Planning Committee Review of Content Boundaries	
Name: Jo Ellen Roseman Date: January 23, 2006	
Some general comments, based on a careful look at all the life science sections, looking over some earth science sections, and spot checking the physical science: **Overall**, the specifications are impressive and reflect careful work. Kudos to the January writing team. In many instances, **Earth Science** specifications seem to have exceeded the intent of the content standards. First, the Earth Science specifications of *instruments* suggest they were thinking about performance assessments rather than about instruments/measurements that students should be familiar with (so that they could interpret data from them). Second, several of the earth science *examples* appear to be specifications for curriculum/instruction (e.g., E8.OU5, E4.OU5, E4.OU6, E12.OU9-12, 14, 15, E8. PE1, 2, 3, most examples for Tectonics) rather than assessment. Third, terms used in some Earth Science specifications go well beyond the terms used in content standards (e.g., E8.HE3, E8.HE12, E8.PE18, E8.PE19, E12.OU17-nebula, supernova, E8.PE2 and 3). All of this misses the point of benchmarks and standards, which intend that students will remember the generalizations, not the details. I've elaborated on a few examples below lacked time to be systematic. In contrast to Earth Science, most of the **physical science** specifications appear consistent with the content standards. My initial concerns about the few excesses in 12th grade physical science content standards are reinforced by the specifications (e.g., P12.CM1, P12.CM7, P12.CM8, PT12.ET5 surely this doesn't mean phase diagrams???) There are inconsistencies within the 5 sections of **life science** specifications in terms of consistency with content standards. I've made suggestions below for how to remedy some of them.	
Page Number/ Boundary Code	Comments
Organization and Development of Living Systems (OD)	
59/L12 examples	Examples should also come from organisms, not just cells. Students should know that human tissues (e.g., bone, muscle, blood vessels) are also made up of the same elements. Examples of cell processes can include transport of materials, energy capture and release, protein building, waste disposal, passing information, movement. All of these are carried out by the molecules cells assemble, mainly proteins.
59/L12 instruments	Are students to use the instruments during assessment, to recognize data that comes from their use, or both?
60/L8 technical vocabulary	Consider restricting systems to those specified in content standard—those that serve needs of cell for finding food, air, waste removal and being explicit about that. So I'd emphasize digestive, circulatory, excretory systems. I'm fine with using the terms for parts of the above systems in assessment items but not with focusing assessment items on whether

	or not students know the terms or what system they are part of. Consider adding to exclusions: liver, gall bladder, pancreas, seed parts.
60/L12 clarification	Notes for possible clarification of L12.1 and L12.2: Living things are made of complex molecules; Complex molecules are made of subunits Subunits (hence complex molecules and living things themselves) are made up of the same elements—carbon, hydrogen, oxygen, nitrogen, phosphorous) Cell processes—replicating genetic information, repairing cell structures, helping other molecules to get in or out of the cell, and generally catalyzing and regulating molecular interactions—are carried out mainly by proteins Cells make the molecules they need Different proteins do different work (and without specific proteins the processes may not be carried out at all or as well) Proteins are long and usually folded chains; are made up of amino acids (smaller molecules that are the building blocks of proteins) The function of each protein depends on the amino acid sequence and resulting shape the protein takes when it folds Exclusions: How proteins are made (RNA, codons, etc.), how proteins function (e.g., molecular basis of enzyme catalysis, muscle contraction, membrane transport); terms hydrophobic, hydrophilic, the structural formulas of amino acids
Matter and Energy Transformations in Living systems (ME)	
61/L4.ME4	A note of caution about the use of arrows. Project 2061's analysis of high school biology textbooks showed books to be inconsistent in use of arrows and to rarely label what arrows mean. Consider including a figure legend in diagrams indicating the meaning of arrows.
61/L12.ME4	A way around the inconsistency between content standard and specification would be to begin the sentence, "*Labeled* structural formulas of monomers…" I'd be comfortable with this.
61/L12.ME8	Exclusions: consider adding to sentence, "Representations of details of synthesis and decomposition (e.g., intermediate steps and molecules, details of dehydration synthesis).
Interdependence of Living Systems (IL)	
63/L4.IL6	Given that the US was unable to make the switch to metric (and hence students' out-of-class encounters of temperature measurement are in Fahrenheit), I'd advocate including both in items.
63/L12.IL7	Why use "anthropogenic" rather than "human generated"?
64/L12.IL8	Consider adding cities as an example of a coupled ecosystem
Heredity and Reproduction (HR)	
65/L12 examples	Shouldn't there be an example that links altered genes and altered proteins (and potentially altered function)? This seems to be a critical part of the 12th grade content standards L12.8 and L12.9 on p. 57.
65/L12.HR2	It is true that sexual reproduction technically refers to form of

	reproduction in which genetic material is combined from two parents in an offspring, typically involving the fusion of two haploid gametes. But often the term is used to refer to both gamete formation and fusion. To avoid confusion consider referring to the process as fusion or fertilization. What is an "intermitted" mutation?
65/L12.HR4-6	I agree with all exclusions. (Though one should shed a tear for poor Mendel: buried, uncovered, then buried again).
65/L12.HR3	Basic bioinformatics is not in content standards and hence students are not expected to know this. This could provide context for items but the information would have to be supplied in the item.
65/L12.HR8 and L12.HR11	Electrophoresis, even basic electrophoresis, is inconsistent with the content standards. While I think it might be helpful during instruction for students to see *that* it is possible to separate biological molecules, such as nucleic acids and proteins, based on differences in their properties such as mass, I think it unreasonable to hold students accountable for knowing *how* the technique works. (We've just interviewed 2 PhD molecular biologists who don't know how electrophoresis works). Similarly, I think it unreasonable to expect students to interpret gels.
66/L8HR5	(Fortunately), the language of the content standards does not include "genes" until grade 12. Without chromosomes or DNA (also grade 12), what will students think genes are? (Note that Benchmarks uses "genetic information," which is similarly confusing. In our clarifications, we're resorting to calling genetic information the stuff that offspring get from their parents that specifies their traits, admittedly a cop out.)
66/L12.HR16	The term genome is not part of the content standard or technical vocabulary. Clarification should include something along these lines: Understanding the molecular basis of heredity requires a coherent understanding of two main functions of DNA: 1) determining the characteristics of organisms, and 2) passing information from one generation to the next. For students to understand the role of DNA in determining the characteristics of an organism (function 1) they need to know that an organism's characteristics reflect the actions of its proteins, that proteins carry out the work of cells (and organs/organ systems), and that DNA directs the production of proteins. These ideas are in content standard L12.2 (in OD) and L12.9 (in HR). To understand that DNA carries hereditary information from one generation to the next (function 2), students need to understand DNA's role in function 1 and that DNA is what gets passed from parents to offspring. Genes and chromosomes are then defined in terms of DNA.
Evolution and Diversity of Living Systems (ED)	
67/L4.ED4	Why not be explicit about *external* features (as you are about *internal*

	features in L8.ED4)?
67/L4.ED5	Note that photographs don't show relationships, just what lives where and what features it has. Relationships have to be inferred and are, at best, hypotheses.
67/L4.ED6 and ED8	Note that the standard uses "characteristics," not "trait" (which is deliberately postponed until grade 8). While examples should use characteristics that are heritable, students are not expected to know the word trait or to distinguish heritable from other characteristics. Suggest replacing "can" in last line of ED8 with "might"
67/L8.ED4	Why stop with measurements or descriptions? Why not insert "of similarities and differences…"?
67/L8 technical vocabulary	Terms adaptation, fitness, evolution are not in grade 8 content standards. The concept of evolution—that the earth's present day species developed (over many generations) from earlier, distinctly different species—requires some understanding of evidence. History of life on Earth, as depicted in the fossil record, is in grade 12 content standards. And without an understanding of natural selection, a grade 12 expectation, the other terms make little sense. Terms used in 8th grade content standards—species, extinction, fossils, traits, degree of relatedness—will be sufficiently challenging for students.
67/L8 or L12 representations	Degree of relatedness in L8.12 implies that students will be familiar with some means of showing that, e.g., pedigree charts. I'd be comfortable with having students use charts to decide which pairs of organisms are more/less closely related. Content standard L8.11 includes knowing that fossil record provides evidence for extinction (i.e., organisms represented in fossils no longer are found today). Wouldn't it be appropriate for representations to include simple timelines indicating when fossils have been found (and not found) for particular species? (I'm ok with this going into L12 representations, but it should be somewhere). This seems to be what Earth science is getting at in E12HE2, p. 84.
68/L8 clarification	Move first bullet to grade 12. Grade 12 content standards deal with natural selection, not grade 8. In second bullet, the focus of grade understanding should be on appearance and disappearance of species, not on changes in species over time.
68/L12 clarification	Students should also be expected to link evidence of similarity within diversity of organisms (including anatomical and molecular evidence) to common descent.
Objects in the Universe	
81/E4.OU1	Sun is toward the south at noon only in the northern hemisphere.
81/E8.OU1 and 82/E8.OU5	Not in content standards. It is in Benchmarks and NSES: These [predictable] motions [of most objects in the sky] explain such phenomena as the day, the year, phases of the moon, and eclipses. It should be in NAEP. Was this a deliberate omission? At present, however, putting in that specification appears to go beyond NAEP. One way out would be to use the grade 4 content standard as

	justification, comparable to what was done and explicitly noted in P12.MM6. It should be made clear to item writers, however, that holding students accountable for explaining (in a later grade) patterns of phenomena they were held accountable for in an earlier grade should only be done when explicitly stated in specifications. For OU5, isn't this a suggestion for instruction rather than assessment?
81/E4.OU Instruments	Is the point that students should be familiar with sundial-type devices and what they reveal about the apparent motion of the sun across the sky? Is it the point that students should be familiar with the period length of the sun's path across the sky (a day) and the moon's phases (about a month)
81/E8.OU2	Relative sizes and distances and shapes of orbits goes beyond content standards. Consider dropping the specification.
Energy in Earth Systems (EE)	
91/E4.EE3	Goes beyond content standards for grade 4 (and learning research). Move to grade 8.
91/8th grade examples	These aren't written as examples, phenomena, or data. What are they? They seem to be additional content to be learned. If they need to be kept, reorder to group related statements: Move E8.EE7 and E8.EE8 to follow E8.EE3. Reorder rest from easiest to hardest (E8.EE6, E8.EE9, E8.EE10, E8.EE5)
92/E4.EE7 and E4.EE9	Convection cells are not in 4th grade content standards. Move to grade 8.