U.S. may be unknown to other cultures. For example, boysenberries and hedgehogs are as unfamiliar to some students that may not have seen them or there may not even have words in their language to refer to them.
Misleading phonetic similarity	Some words are phonetically similar to English words but may refer to different things. For example, in Spanish "*ruibarbo*" is not the same plant as "*rhubarb*", "*lima*" is "*lemon*" (not "*lime*"); "*limón*" is "*lime*" (not "*lemon*"), etc.

2.2.2 Auditory Transfer

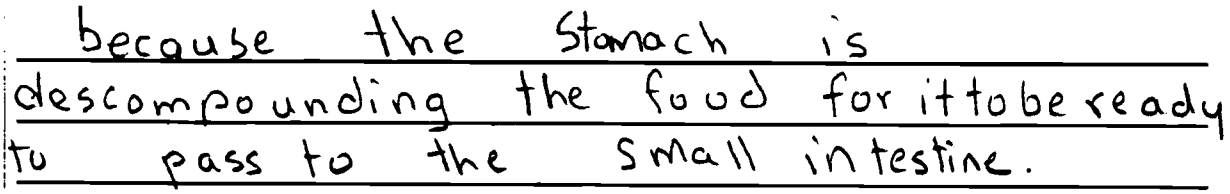
Students use first language words that sound like English language words, but which mean something different. Students transfer the meaning by using the words in the wrong context. Here are examples of same root or homologous words in English and Spanish that have completely different meanings.

English word/meaning	Spanish transfer and new contextual meaning
Insulated: thermal protection	**insolado:** being ill with sun stroke
Library: book repository - study hall	**librería:** stationary and bookstore (Students will use library as bookstore)
Saturated: type of fat	**saturado:** highly concentrated, relating to solubility
Fabric: a type of material / cloth	**Fábrica:** a factory
Carpet: a type of rug	**carpeta:** a binder
Facility: building	**facilidad:** to do something with ease

2.2.3 Neologism

It is common for ELLs to create new words in English that are adapted from their native language. For instance, in **Figure 2.20,** the student creates the word "*descompounding.*" This new word resembles the Spanish word "*descomponiendo,*" which means to break apart. The **"iendo"** ending in Spanish is equivalent to the **"ing"** ending in English. The student has a basic understanding of the breakage of food into smaller components during digestion.

Explain why food stays so long in the stomach before being allowed to pass gradually into the small intestine.



"because the stomach is descompounding the food for it to be ready to pass to the small intestine."

Intended Meaning: Because the stomach is breaking down the food, for it to be ready to pass it to the small intestine.

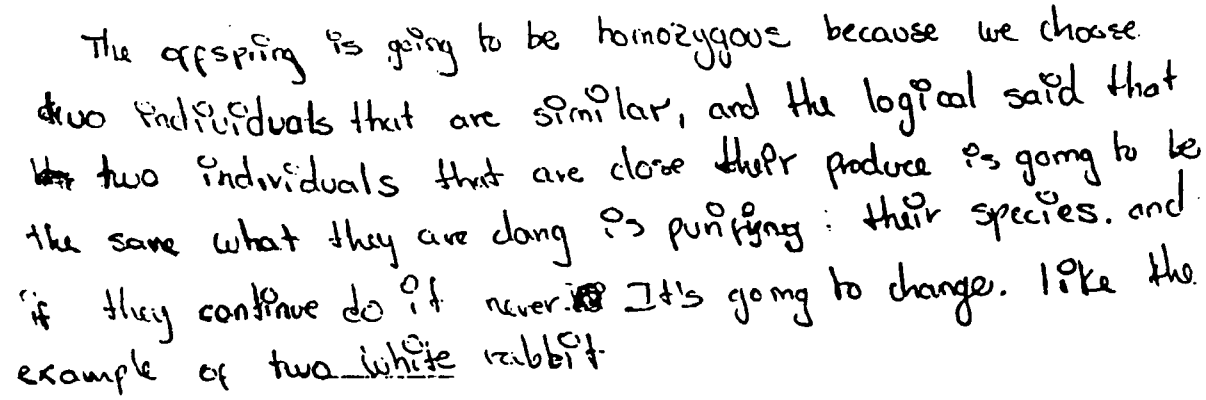
Figure 2.20 - Spanish

2.2.4 Long Sentences

Closely related to circular responding, and often a consequence of it, is the use of long, descriptive sentences. Some students embellish their responses more than others, sometimes to the point of frustration for scorers who are in high-volume, time-constraining situations. Even though scorers are probably sensitive to this issue, it is quite possible that time pressure or scorer response preference may lead to the assignment of lower scores than is appropriate.

In **figure 2.21** the student demonstrates basic understanding of the concepts in the task, drawing upon rules, cause and effect relationships, lengthy varied explanations, and examples to justify the response. It is a written form of the oral Spanish language that touches in an indirect manner upon many points or issues of a conversation. It reflects a "back and forth" pattern between the support statements and the main idea being addressed.

Why does choosing a mate with as similar phenotype produce more homozygous individuals in a population?

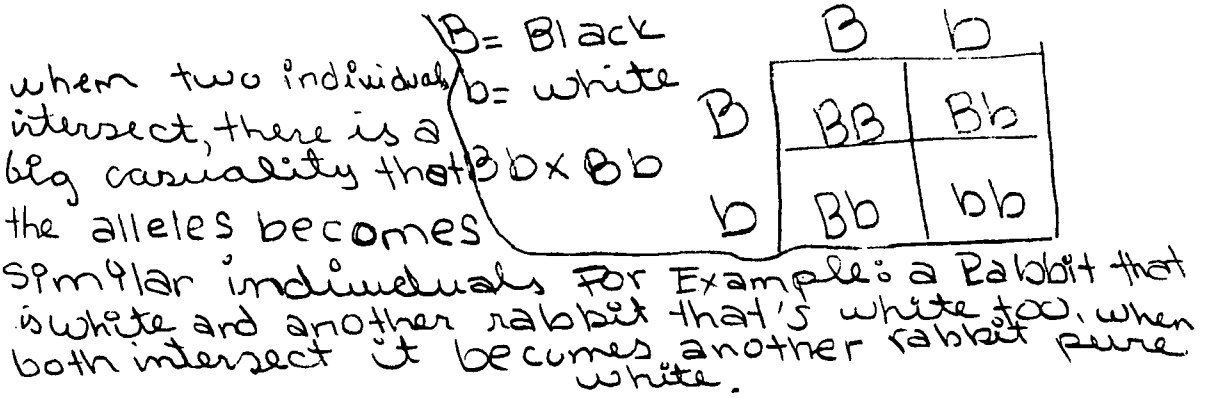


"The offspring is going to be homozygous because we choose two individuals that are similar, and the logical said that two individuals that are close their produce is going to be the same what they are doing is purifying their species, and if they continue do it never It's going to change, like the example of two white rabbit."

Intended Meaning: The offspring is going to be homozygous, because we chose two individuals that are similar. Logic says that two individuals which are close (phenotypes), produce offspring with the same (phenotypes). What they are doing is purifying their species. If they continue to do it, there won't be a change, like the example of the two white rabbits.

Figure 2.21 - Spanish

In **Figure 2.22** the student uses the word "*casuality,*" which comes from the word "*casualidad*" (by chance). The neologism is really meant to be in context with the idea that it is a matter of chance. The intended meaning represents that there is a big chance that the alleles of the individual - offspring would be the same. This is reinforced by the content in the example given and the graphic Punnett square representation.



"when two individuals intersect, there is a big casuality that the alleles becomes similar individuals. For Example: a Rabbit that is white and another rabbit that's white too, when both intersect it becomes another rabbit, pure white."

B = Black b= white {Punnett square chart}

Intended Meaning: When two individuals mate, there is a big chance that the alleles of the individual are similar. For example: When two rabbits are white and mate, the other rabbit becomes pure white.

Figure 2.22 – Spanish

2.2.5 Stylistic Preferences

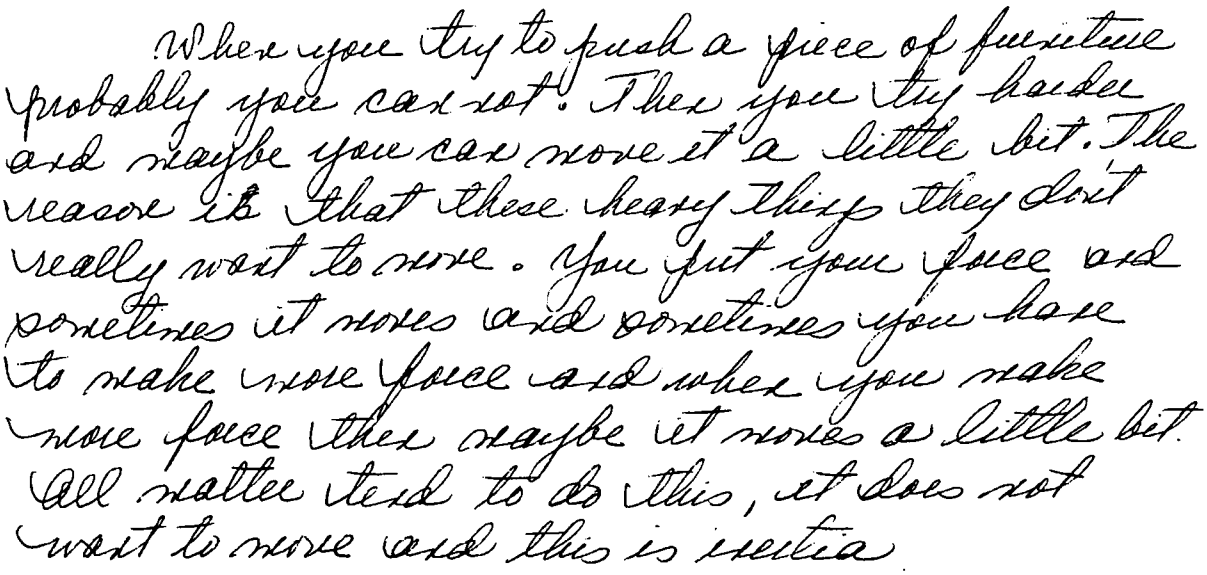
Traditionally, assessments have tended to favor a limited range of response and writing styles. Responses might be scored unfairly when the students use writing patterns and styles unfamiliar to the scorers. The following are some of the more common types of response preferences scorers are apt to encounter among ELL student responses. It should be noted that stylistic preferences may not be evident because of students' lack of proficiency in the language. Their response may simply be a basic verbatim translation with very little understanding of structure, style, or voice.

Being aware of the existence of those cultural and stylistic differences can help scorers to understand ELL responses better.

2.2.6. Circular Responding

A circular style is defined as a style where students appear to be talking around the primary issue. Often they discuss and explain other, less direct, influences to the problem, sometimes including discussions about topics that do not appear initially to be germane to the subject at hand. Eventually these students explain many of the connections and do deliver a response. It is not uncommon for these responses to be fuller and richer than traditional responses. However, they often are wordy and include some discussions of material the students never link directly to the problem or their response. Often, some components of their understanding, for instance, the **scientific rationale,** does not show up until fairly late into their explanation. In **figure 2.23** the student restates an example to justify conceptual understanding of inertia.

Define Inertia


Where you try to push a piece of furniture probably you can not. Then you try harder and maybe you can move it a little bit. The reason is that these heavy things they don't really want to move. You put your force and sometimes it moves and sometimes you have to make more force and when you make more force then maybe it moves a little bit. All matter tend to do this, it does not want to move and this is inertia

"When you try to push a piece of furniture probably you cannot. Then you try harder and maybe you can move it a little bit. The reason is that these heavy things they don't really want to move. You put your force and sometimes it moves and sometimes you have to make more force and when you make more force then maybe it moves a little bit. All matter tend to do this, it does not want to move and this is inertia."

Intended Meaning: When you try to push a piece of furniture and you probably cannot, then you try harder. Maybe then you can move it a little bit. The reason is that these heavy things don't really want to move. You just put your force and sometimes you have to (give it) more force and when you have (added) more force, then maybe it will move a little bit. All matter tends to do this; it does not want to move. This is inertia. (Law of inertia: an object at rest will tend to stay at rest, until an external force is applied to it.)

Figure 2.23 - Spanish

After a lengthy description in **figure 2.24** the student shows a basic understanding of the connection between the use of a backing tint in mirrors, which helps to form the reflecting image, in contrast to a window, which allows images through.

Raul's little sister, Sarah, wants to know why she can see herself in a mirror, but she can see through a window. What should Raul tell his sister to explain the differences between mirrors and windows?

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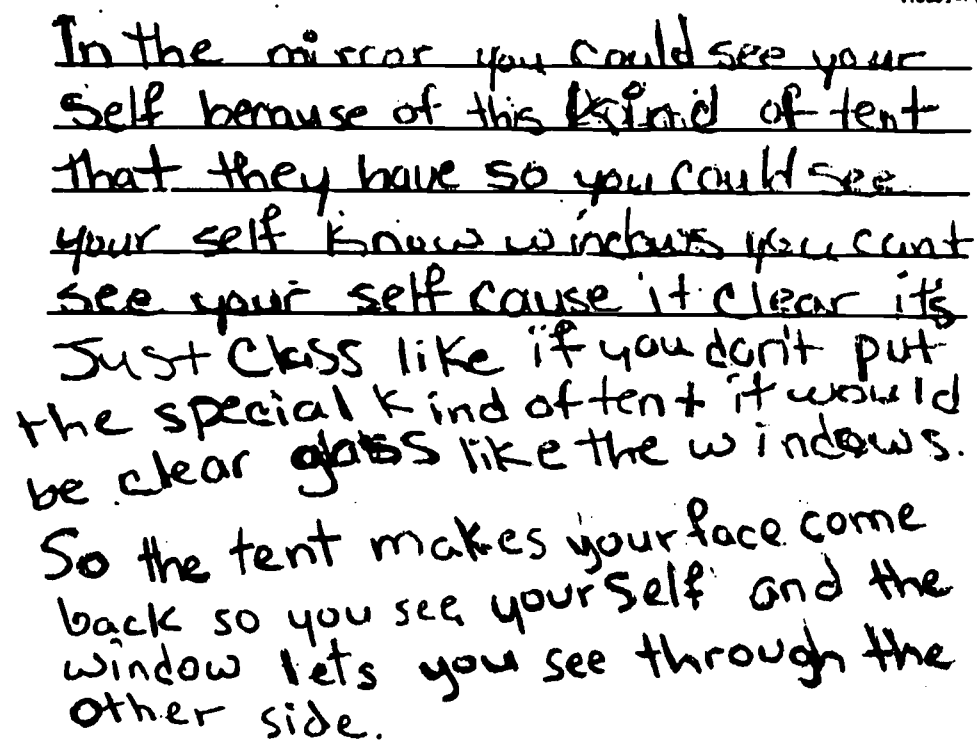


"In the mirror you could see your self because of this kind of tent that they have so you could see your self know windows you cant see your self cause it clear its Just class like if you don't put the special kind of tent it would be clear glass like the windows. So the tent makes your face come back so you see your Self and the window lets you see through the other side."

Intended Meaning: In the mirror, you could see yourself, because of this kind of tint that they have. So, you could see yourself. Now, on windows you can't see yourself, because it is clear and it is just like glass. If you do not put the special kind of tint, it would be clear glass like the windows. So the tint makes your face come back, so you see yourself. The window lets you see through to the other side.

Figure 2.24

2.2.7 Inductive/Deductive Reasoning Approaches

A person's deductive response style takes the approach of leading up to a point or topic sentence by presenting arguments in a series of often-lengthy paragraphs rather than stating the point at the outset. A response employing this style can be scored lower because scorers assume the students are not focused, have less understanding of the problem than they may in fact have, or are simply off topic. **Figure 2.25** is an example of such an approach. The student tries to reason how traits are passed on, includes some misconceptions such as the number of chromosomes, as well as including the process of reproduction, while using a deductive approach.

Explain how traits are passed on from one generation to another.

The TraiTs are passed Two person have sex
In The Male reproductive cell is The Sperm
INside of The sperm is The chromosome inside
is The DNA There is all TraiTs fro The male
And When female and male have sex The egg
is fertilized-n
is a Total of
46 Chromosan
and They
is formed
a ball of cell
That have all
The TraiTs fro
The Mother
and The father
The end.

"The TraiTs are passed Two person have sex In The Male reproductive cell is Sperm inside of the sperm is The chromosome inside is the DNA There is all Traits fro The male And When female And male have sex The

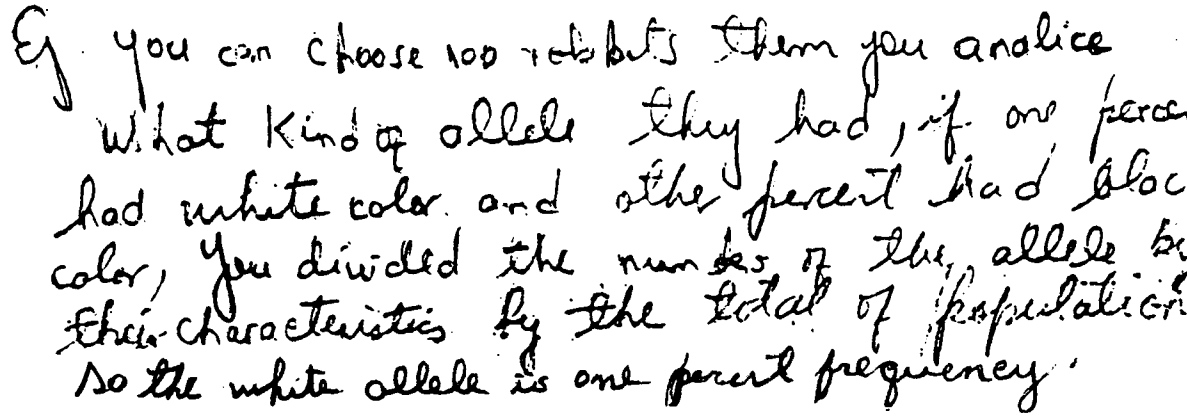
egg is ferTilized is a ToTal of 15 Chromoson and They is forced a ball of cell That have all The TraiTs from The Mother and the father The end."

Intended Meaning: The traits are passed when two persons have sex. The male reproductive cell is the sperm. In the sperm are the chromosomes. Inside the chromosomes is the DNA. There, (in the DNA) are all the traits from the male. When a female and male have sex, the egg is fertilized. It has a total of 15 chromosomes and they are formed into a ball of cells that have all the traits from the mother and the father. The end.

Figure 2.25 – Portuguese

In **figure 2.26** the student leads the response with an example, which although it seems removed from the task, ultimately adds to the student's understanding of the task. By choosing 100 rabbits, the student is able to express his/her limited understanding of frequencies in terms of percentiles, and as a sample from the population.

How is the frequency of an allele in a gene pool determined?



"Ej you can choose 100 rabbits them you analice what kind of allele they had, if one percent had white color and other percent had black color, you divided the numbes of the allele by their characteristics by the total of population So the white rabbit allele is one percent frequency"

Intended Meaning: For example: You can choose 100 rabbits and analyze what kind of alleles they had. If one percent had white color and the other percent had black color, you (take) the numbers of the alleles by their characteristics and divide them by the total (number) in the population. So, the white rabbitt allele is one percent in frequency.

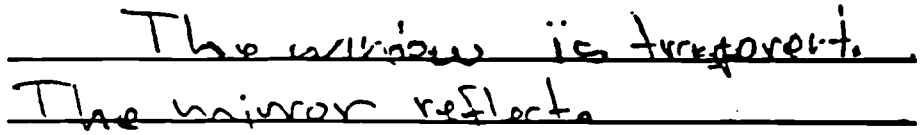
Figure 2.26 - Spanish

2.2.8 Abbreviated Reasoning Approach

Conversely, because of some students' native language discourse structure and independent system of visual communication (e.g., characters or syllables), they prefer a compact, abbreviated response style where every sentence in a paragraph is a topic sentence. Scorers in high-volume situations, who often do not read every word carefully, may miss some important arguments that are presented by students using this style. These responses may be scored lower than is appropriate.

In **Figure 2.27,** the two topic sentences are different points that are called for in the rubric. One refers to the physical property of materials and the other refers to the property of light. It could be dismissed as limited, even though it matches two of the criteria set out in the rubric.

Raul's little sister, Sarah, wants to know why she can see herself in a mirror, but she can see through a window. What should Raul tell his sister to explain the differences between mirrors and windows?



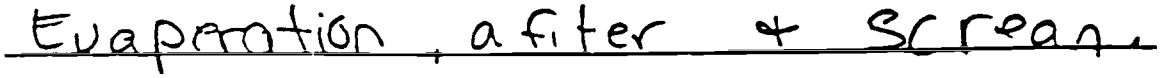
"The window is transparent. The mirror reflect."

Intended Meaning: the window is transparent. The mirror reflects.

Figure 2.27 - Laotian

In Figure **2.28,** the student lists two ways to separate a mixture, since using a screen is another form of filtration. The apparent discrepancy by the abbreviated response may stem from the prompt's design itself. The word "*describe*" in the prompt does not include qualifiers. A student may interpret it as having a range of descriptions within which to respond, from simple and brief descriptors to a more elaborate response. Given the time for responding, the level of fluency, as well as the student's discourse structure, the response may still be abbreviated, but within acceptable range. However, if the prompt read: "Describe in detail two ways to separate a mixture" or "*Explain in detail at least two ways to separate a mixture,*" there would be an explicit range and specific criteria for the response to include more information than a brief description. Therefore, it is very important for the prompt criteria to be well defined, explicit, and clear.

Describe two ways to separate a mixture.



"Evaporation, a fiter & screan."

Intended Meaning: Evaporation, a filter and a screen.

Figure 2.28 - Hmong

2.3 Issues Related to Language Acquisition Development

Most students first develop a certain level of social communicative competency in the second language (i.e. English). The appropriate use of academic terms and ways to structure academic explanations and arguments usually occur later. A transition period is usually noticeable when students have attained a sufficient level of social English proficiency (commonly referred to as basic interpersonal communication skills or BICS). These students are often placed in classrooms where English is only or predominantly used in instruction, and where students are expected to interact and take tests in English. Although this stage of second language acquisition is developmentally appropriate, given the ELL students' experience with English, it is often not grade-level appropriate in relation to native English speakers. These students may be placed in regular classrooms because their BICS seems fully proficient, even though academic language (CALP) may not be fully developed. This would place the student at a disadvantage if instruction and assessment were carried out with the assumption that the student's academic language were fully developed (or as developed as BICS).

It becomes important to separate what students know in a subject from *how* well they can read and *what* is required to successfully and clearly articulate their responses in English. Certain rather standard patterns of misunderstandings can be identified by scorers, which should be helpful to them as they attempt to evaluate what ELL students know.

2.3.1 Confusion in Meaning

Sometimes there is misunderstanding about the meaning of words because of typographical conventions unique to writing in the scientific language. The confusion often results from the dual meaning of terms used in science and in their own native language. For example, Earth **(the planet)** vs. earth **(soil)**, plate **(as tectonic structure)** vs. plate **(hot plate)**; fault **(geologic feature)** vs. fault **(error)**; mole **(chemical unit)** vs. mole **(birthmark)** and mole **(rodent)**. Also, the use of homophones can cause confusion: **hole** vs. **whole**, **break** vs. **brake**, and **passed** (read as past) vs. **past** (time).

2.3.2 Emerging Syntax: Novice Sentence and Paragraph Structures

Other features of the second language development process include developmentally immature sentence and paragraph structures (e.g. chopped sentences) and little variation in sentence structure among sentences. This is EXTREMELY common in the responses of English language learners. **Figures 2.29** and **2.30** depict examples of syntax emergence: misuse of subject/verb agreement, run-on and fragmented sentence structures, and limited use of the comparison of adjectives. The student demonstrates an adequate understanding of geological processes in the model given.

Investigating the Fault Line - Observations on the process that causes rock layers to fold.

PART A - (Simulation of a subduction zone, by sliding material against each other)

Part A

"When we pushes the plate the sand moves and forms the rock layers to fold"

Intended Meaning: When we push the plate, the sand moves and the rock layers fold.

2.29 Figure - Laotian

In **figure 2.30** the student describes observation of the changes in the geologic model in detail, despite limited experience with sentence and paragraph structures.

Investigating the Fault Line - Observations on the process that causes rock layers to fold.

PART A - (Simulation of a subduction zone, by sliding material against each other.)

The flat sand move up into the middle forming a new higher pile of sand, but small size than before.

"The flat sand move up into the middle forming a new higher pile of sand, but small size than before.

Intended Meaning: The flat sand moves up into the middle, forming a new higher pile of sand, but smaller in size than before.

PART B - (Lateral slip movement simulation, sliding material past each other.)

The new pile of sand become uneven, the bottow Length didn't lies up against the other end. The pile was crooked and the mid of the pile seperate or split.

"The new pile of sand become uneven, the bottow length didn't lies up against the other end. The pile was crooked and the mid of the pile separate or split."

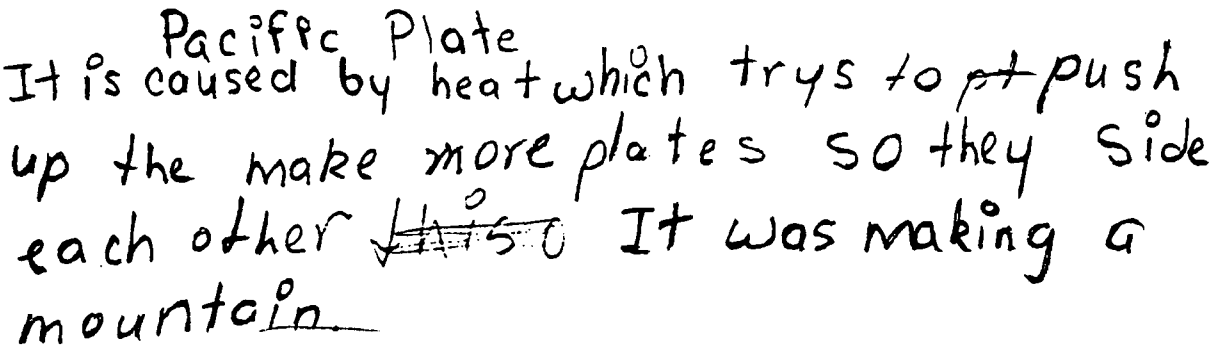
Intended Meaning: The new pile of sand becomes uneven. The bottom length doesn't line up against the other end. The pile was crooked and it separated or split in the middle.

Figure 2.30 - Chinese

42

Emergent syntax is evident in **Figure 2.31** where the student is attempting to describe the cause and ensuing effects or processes in mountain formation. This fragmented sentence structure is a very typical type of response during standardized "on-demand assessments, when students have a limited amount of time to respond to each prompt. Depending on the prompt and the level of fluency, ELLs' responses may reflect varied degrees of emerging sentence structure. In this figure the student is trying to say that the heat pushes up and helps to make more plate material {crust}. When the plates slide {collide against} each other, mountains form.

Pacific Plate



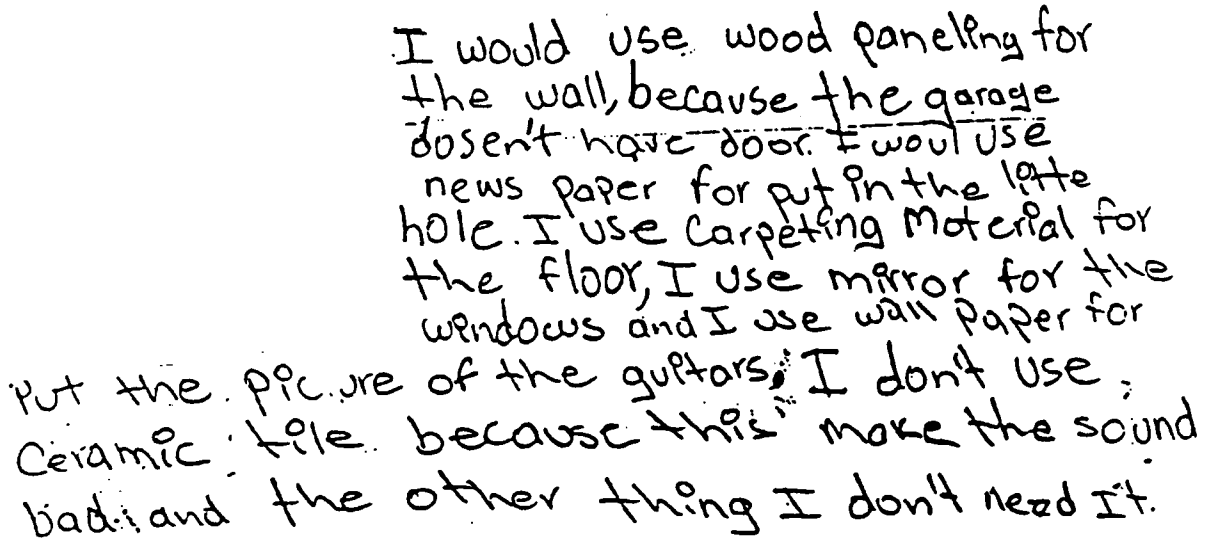
"It is caused by heat which trys to ~~pt~~ push up the make more plates so they side each other ~~this o~~ It was making a mountain."

Intended Meaning: It is caused by heat, which pushes up to make more plates. So, when they (the plates) slide into each other, they make a mountain.

Figure 2.31 - Vietnamese

Figure 2.32 is a sample from a sixth grade ELL student. Developmentally, the student uses very simple and repetitive sentences, and writes in the form of a list in response to the nature of the prompt. However, there is an emerging fluency with a slightly higher command of the language, as evidenced by the introductory sentence, verb tense usage, and more accurate use of spelling and punctuation. The response also reflects a focused understanding of the content in the prompt. The student uses adequate justifications for the use of materials and attempts to describe their link to the effect they will have in the sound production of the scenario in the task.

You are planning to use an empty garage as a studio for your band. Using what you know about sound, explain which materials you would use to help you set up the studio, so the music would sound good for recording, yet not disturb the neighbors and your friend's grandma, who lives in a room above the garage. List of materials: carpeting, ceramic tile, wood paneling, wall paper, mirrors, cork paneling, wool blankets, plaster/gypsum boards, newspaper.



"I would use wood paneling for the wall, because the garage dosen't have door. I woul use news paper for put in the litte hole. I use carpeting material for the floor, I use mirror for the windows and I use wall paper for put the picture of the guitars. I don't use ceramic tile becauses this make the sound bad and the other thing I don't need it."

Intended Meaning: I would use wood paneling for the wall, because the garage door doesn't have a door. I would use newspaper to put it into the little holes. I would use carpeting material for the floor. I would use the mirrors for the windows and I would use wallpaper to put the picture of guitars. I wouldn't use ceramic tiles, because this makes the sound bad and because I do not need them.

Figure 2.32 - Spanish

2.3.3 Limited Use of Language - Alternative Response Formats

Young learners of English as a first language use pictures and drawings as texts. This is a typical stage in their literacy development. Similarly, second language learners rely heavily on numbers, charts, and pictures so that there is a minimum use of language (Masuda, 1996). Consistent with strategies used in the visual driven instruction of LEP students, these students will also frequently use graphic organizers, brainstorming outlines, numbers displayed in computations and algorithms, graphs, charts, and other visual aids. Depending on what is being measured, this may or may not be an acceptable response.

It is important to emphasize the role of scoring guide criteria in the scoring of student work. Inclusion of illustrations as acceptable representations of content is very important, especially with ELL student work, even though there are some errors in content. In **figure 2.33,** the student's illustrations are responding to the example criteria stated in the prompt.

What are the six simple machines. Explain. Give one example of each.

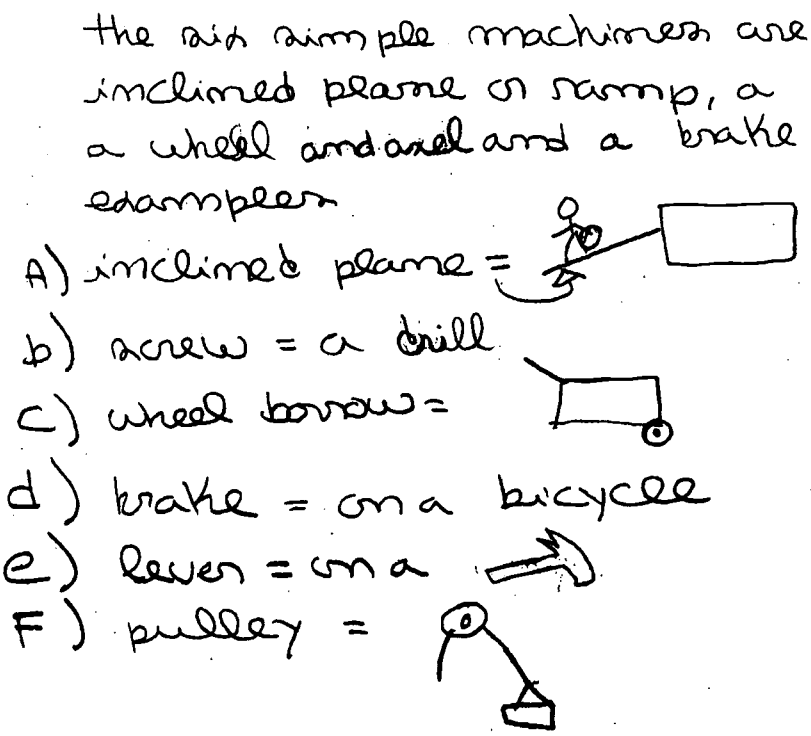
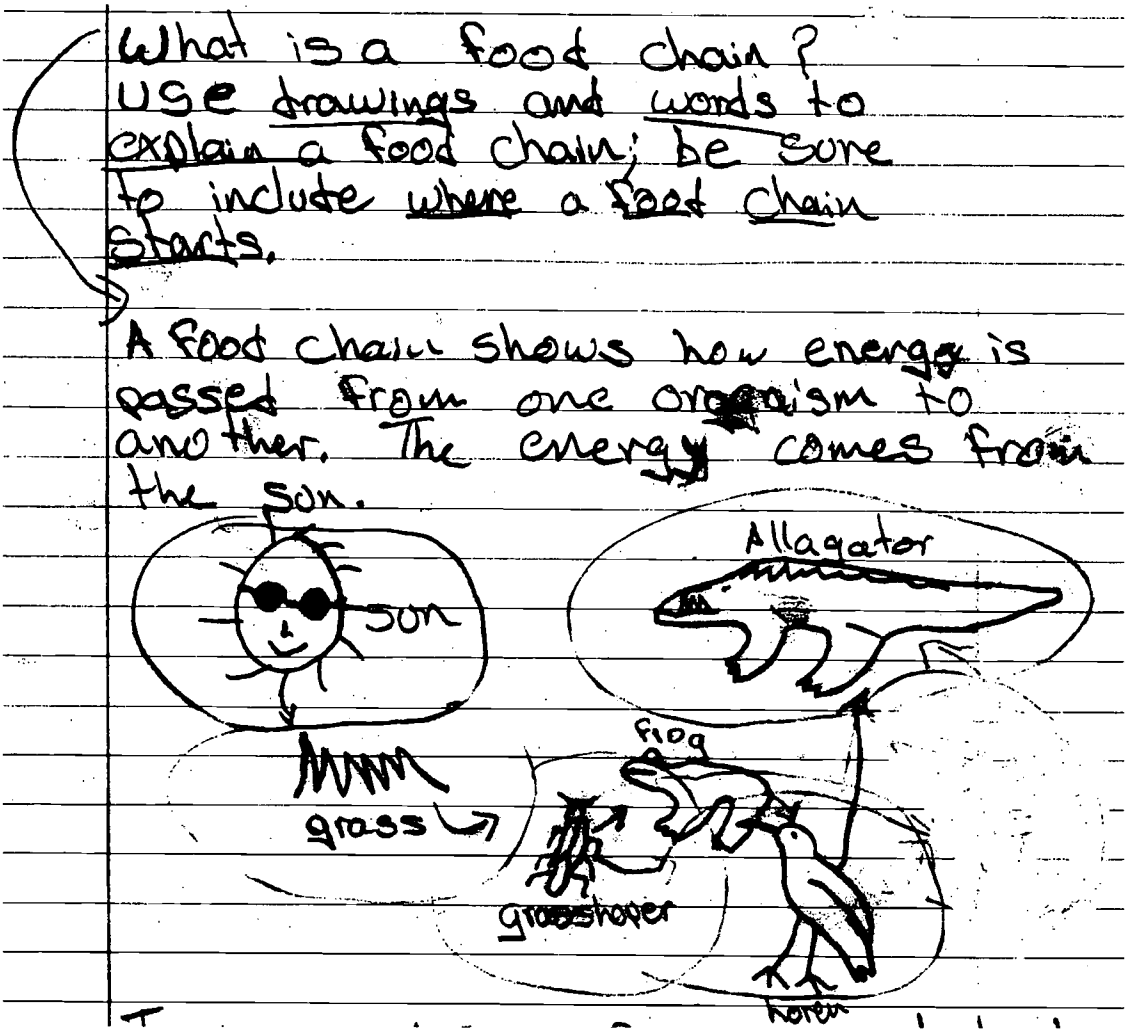


Figure 2.33 - Spanish

In **figure 2.34,** the student's illustration enhances the understanding expressed in the writing by the use of the arrow showing the direction of the energy flow from the sun to the grass, etc.

What is a food chain?



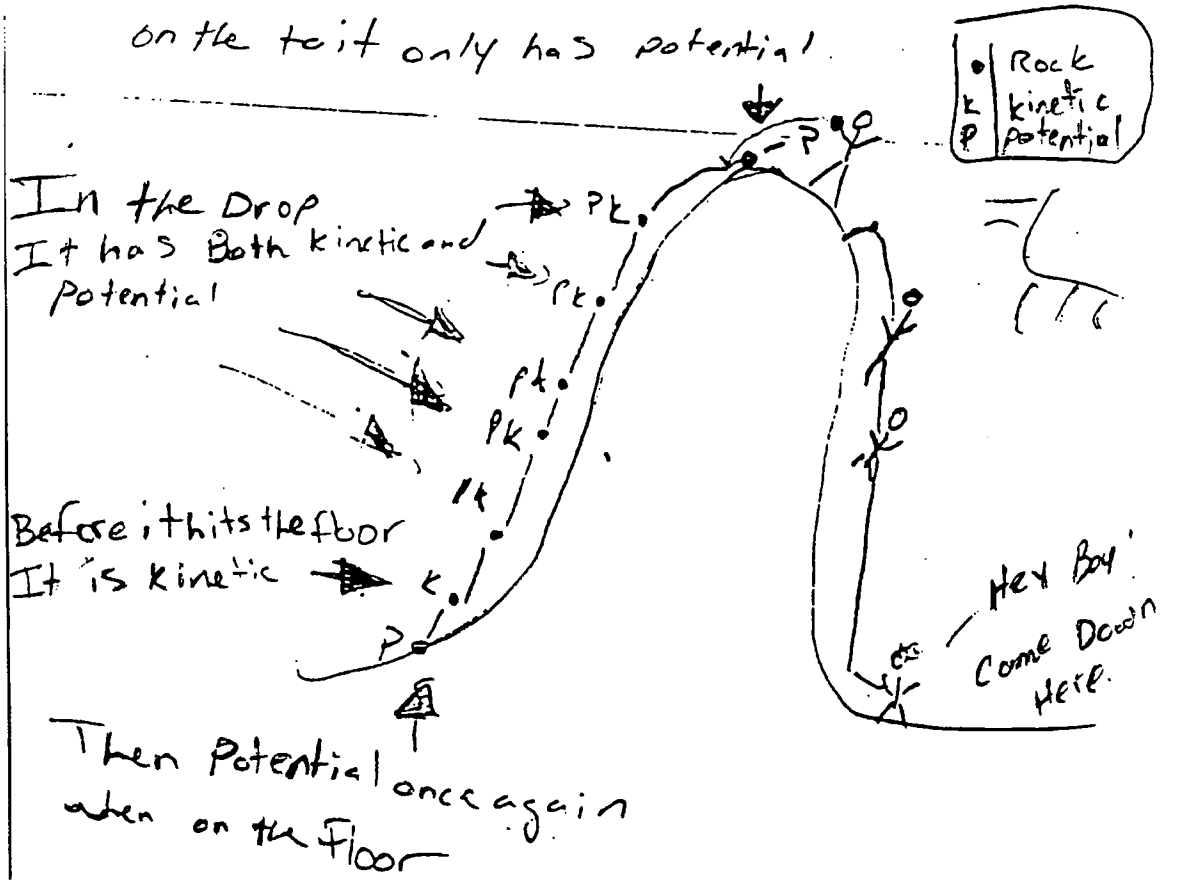
"A food chain shows how energy is passed form one organism to another. The energy comes from the sun. (sun → grass → grasshoper → frog → horen → Allagator)"

Intended Meaning: A food chain shows how energy is passed from one organism to another. The energy comes from the sun and then is passed on to other things (sun → grass → grasshoper → frog → wren → alligator)

Figure 2.34 - Spanish

Figure 2.35 is a high school student's visual representation of kinetic and potential energy concepts.

Explain in detail the change in potential and kinetic energy that occurs to a rock when it is first sitting at the top of a mountain, then when it starts to roll down the mountain, and finally when it reaches ground level.



"on the to[p] it only has potential - In the Drop It has Both kinetic and potential - Before it hits the floor It is kinetic - Then Potential once again when on the Floor - (Hey Boy' Come Down Here)"

{•=Rock k=kinetic P=potential} chart and arrow/sequential coding.

Figure 2.35 - Spanish

3.0 EFFECTS OF ENGLISH LANGUAGE DEVELOPMENT ON UNDERSTANDING AND INTERPRETING ASSESSMENT ITEMS

It is important to realize that students' responses to assessment items depend on their interpretation and understanding of the items. This interpretation and understanding is in part influenced by what is being asked, the student's language background, and cultural reference. This is true for all students, and because of the open-ended nature of performance assessment items, a variety of interpretations is often possible, and appropriate, for the same item. However, ELL students' cultural backgrounds are often very different from the traditional American "*educational culture*" used in assessment, and may result in these students interpreting items in an unexpected fashion. Existing evaluation systems help to assess whether a selected instrument is valid or not, and assuming that it is, there is still a need to look at the options to revisit and revise existing assessments, under the light of this manual's context. There are a number of ways the misunderstandings described below might be handled in scoring responses, depending on how critical the misuse is to the content being assessed.

3.1.1 Misunderstanding the Meaning of Words or Phrases

Sometimes an explanation of what an item requires can be misunderstood because words or phrases in the item mean something different to some English language learners. Accurate scoring decisions sometimes rest on scorer awareness of how some ELL students interpret the task requirements in a specific item.

When scorers are aware of these influences, they may extract more meaning from the responses of LEP students and appropriately understand that the response may fulfill the requirements of an item, albeit in an unexpected way.

Another example occurs when an English test was translated in Spanish. During the development of a task involving the processing of waste products, several materials were chosen as the "*trash items*" to be categorized and to observe their re-usable or recyclable characteristics. While the English test version used aluminum foil among the items to sort as once living or not, when the test was translated into Spanish, the words used for aluminum foil were "*papel de aluminio.*" Therefore, when students were guided to define and identify the characteristics of some of the items which were once living, the Spanish speaking students chose "*papel de aluminio,*" because the word "*papel*" is paper, thus misleading them to believe that it came from trees.

3.1.2 Misunderstanding Systems and Symbols

Misunderstandings based on different systems of number, measurement, writing, and mathematics and science conventions, and different use of symbols could affect the interpretation of the requirements of the item. Examples of the different systems and symbols are explained in Section 2.2, Cultural Influences.

3.1.3 Misunderstanding Because of Differences in What Is Valued and Experienced

Students read an item based on their values and experiences, and the values and experiences prevalent in their culture. Since the values and experiences of the students' native culture and the U.S. culture may be dissimilar, there is room for misinterpretation.

Culture can affect a student's interpretation of an item in a variety of contexts. For example, an assessment item that asks students to create a fair race may elicit unexpected responses from some students. See **Figure 3.1.** Whereas the creators of the item expect students to create a race-course in which all of the contestants have to run equal distances, some students may interpret fair to mean that all contestants have an equal chance of winning. This may be especially true in cultures that do not place as much emphasis on competition. As a result, these students may create a race course in which the slower contestants will run shorter distances. On the basis of their interpretation of a race and the notion of fairness, this is a valid response.

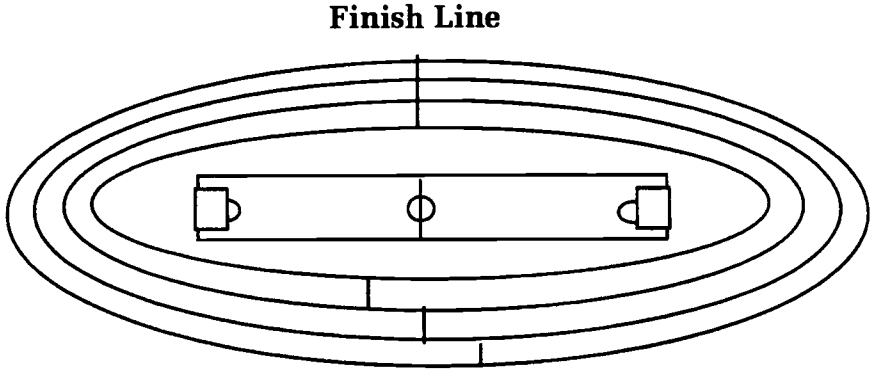


Figure 3.1 - Racing track

Another example would be a question, asking students to explain how a community water distribution system works. An LEP child from a rural area in his/her native country might depict a bamboo channeling system for accessing and distribution of fresh water to the community and collecting it for storage in a water tank. **(Figure 3.2)** By contrast, most students from the United States, where such systems are quite

sophisticated, could depict an intricate treatment plant, or the piping from the source to the tap in the house. A scorer might underscore the relevance of the student's rural system's design shown below. Nonetheless, such a design would be just as valid as those depicted by students living in other localities.

Draw and label a picture showing the source and distribution of water in a community.

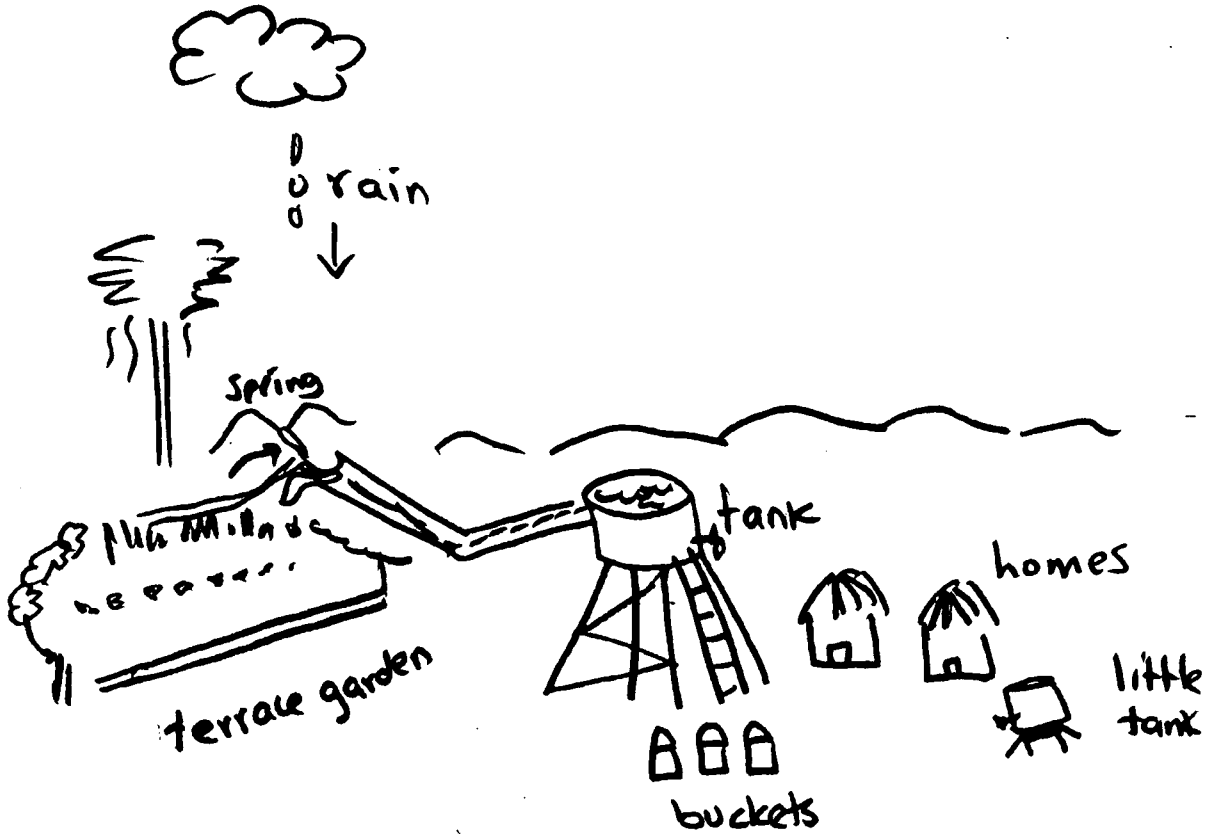


Figure 3.2 - Spanish

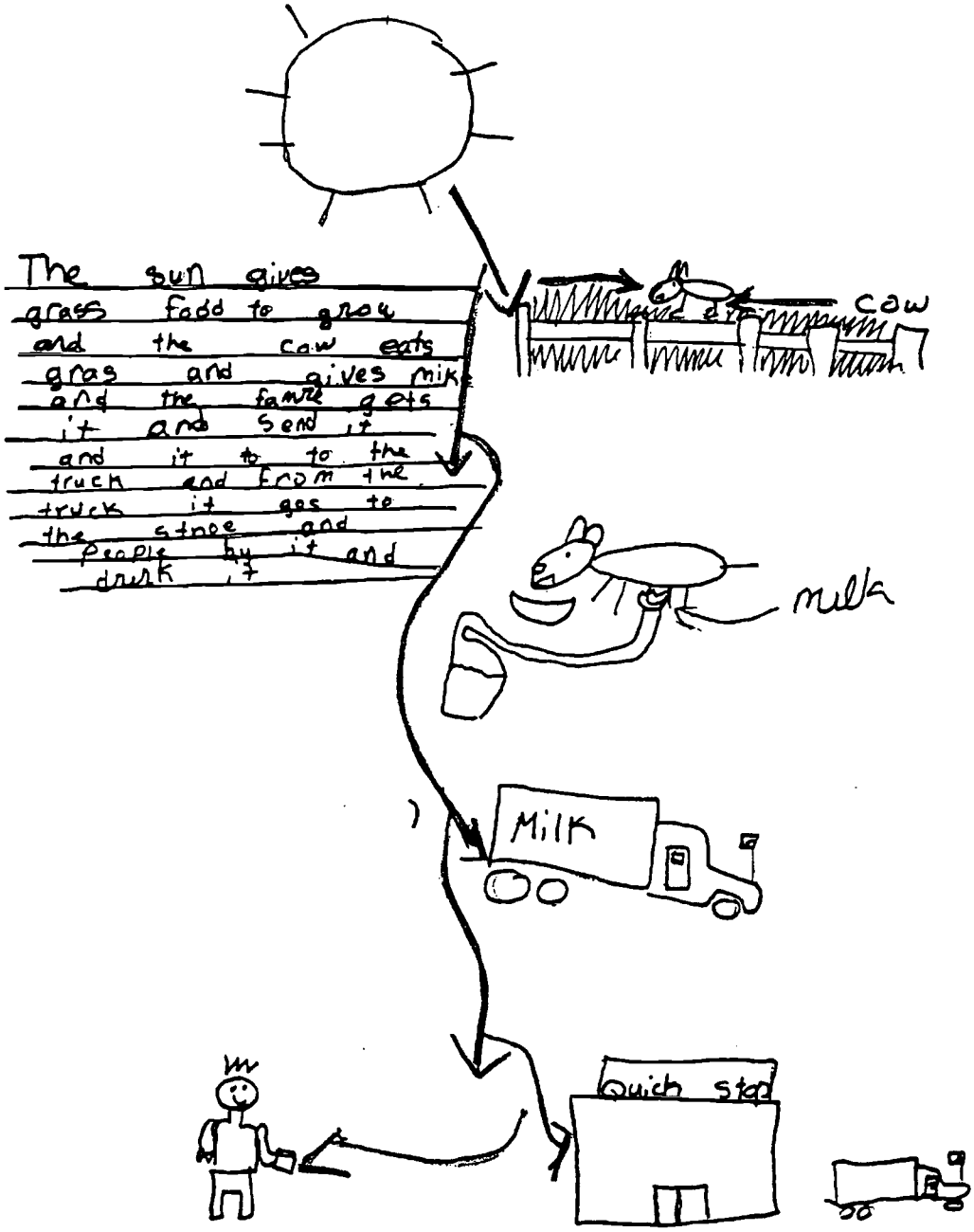
In **Figure 3.3,** students are asked to show an example of a food chain. The sample selected shows a response by a Punjabi student, whose cultural background prohibits the consumption of beef, yet allows milk consumption. The representation of this student's food chain is depicted as follows:

Sun → plant → cow/milk → human

Although there are misconceptions in the content (e.g. sun giving food to the grass), the student has a very basic understanding of a food chain in terms of flow of energy. It identifies the source of energy as the sun, and then the flow of energy from one organism to another is represented by the arrows between the grass and the cow. Given the cultural influences in place, the product from the cow is ultimately consumed by a human. The student gives details of transport of goods for human

consumption, which are not part of a food chain. However, he/she deemed these steps necessary, in order to clarify that the cow is not eaten, but rather it is the milk that is consumed.

Draw and label a food chain



The sun gives to the grass the food to grow, and the cow eats the grass. It gives milk and the farmer gets it and sends it to the truck. From the truck, it goes to the store and people buy it and drink it.

Figure 3.3 - Punjabi

4.0 ISSUES RELATED TO THE CONSTRUCTION OF ACCURATE ASSESSMENTS FOR ELL STUDENTS

4.1 Validity Considerations

It appears that most of today's problems in accurately assessing academic achievement in English language learners are related to validity (Kopriva and Lowrey, 1994). That is, developers assume that ELL scores on tests and their items are functions of the intended ability. Even the bias analyses assume that the responses are measuring the intended ability, once the influence of item response theory (IRT) parameters have been taken into consideration. This appears to be especially true if the analyses do not detect significant differences in item response curves, or if the results reflect what we know or what we think we know; for instance, if we assume that socioeconomic status is primarily responsible for affecting the response curves. Steps to validate the assumption of ability do not appear to have been done extensively by test developers.

Test development and implementation issues are dealt with extensively in a forthcoming document *Ensuring Accuracy in Testing for LEP Students: A Practical Guide for Assessment Development* (in press.) The following section will briefly summarize some of the recommendations in the guide. Readers are encouraged to review the development guide if they have further questions or interest in ensuring accuracy for LEP students in the development and implementation of assessments.

4.1.1 Item and Test Development

The item formats common within performance assessment systems often require more reading, and more communication of knowledge, generally through writing. Further, as discussed above, the additional element of scoring the responses of English language learners can introduce significant error into the measurement of subject matter knowledge. For instance, the development and use of scoring criteria and guides, and the training and monitoring of scorers are intervention points that can inversely affect the academic evaluation of ELL students, particularly because most scorers, to date, are monolingual native English speakers.

In attending to the potential problems inherent within traditional tests, and as well as tests that use a broader range of item formats, we need to be alert to many of the following challenges posed within the portions of the assessments that are presented to the students:

- The directions
- the items and prompts

- Contextual passages (e.g., passages that introduce or explain a science experiment)

Other intervention points include recognizing and minimizing the unintended effects possible in:

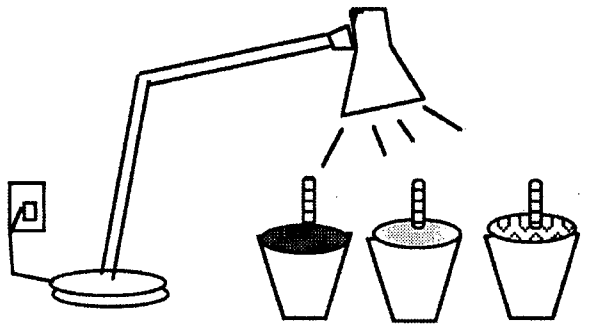
- Administration procedures
- The composition of test forms
- Samples used in pilots/tryouts of items
- The equating procedures
- Procedures around mapping scores onto performance levels and standards
- The types of designs of technical studies
- The interpretation of and use of results
- Reporting

In the directions, items, and response criteria, large-scale assessments generally mirror the elements associated with the average literacy expectations of native speakers in a given grade. Unless the test is assessing reading or writing, it seems reasonable that the breadth and depth of literacy sophistication in tests should be kept to a minimum, with the exception of certain vocabulary that is germane to a subject area and should be learned as part of learning the concepts the vocabulary represents. This includes scientific concepts.

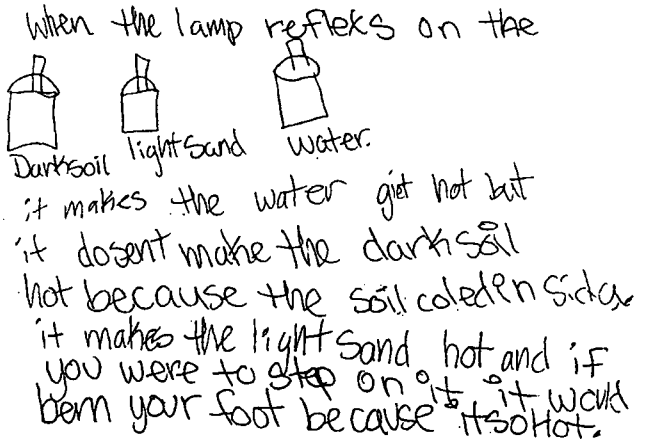
As often as possible, teachers of LEP students suggest that simple visuals be used to facilitate the understanding of what is being asked/presented in a specific item or group of related items. The illustrations or charts should not be so complicated as to distract from the intention of the item. **Figure 4.1** illustrates an effective use of a drawing. Notice the bendable arm lamp, the different textures to represent water, soil, and sand, and the thermometers to underscore the heating aspect of the question. Also, to facilitate accurate understanding of the item, the words "*dark*" and "*light*" are used to describe the soil and sand - item writers shouldn't assume that soil is darker than sand. The student uses prior experiences with soil, water and sand to show that light energy transfers to heat energy. It also shows some understanding of the interactions that take place by identifying depth as a factor affecting the amount of energy being absorbed.

WHERE ON EARTH?

Mrs. Flores' class has been learning about the position and composition of the Earth, and the interaction between the Earth and the sun. The following experiment was used in part of their study.



Using everything you know about light, heat and water, how do you think this activity helps explain the uneven heating of the Earth's surfaces?



When the lamp reflexes on the Dark soil, light sand, water it makes the water giet hot but it dosent make the dark soil hot because the soil coled insida it makes the light sand hot and if you were to step on it it would bern your foot because itsoHot.

Intended Meaning: When the lamp reflects the dark soil... light sand water it makes the water get hot, but it doesn't make the dark soil hot, because the soil is cooled inside. It makes the light sand hot, and if you were to step on it, it would burn your foot because it is so hot.

Figure 4.1 - Vietnamese

4.1.2 Language Complexity

The Council of Chief State School Officers suggest the following guidelines dealing with the issue of language complexity for ELLs in assessments of subject areas other than language arts. These guidelines would also be useful within the assessment of language arts, when the particular skills noted below are not being specifically evaluated. In items, test directions, and contextual passages:

- Paraphrasing words or ideas should be recognized as such and either not used in achievement assessments taken by ELLs or used with all the words in parentheses. This means using the same words to refer to the same phenomenon, concept, person, place, thing, action, or modifier rather than using a variety of words. While repetition may be considered bad writing by most teachers, it is necessary to present test questions that use a limited range of variant terms and constructions that make question comprehension easier for second language learners (Masuda, 1996).
- The rate of organizational structures in sentences and paragraphs needs to be restrained. Again, this might be good writing, but it is common for ELL students to not recognize alternative ways of communicating the same thought, or to be confused by different approaches to discussions of an issue, or to a contextual explanation. A restricted, straightforward, consistent, and common (present or past) tense approach is best and will lead to more accurate measurement of the subject under consideration.

4.1.3 Primary Language Assessment

One should not assume that ELL students have been taught the skills necessary to adequately take a primary language achievement test, as they are currently written. Many such tests are generally written in a style that assumes a sophisticated level of literacy in the primary language, consistent with the grade-level literacy expectations of English speakers. Even though students may speak their native language fluently, they are often not literate in the primary language.

If primary language assessments are to be developed and used, it makes sense that at least some forms of the test be edited as an ELL accomodation to reduce language complexity.

4.1.4 Item Overload

Item load is defined here to mean the amount of work required to successfully complete the demands of a test item, prompt, or task. Overload frequently can occur for English language learners because of the increased work they face in having to decode the language, in addition to reading the items and text for subject matter intent. This includes the intent of the distracters in selected-response items. Increased work requires additional time. It also significantly raises the probability

of experiencing fatigue and frustration that may adversely affect responses.

To address this problem, it is recommended that:

- Test developers specify and allow additional administration and response time for ELL students.
- Test booklets be structured to ensure enough breaks for students. For instance, if a history assessment is generally designed to go over two class periods with a break in between, then it might be prudent to structure some forms with the same number of items types per form but recommend that the test be completed with two breaks.

4.2 Recommendations

1. Test developers need to answer the question: Are we testing science or language/science? To get the highest score possible, should students be required to use English or their native language fluently to explain themselves? The National Science Education Standards, as well as many state standards, emphasize a student's ability to communicate about science as an important component of knowing and demonstrating science. Does it only mean communicating through writing? How about communication through algorithms or communication by performance? How should this be handled for all students, including ELL students?
2. Items should be reviewed specifically for linguistic and cultural inconsistencies. This review should include field-testing where students and teachers are specifically asked to comment on words or phrases, and not just be a review by experts familiar with particular cultures.
3. Currently, most bias review panels focus on eradicating stereotypes in items and tests. The charge of review panels should be expanded to include a discussion and review of the type of skills that would be required to successfully complete complex performance items. This review should be supplemented with student work, field test data, and evaluations. Recommendations should be made about item requirements.

4. Flexibility in both administration and response formats can noticeably affect the accuracy of ELL scores. LaCelle-Peterson and Rivera (1994) emphasize that some students initially develop a higher level of listening and speaking proficiency in English as compared to their reading and writing English proficiency levels. This appears to be especially true when the students are not literate in their primary language (Wong-Fillmore, 1994). Therefore, the reading and writing formats traditionally used in large-scale assessments may not be an effective way to measure subject matter achievement. While Kopriva and Lowrey (1994) found that cueing regularly occurs when teachers are allowed to read the test aloud to students, it is recommended that some kind of standardized read-aloud approach, perhaps using cassette tapes, be available to students to use in appropriate situations. It is also recommended that tapes or a computer voice recognition program be used to enable students to respond orally to performance items.
5. To ensure that assessments are actually measuring the types of skills and knowledge inherent in the items rather than coping skills needed to deal with novel curricular or assessment approaches, students must have similar experiences in their classrooms. That is, they must have ongoing classroom opportunities and communications that require them to use content by demonstrating critical thinking skills and that require them to verbalize and write about these experiences in the language of the test.
6. Repeated classroom experiences with the types of items and tests that are being used in large-scale situations are also important, if the assessments are going to accurately reflect what students know. This includes (a) the setting of the tests, e.g., on-demand or completed over days, with or without feedback from others; (b) item formats, i.e., open or closed, short answer, or extended response; and (c) the response requirements, i.e. written, numeric, or graphic, and first or finished draft.

5.0 SUMMARY

To date, little work has been done to ensure that LEP students are accurately assessed on large-scale (Olson and Goldstein, 1997). The purpose of this guide is to help scorers in high-volume situations be able to effectively evaluate the open-ended responses of this population. Section 1 presented a brief overview about CCSSO's SCASS LEP Consortium Project and some background information about the nature of the development of language proficiency. Section 2 provided guidance about linguistic issues in the students native language, developmental benchmarks associated with learning English, and cultural influences - all of which affect the written responses of LEP students. This section illustrated numerous examples and provided specific recommendations about how to accurately read the responses.

Sections 3 and 4 placed the scoring of items in the larger context of test development and implementation. Section 3 briefly discussed the effects of English language development on how ELL students understand and interpret some assessment items, and Section 4 provided an overview of how tests might be constructed and administered to ensure the validity of the tests for these students. Recommendations included throughout Section 4 highlighted where and how to improve large-scale testing for English language learners.

The Guide is designed so that it can be efficiently integrated into the regular training that scorers receive when they are preparing to score test items. Used with the accompanying training guide, it has been found to be a useful tool for scoring LEP student work in large-volume settings (Kopriva, 1997). As more and more English language learners are included in large-scale assessments, this guide will help ensure that their work is evaluated reliably and responsibly, so that the real progress toward meeting challenging standards can become a reality for all.

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Appendix A

SCASS LEP PROJECT

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Appendix B

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Appendix C

GLOSSARY

Access. Rights and means to approach or engage in with understanding. Assessments provide for equal access when they include items that are shown to be equally appropriate for all students, allow multiple approaches and strategies, and accept multiple justifiable responses.

Allele. Information determining characteristics of an individual is passed to the offspring in units called genes. Every individual possesses two forms of a gene for each trait (hair/eye color, etc.). Each form of the gene is called an allele, which is usually represented in genetics with letters. E.g., coat color of a rabbit population could be white (W) or black (w). Assuming that the white color is a dominant trait, and black the recessive trait, their symbols would be: WW = white, Ww = white with potential to pass on an allele of black coat coloration to offspring, and ww = black coat.

Assessment. The process of gathering evidence about a student's knowledge of, ability to use, and disposition toward a subject and of making inferences from that evidence for a variety of purposes. Assessment is a term that has often been used interchangeably with the terms testing, measurement, and evaluation, or to distinguish between student assessment and program evaluation. In this document, assessment is used as defined above to emphasize understanding and description of both qualitative and quantitative evidence in making judgments and decisions.

Assessment Instrument. A set of assessment items and/or activities for a particular academic area that are tied to content and student performance standards and used for measuring student academic performance and achievement.

Assessment Items. Test questions or activities based on content used to determine students' achievement of performance standards.

Assessment Validity. Refers to whether the assessment instrument measures what it purports to measure.

Benchmarks. Descriptions of student performance at various developmental levels that contribute to the achievement of performance standards.

Bias. The systematic under-measurement or over-measurement of a student's "true skills."

Code Switching. The alternate use of two languages. Language selection depends on the context.

Conduction. Transfer of energy through a medium from a region with high energy (hot) to a medium of lower energy (cold) without perceptible movement of the medium itself (heat and electricity).

Content Standards. Statements about what students must know and be able to do in various disciplines such as English language arts, mathematics, science, and social studies.

Convection. Transfer of energy through liquids between regions of unequal density, caused by unequal heating or gravity.

Curriculum. (1) An educational program that may include a program of studies, a program of activities, and a program of guidance; (2) an operational plan for instruction that details what students need to know, how students are to achieve the identified curricular goals, what teachers are to do to help develop their knowledge, and the context in which learning and teaching occur.

Curriculum Framework. A comprehensive document outlining the broad goals and content standards of an entire system of education, while leaving the local district the freedom to develop a specific program to address the framework.

Embedded Assessment. Assessments that are developed, integrated, and used within an instructional context; for example, within an instructional unit.

Entropy. The measure of disorder at the atomic, ionic, or molecular level of a system. Energy not available for useful work. The tendency towards disarray in a system; i.e., as water changes from liquid to gas, molecule movement increases in disorder due to the larger volume in the vapor, so the entropy increases.

Environmental Factor. Any one of the aggregate of external conditions that influence the life of an individual organism or population.

Equitable Assessment. The degree to which the process of gathering evidence has provided opportunities equally appropriate for each student to demonstrate the valued thinking processes, knowledge, and skills that he or she has developed. Equitable assessment is not achieved by creating the same assessment conditions for all students, but rather by creating conditions that are appropriate to the same extent for each student.

Equity, Fairness. A matter of equal opportunity; providing for each student the opportunity he or she needs to succeed educationally. For example, tests and assessments should not systematically penalize an individual because of gender, race, or cultural background. Likewise, differences in educational programs to address individual student needs should not systematically offer some students less rich educational experiences.

Fault Line. A fracture in the Earth's crust, accompanied by a displacement of one side of the fracture with respect to the other and in a direction parallel to the fracture. Fault lines are a result of movement and stresses of the crystal plates of the Earth. There are different types of motion along a fault line. Not all faults are on plate boundaries. When two plate boundaries collide or merge towards each other, it is known as a subduction zone. Usually mountains form, rock layers fold, and pressure builds underneath the crust along subduction zones (one plate slides under another). On the contrary, sea floor spreading and divergence of plates occur in zones where the plates are separating. Magma flows outward through the mid-oceanic ridges at continuous and periodic intervals. The San Andreas fault is on a plate boundary and it is distinguished by its lateral strike movement, sliding northwesterly against the American plate, which is moving in the opposite direction, at the rate of approximately one inch per year.

Food Chain. Sequence of transfers of energy in the form of food from organisms in one tropic level to those in another. There are two types of food chains: grazing food chain - energy transfer from plants to animals; and detritus food chain - transfer of energy by decomposers.

Gene. A hereditary unit residing in a specific location on a chromosome, with a specific influence on a phenotype, giving the characteristic traits of an individual.

Gene Pool. Total genetic information possessed by a given reproducing population.

Generalizations. Inferences or conclusions from many particulars of the evidence in hand, supported by a theory of the relationships between the particulars and the more general inferences or conclusions.

Heat transfer. There are three main ways of heat transfer: conduction, convection, and radiation.

Home Language. The primary language learned by the child, usually the language spoken at home.

Homozygous. Having a genotype containing like alleles; i.e., SS is the genotype for smooth seeds, while ss is the genotype for wrinkled seeds. Since each letter represents an allele and both are alike, these are homozygous genotypes. Otherwise, if the combination of alleles in a trait pair is made up of two different alleles (one dominant and one recessive), the genotype is said to be heterozygous.

Inclined Plane. A type of simple machine used to raise or lower a load by means of rolling or sliding materials on it. A ramp.

Inertia. The tendency of a body at rest to resist acceleration. The body at rest will stay at rest or a body in motion will remain in motion in a straight line, unless an external force is applied to it.

Inferences. Conclusions or assertions derived from evidence; deductions.

Integration. The idea that more than one discipline can and should be taught or assessed at the same time, or that behaviors of thought (e.g., problem solving and referencing) are not the exclusive domain of any one discipline. Integrated instruction connects subject areas in ways that reflect the real world. For example, a student's writing in his or her science or social studies class can serve as a sample of writing for assessment purposes. The literature studied in English class can reflect and be taught in concert with history or world cultures units or with scientific concepts and theories under discussion in science. Key scientific discoveries can be studied in concert with their effect on the history of a nation or people.

Item. A single test question or problem.

Judgments. Authoritative estimates or opinions of quality, value, and other features, formed by distinguishing the relations among multiple sources of sound and reasonable evidence; formal decisions.

Kinetic Energy. Energy associated with motion.

Language Dominance. The language in which a bilingual person has the greatest command. Dominance of one language or another can vary depending on the context or situation.

Lever. A simple machine consisting of a rigid body pivoted along a fixed fulcrum, to move or lift objects. It maximizes the force input in order to do work. There are three types of levers depending on the location of the fulcrum with relationship to the force and the body being moved or lifted; e.g., hammer, wheel barrow, scissors, see-saw.

Mixture. A combination of two or more substances that are not chemically bound to each other. A mixture can be separated into its components by physical means: by evaporation (crystallization), distillation, filtering or if iron is present, by magnetic separation. The total mixture is a sum of its components. Each substance retains its own properties while in the mixture.

Offspring. The progeny of a person, plant or animal. Children, product, descendants.

On-Demand Assessments. Assessments that are administered at a specific time under standardized testing conditions.

Open-Ended Questions. Items that ask students to formulate their own responses, which typically take anywhere from two to twenty minutes to complete. Open-ended problems engage students in interesting situations and allow students at many levels of understanding to begin working on the problems, make their own assumptions, develop creative responses, and effectively communicate their solutions.

Opportunity to Learn (OTL). The degree to which a student has been exposed to the learning experiences needed to meet high academic standards, which is largely a function of the capacity and performance of the courses and schools the student has attended. Equitable opportunities to learn consist of equal chances for learning, with equally appropriate, favorable, or advantageous combinations of circumstances, i.e., opportunities to learn are equitable when they are responsive to the same extent to each student's needs.

Performance. The carrying out or bringing to completion of an activity or production of some significance, which displays a student's knowledge and judgment while engaged in the task.

Performance Criterion or Standard. A statement of expected performance quality that can be used to make judgments about performances that are central to the curriculum. A set of performance criteria, or standards, includes the nature of the evidence required and the quality of performance expected to demonstrate that a curriculum or content standard has been achieved. These statements often describe performances at one level, such as either adequate or exemplary, but may also describe a range of quality levels.

Performance Assessments. Assessments that require students to demonstrate what they know and can do according to established education standards. Performance events are assessment activities that require students not only to choose the best answer, but also to explain the reasoning behind the answer or solve a problem either individually or with a group of students.

Phenotype. The observable expression of the genetic make-up of an organism as it refers to specific traits identified by the specific genotypes; i.e., tall, long-eared, smooth seeds, black hair, are phenotypes. The letters to identify them, such as SS or Ss (for smooth seeds), are genotypes.

Population. A group of organisms of the same kind.

Potential Energy. The amount of energy a piece of matter has, due to its position, rather than due to its motion, or because of the arrangement of its parts.

Pulley. A simple machine used to change the position and direction of a force being applied, mainly for lifting or weighing, mainly composed of a wheel with a grooved rim through which a rope or chain is run.

Interrater Reliability. Degree to which multiple scores judge student performance consistently.

Radiation. Transfer of energy that does not require a medium. Any form of energy emitted in the form of waves or particles, such as light, sound, alpha and beta particles.

Rubric. A set of definitive guidelines and criteria to give direction to the scoring of assessment items or activities. To be useful a scoring rubric must be derived from careful analysis of existing performances of varying quality. An item-specific rubric describes levels of performance for a particular complex performance item and guides the scoring of that item consistent with relevant performance standards. (An item-specific rubric is more specific than a performance standard and can apply a performance standard to a particular context found in a performance item.) A general rubric is an outline for creating item-specific rubrics, or for guiding expert judgment, where item-specific scoring rules are internal to the scorer.

Scientific Method. The set of principles considered characteristic or necessary for scientific investigation. It includes the rules for concept formation, conduct of observations and experimentation, and validation of hypotheses by observations and experimentation.

Scoring. Discriminating among performances according to differing levels of quality and assigning a descriptive label or number to the performance. In holistic scoring, the entire performance as a whole is considered, and one label or number is assigned. In analytic scoring, separate scores are assigned to fundamentally different dimensions of the performance.

Screw. A type of simple machine in the form of a cylindrical rod with one or more spiral threads. A spiraling inclined plane.

Simple Machine. Any of various elementary mechanisms formerly considered as the elements of which all machines are composed and including the lever, the wheel and axle, the pulley, the inclined plane, the wedge, and the screw.

Species. Natural population or group of populations that transmit specific characteristics from parent to offspring. They are reproductively isolated from other populations with which they might breed.

Standard-Referenced Assessment. An assessment that compares the quality of performances to relevant performance criteria or standards to make a determination of the degree to which the standards have been attained or to describe progress toward the attainment of the standards.

Technical. Relating to formal, psychometric determinations of the quality of scores.

Valid. Justifiable, well grounded, sound; producing the desired results, efficacious; incontestable.

Valid Inference. Justifiable assertions and conclusions that lead to and support desirable results. Justification is made primarily on the quality of the evidence and its adequacy for the intended purposes and their consequences.

Wedge. A type of simple machine in the form of a tapered piece of metal or wood used for insertion in narrow crevices or for splitting, securing, tightening or levering.

Wheel and Axle. A type of simple machine composed of a circular ring or disk, connected to a central hub and designed to spin around a central axle; i.e.: a bicycle wheel, door knobs, etc.

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