Science and Technology/Engineering Panel Review

STE Framework Pre-Review Survey Results

April 2009

The *Science and Technology/Engineering Curriculum Framework* survey launched on **March 3, 2009** and closed **April 21, 2009**. This document summarizes the **462** survey responses.

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Demographics of survey respondents

School district, agency or other affiliation. (Select one) (462 responses)

- Non-Urban Districts 241
- Urban Districts 147
- Regional 54
- STE Agencies/Other Affiliations 10
- Charter 5
- Colleges/University 5

Primary Role (Select one) (461 responses)

- Teacher 342
- Department Chair 26
- Curriculum Coordinator 22
- Other 17
  Including: Consultants, Researchers, Retired Teachers, and a Librarian, among others
- Elementary Science Specialist 14
- Principal 9
- Special Education Educator 8
- Professional Developer 6
- Science Coach 4
- Student 3
- Faculty: College or University 3
- ELL Educator 3
- Superintendent 2
- Parent or Community Member 2
- Business Representative 0

Discipline(s) represented (Select all that apply)

- General Science 202
- Biology 140
- Technology/Engineering and/or Technology Education 86
- Earth Science 82
- Chemistry 78
- Other: 71
  Including HS Science courses: Environmental Science; Anatomy and Physiology; Forensics; Biotechnology; Marine Science; Astronomy; Geology
- Physics 61

Grade level(s) represented (Select all that apply)

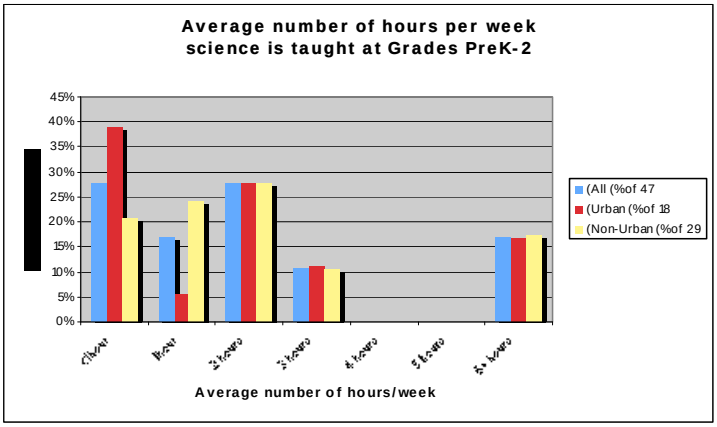
- Grades 9 – 12 200
- Grades 6 – 8 176
- Grades 3 – 5 125
- Grades PreK – 2 75
- College or University 18
- Adult Education/ESOL 1

Amount of time for science

For respondents that teach PreK-12, the average time per week they spend teaching science.

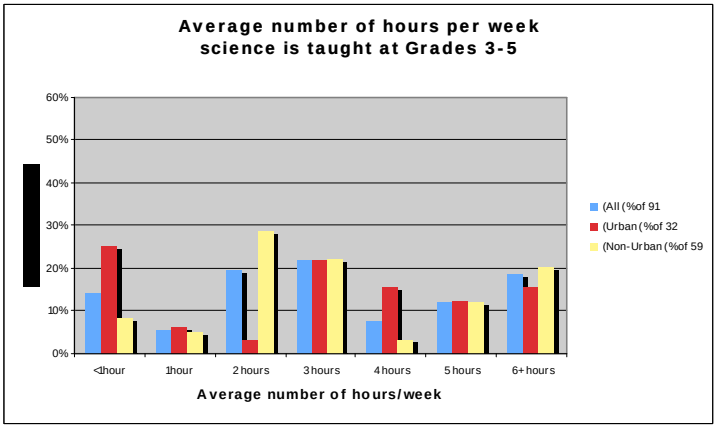
Grades PreK-2 (Average = 2.19 hrs)

Avg # of Hours	All (% of 47)	Urban (% of 18)	Non-Urban (% of 29)
<1hour	28%	39%	21%
1hour	17%	6%	24%
2 hours	28%	28%	28%
3 hours	11%	11%	10%
4 hours	0%	0%	0%
5 hours	0%	0%	0%
6+ hours	17%	17%	17%



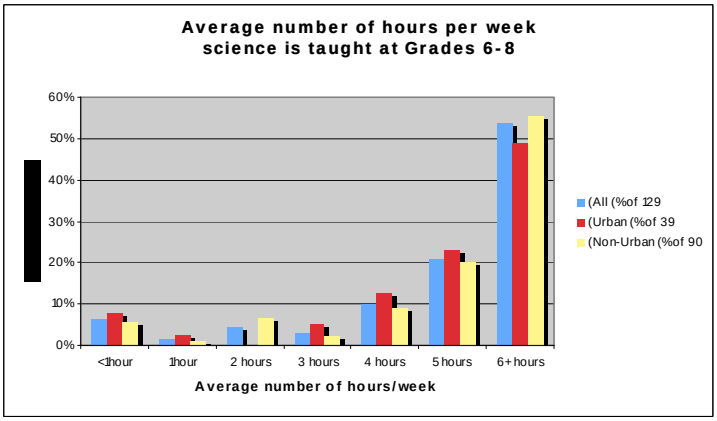
Grades 3-5 (Average = 3.25 hrs)

Avg # of Hours	All (% of 91)	Urban (% of 32)	Non-Urban (% of 59)
<1hour	14%	25%	8%
1hour	5%	6%	5%
2 hours	20%	3%	29%
3 hours	22%	22%	22%
4 hours	8%	16%	3%
5 hours	12%	13%	12%
6+ hours	19%	16%	20%



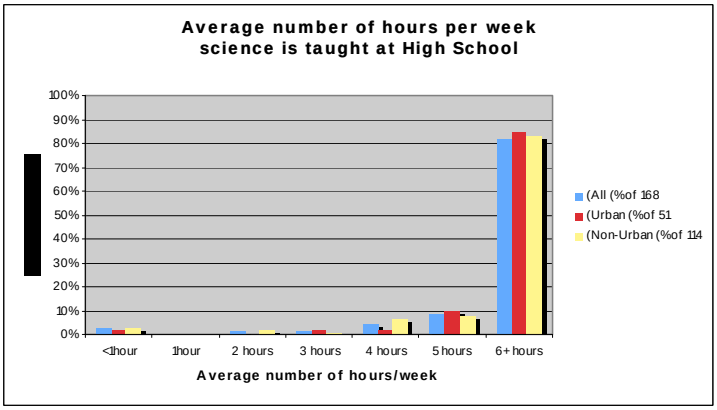
Grades 6-8 (Average = 4.91 hrs)

Avg # of Hours	All (% of 129)	Urban (% of 39)	Non-Urban (% of 90)
<1hour	6%	8%	6%
1hour	2%	3%	1%
2 hours	5%	0%	7%
3 hours	3%	5%	2%
4 hours	10%	13%	9%
5 hours	21%	23%	20%
6+ hours	53%	49%	56%



High School (Average = 5.61 hrs)

Avg # of Hours	All (% of 168)	Urban (% of 51)	Non-Urban (% of 114)
<1hour	2%	2%	3%
1hour	0%	0%	0%
2 hours	1%	0%	2%
3 hours	1%	2%	1%
4 hours	5%	2%	6%
5 hours	8%	10%	8%
6+ hours	82%	84%	83%



Keep as grade span or change to grade-by-grade?

Responses from:	All respondents (459)	Who teach K-8 (286)	Who teach K-5 (151)	Who teach 6-8 (176)
Keep as Grade Spans	157 (34%)	111 (39%)	46 (30%)	81 (46%)
Change to Grade-by-Grade	222 (48%)	164 (57%)	100 (66%)	87 (49%)
No Opinion	80 (18%)	11 (3%)	5 (3%)	8 (5%)

**Please note: bulleted quotes are directly from survey responses. Quotes are *representative* of themes, perspectives and suggestions, not fully inclusive of all individual comments.

THEMES FROM THOSE WHO RESPONDED "Keep as Grade Span"

Allows districts and schools the flexibility to choose what is taught when

- By keeping the standards arranged by grade span, schools have greater flexibility in determining what the scope and sequence will look like. Given that there is no plan to change the timing of the MCAS (end of grades 5 and 8), it makes sense for districts and schools to have some autonomy over which standards are taught in any given year.
- Districts should have some choice in teaching topics in specific grade levels.
- It allows flexibility district to district and 3 years seems appropriate and aligns with some national standards.
- Keeping the standards by grade span helps local communities to creative and cater to their population well.
- Grade spans are helpful. We have been able to arrange our science topics so that all that needs to be covered within a span is. Some grade levels within a span are teaching more topics than others as some of the topics are more extensive than others. Because there is a span, we can do this without worrying that a student will be short-changed on science.

There are immediate impacts that would be difficult to implement (staff shuffling, rewriting curriculum, costs)

- There's massive variation between school districts right now. Going grade-by-grade would require almost everyone to rewrite all of their curriculum and might force many to stop teaching things that work well for them because that particular strand moved to a different grade.
- Switching to a grade-by-grade system would also create a lot of staff shuffling.
- It is critical to KEEP the current grade spans, as long as some revisions are made so that standards are more age appropriate. Grade level standards would dictate which topics were covered at a grade level. This would involve massive PD for teachers and possibly the large scale purchase of new materials if a system's current scope and sequence in K-5 science did not correspond to the grade level state standards, both of which are cost prohibitive. There is VERY LITTLE TIME at the elementary level for ANY science PD (an hour or two a year in my system) I urge you to NOT go to a grade level statement of standards for K-5.
- As much as I would like to see more detailed standards per grade, there are not enough teachers to do such a thing, and should there be more demands, some schools would opt

to not even try according to some administrators ive talked to. Most blame the lack of funding for it, but there is also not enough Engineering teachers out there to fill such a task.

Grade span standards allows for spiraling curriculum design

- By grade span gives districts the flexibility to work with the curriclum, and to spiral the standards
- If something is not covered in one of the grades due to whatever reasons, it is nice to know they will cover it again. Repeated instruction is helpful to children.
- Students learn concepts best with a "spiral learning" technique that cirlces back and builds on past experiencs.

Multi-age classrooms, looping, and elementary curricula that are arranged to draw upon teacher strengths are better served with grade span standards

- In my district we teach by grade span and to teacher strength. Grade-by-Grade would be a change not necessarily for the better.
- I keep some of my students for 2 years and it gives me a way to do a 2 year cycle with them. At the K-1 grade level it gives flexibility to individual school systems to decide when they feel it is best to teach specific concepts.
- Maintains flexibility for schools and the variations in proficiency of the elementary school teacher in science, such that the administration can balance inequivalences of teachers talents better over a reasonable time span.
- Grade span works well because in any system there are teachers in a grade who have developed an expertise in teaching a unit or topic. Given that at the elementary level, teachers are not generally content specialists, it is key that we retain the content expertise we have worked hard to establish in the district.

The flexibility of grade span standards allows schools to respond to individual student learning needs

- Students are individuals that mature and learn at different rates.
- Our special needs students would benefit from a broader span of time.
- Reduce day-to-day focus on MCAS and allow students time for multiple exposure to content.

THEMES FROM THOSE WHO RESPONDED "Change to Grade-by-Grade"

Grade-by-grade standards provide specificity of what to teach and learn

- I think it is helpful for teachers who are organizing their activities to know what they can expect students to have learned in a previous grade level. This would help minimize unnecessary overlap of activities.
- This will help teachers coordinate which grade level is responsible for which material, to ensure it is all covered before high school.
- I think that if the standards are grouped grade-by-grade it will be much clearer to teachers what standards they need to target, and they will have a better understanding as to what has been taught before the students enter their grade and what will be taught after they leave.

- Grade to grade standards ensures that communities will be meeting the same benchmarks and allows the communities to create common assessment across grade levels

Provide consistency across schools and districts and reduce discrepancies that students experiences when they move

- They should be grade by grade given the mobility of students. Graded by grade ensures students will be exposed to the standard.
- Grade-by-Grade standards would allow students all over the state to receive a more uniform science education.
- Many times I have had students that transferred into my class and were studying standards that they had already studied the year before. In this case they miss standards that they need to learn.

Allows for district coordination and grade-level benchmarking

- Many districts utilize a 'science program' prk-8 and lean heavily on it to meet science standards in the span. With grade level organized standards, articulation between resources and district curriculum is enhanced and this also leads to better grade level benchmarking as well.
- Grade to grade will give us a clearer picture of what topics need to be presented at each grade level and for a district like Worcester, with 33 elementary schools, it would make curriculum alignment and selection of resources and Prof. Dev much more efficient.
- It is essential to assign grade by grade standards so that appropriate benchmark assessments may be developed and appropriate accountability be assigned.
- I'm thinking this would be best for consistency and for providing developmentally appropriate benchmarks within a standard.

Allow for continuity with other curriculum Frameworks

- Although I like grade spans, changing to grade by grade will allow for continuity with the other frameworks. Teachers do not always have time to connect with other teachers to ensure that the content is taught, reviewed and reinforced in their respective grade spans. This is especially true of the elementary level teachers as they are responsible for so many frameworks that it becomes unrealistic at times. Clarity of expectations by grade level would allow for better interdisciplinary and metacognitive connections.
- This provides ownership by students and teachers each year and is consistent with math and ELA

Curriculum can be developmentally sequenced

- If the curriculum is designed to build upon previous knowledge and not stand alone
- The k-3 grade levels are studying subject and vocabulary too difficult for them.
- If grouped grade-by-grade, developmentally appropriate standards could be developed.

Increased teacher accountability

- Teachers will be held accountable to complete the science standards. Teachers of subsequent years will know what was taught to students.
- Better able to measure yearly improvement and not penalized for material not taught in previous year.
- I think grade-to-grade holds teachers and students more accountable.

Reduce the gaps and redundancies in current teacher-driven curriculum

- Faculty do not have clear ownership of their curriculums allowing for favoritism and selective delivery of curriculum that creates gaps in the scope and sequence.
- This stops too much overlap. Subjects are being completely missed because some items are still being over taught while others are missed completely. Right now we are spiraling our curriculum.
- Some teachers teach what they are comfortable with, and because of that, some students get subjects taught twice and subjects not taught at all.

Would reduce the pressure that 5th grade teachers currently experience

- The grade levels are not sure what they are expected to cover with grade 5 trying to cover the entire span due to MCAS.
- I think they should be articulated grade by grade. Each district is responsible for dividing the standards into different grades. AS a teacher of 5th grade it is difficult to be held accountable for making sure the students know all the 3-5 standards.
- If given the standards for a year I can depend upon myself to be sure that the information has been taught. Ideally it would be nice to dovetail with years before but one is at the mercy of those that come before us and often the "catch up" is impossible at times.

Suggest annual testing aligned to grade-by-grade standards

- I think all the grades should be tested each year on specific topics
- MCAS should only test grade level content.
- If we could test according to grade as well. The problem is still you want grade 5 to assess on the MCAS content that is anywhere between grades 3-5, as well as two grades in which we personally have not taught.
- Change to grade by grade and test grade by grade. I feel it is unreasonable to expect a child to remember in 8th grade what was taught in 6th grade or earlier.

Middle school strands taught by grade

For those who teach or coordinate **Grades 6, 7, or 8**, the following **strand(s)** are taught.

Among the 148 respondents:

Those that Teach:	**Gr. 6**	**Gr. 7**	**Gr. 8**
ESS only (+/- T/E)	19	2	6
LS only (+/- T/E)	3	33	4
PS only (+/- T/E)	3	3	17
T/E only	14	18	20
All strands	17	19	15
All strands but T/E	15	8	11
2 or 3 strands (+/- T/E)	14	16	20

Defining Discipline-Specific and Spiraling Curriculum

A discipline-specific curriculum is identified as one where only one or two strands are taught at any one grade. Those identified as teaching a discipline-specific curriculum are in either of the following categories in the chart above: "ESS only (+/- T/E)", "LS only (+/-)", "PS only (+/- T/E), or "T/E only." A spiral curriculum is identified as one where three or more strands are taught at any grade and possibly repeated at another grade. Those identified as teaching a spiral curriculum are in either of the following categories in the chart above: "All strands", "All strands but T/E", or "2 or 3 strands (+/- T/E)."

Findings

Among the respondents that focus on one particular strand at a particular grade, the data shows that Earth and Space Science is primarily taught in Grade 6, Life Science is primarily taught in Grade 7, and Physical Science is primarily taught in Grade 8. The number of those that teach Technology/Engineering exclusively is fairly consistent from grade to grade. Among the respondents, 49% have a discipline-specific curriculum and 51% have a spiral curriculum.

Specificity of standards

Responses from:	All respondents (424)	Who teach K-5 (140)	Who teach 6-8 (170)	Who teach HS (183)
Keep as is	205 (48%)	65 (46%)	72 (42%)	97 (53%)
Make more specific	166 (39%)	59 (42%)	83 (49%)	56 (31%)
Make more general	53 (13%)	16 (11%)	15 (9%)	30 (16%)

**Please note: bulleted quotes are directly from survey responses. Quotes are *representative* of themes, perspectives and suggestions, not fully inclusive of all individual comments.

COMMON THEMES ACROSS ALL CATEGORIES

There needs to be consistency across the standards

- Some are very specific while others are very broad and comprehensive. Should try to get all to be the same
- Some standards are very specific while others are too general with respect to depth and range of content.
- I go back and forth between 2 and 3 for this question. In some cases they are way too specific: too many 'factoids' and not enough content or skills. In others, there doesn't seem to be a clear goal for understanding.

Sometimes a mismatch between standards and MCAS items

- The standards are specific enough, but sometimes there are MCAS questions that don't seem be based on anything described in the standards, or require a student to go beyond the standards and synthesize an answer from several standards.
- The open response questions on MCAS seem to be asking for very specific examples.
- Depends-Is the MCAS test going to start asking less specific questions? When they stop asking microscale information questions, the standards could/should be more general.

THEMES FROM THOSE RESPONDING "Keep as is"

Good as is

- Standards are specific and written well.
- The science standards are written well and are easy to adapt into essential questions or areas of learning for students.

Good specificity, just too much (particularly in HS Biology and Chemistry)

- Standards are very clear in biology - and they are good; there is just too much for many students
- They are specific which is good, I believe there is too much material to cover and also deliver depth of understanding
- Current standards have an adequate amount of information needed for an educator and for a student to evaluate understanding but there are too many to get through in a single [high school] course.

THEMES FROM THOSE RESPONDING "Make more specific"

More specificity is needed

- The current standards need to be made a little more specific for the students to grasp the concepts better
- Middle school standards are extremely vague.
- A lot of interpretation. Adding more specific benchmarks would help to make things more consistent.

Make more specific and reduce the amount or change the focus

- Standards should be more specific and have fewer of them. The standards should be key concepts/big ideas, not factoids.
- I would enjoy seeing more specificity, but with more of a focus on the skills and less of a focus on specific content pieces.
- Fewer more specific standards that can be taught in depth would be appropriate in my opinion for the high school student.

Fill in the gaps

- There are too many holes to allow for the diverse things our students want to learn, and for the diverse careers for which they want to prepare.
- I would take a look at the current standards and fill in the "blanks" such as teaching Sun-Earth in middle school

THEMES FROM THOSE RESPONDING "Make more general"

Focus more on skills and problem solving

- Specifying specific content that all teachers teach is less useful then specifying skills that students should have, such as problem solving skills.
- Making standards more general would allow time for inquiry which develops critical thinking skills. To many specifics will lead to a shallow depth of concepts. Learning to think is what has been lacking due to the large amount of specific concepts that need to be taught.
- It would be great to see the standards less specific in order to focus more on skill-sets _really_ necessary in college.

Focus on the broad topics, not the specific concepts, to promote depth of learning

- I would like to see "big ideas" represented so that the opportunity for some in-depth study becomes more available.
- I agree here should be guidelines so every student gets a fair education, but the high school frameworks do not leave time to get in depth. Just today NSTA agrees that students who get more in depth in their sciences do better in college. Our students need to cover too much in one year.
- By covering such a broad range of topics in a limited time frame it is necessary to give a more general view, breadth not depth of each topic.

Need more flexibility for instruction

- I think it doesn't give teachers much flexibility to reach the over arching concepts because of the specificity. Give us "Energy" at grade 4 for example, with suggestions by grade level on how to teach it.
- In grade four the standards are very specific and simple. It limits the activities that reach each standard. For instance, our magnet unit in grade four only requires that the students understand what each pole does and what materials are attactors. This is a very simple concept that can be taught within the context of just one or two lessons. I feel that the depth of this concept should be extended. If the standards were not as specific it would leave room for more activities within the unit.

Scope of grades PreK-2 standards

Gr. PreK-2	Responses	Too Much	Reasonable	Incomplete
Grade Span	**236**	**40 (17%)**	**175 (74%)**	**21 (9%)**
ESS	228	38 (17%)	174 (76%)	16 (7%)
LS	202	29 (14%)	163 (81%)	10 (5%)
PS	190	31 (16%)	144 (76%)	15 (8%)
TE	197	39 (20%)	134 (68%)	24 (12%)
Skills	211	20 (9%)	168 (80%)	23 (11%)

**Please note: bulleted quotes are directly from survey responses. Quotes are *representative* of themes, perspectives and suggestions, not fully inclusive of all individual comments.

Grades PreK-2 TOO MUCH

Lack of time to teach science due to focus on reading, writing, and math

- Time needs to be allocated to reading, writing, and math. Not enough time for in-depth science.
- With the emphasis on literacy and math in the early grades, it is unreasonable to expect students and teachers to focus on the specific learning standards in this grade span. In this grade span students should be learning the skills of observation and description. Activities should be focused on the development of those skills without regard for specific content.
- Teachers are so focused on teaching children to read in this grade span that they feel overwhelmed by the idea of teaching science and Tech/Engineering.

Some standards are not developmentally appropriate

- Some of the learning in this strand is too advanced for kindergarten and is more appropriate for older learners. In other words, they aren't ready for it - it's over their heads.
- Content is too difficult for their developmental age
- Standards should be more broad to allow for the realistic differences in ability, curiosity, talent, and interests students present. It is unrealistic to expect every human being to walk away with the same understanding of an experience. The human brain does not work in this way. Exposure to concepts and ideas makes more sense than mandatory information expected to be regurgitated and then ultimately forgotten.
- Too many and pacing is too fast. Children need time to internalize and master the concepts. We need to take into account the diverse student population, learning styles, as well as testing tools that favor one kind of learner.

Science at these grades should focus on skills and inquiry rather than content

- Having so much in terms of material to cover takes away from the essence of teaching science - to question and wonder about the world. We, as teachers are forced to get through content over a true understanding or appreciation of science.
- The focus is on content and it should be on skills. Teachers are too focused on the content and not the skills because the skills are essentially an appendix and not within the actual learning standards.

- I think students should be exposed to general science applications i.e. exploring and discovering their surroundings. Then ask questions to advance their learning.

PreK-2 ESS
- developmentally too young for much of the content

PreK-2 LS
- Need more simple expectations at our level
- Maybe focus on less material, and more material familiar to students.

PreK-2 PS
- Students are asked to understand things that are beyond their cognitive ability for their age group.
- This needs to be broken down more for grade levels instead of for the grade span. In order to teach effectively, teachers need to know the most important aspect of Physical Science the students in their grade levels really need to know!
- Some of these concepts are very abstract & teachers do not have appropriate materials to teach them. Young children need things presented in a concrete manner.

PreK-2 TE
- Some of these concepts are above this age group. Technologies are better left for older children who can systematically eliminate possibilities.
- The fact that many schools do not have technology specialists needs to be considered.
- The Tech/Engineering standards, while relevant, are too much in additional to all the other strands. Their concepts are broad and would require more time than an elementary school can dedicate to science in a given day/week/month/year.
- Lower elementary teachers are not taught engineering content or shown how to teach it.

PreK-2 SKILLS
- I do not believe that students at this age have the level of cognitive development needed for students to make predictions or understand results under altered conditions.
- Just need to be tweaked a little to be reasonable to fit in with the issues of time.
- Needs to be aligned with more reasonable developmental expectations.

Grades PreK-2 REASONABLE

The standards at this level are reasonable
- The number and scope of the standards works at this grade span. Our K-2 teachers use the same curriculum map, teach all of the standards each year, but at different depths.
- Actually, I think children could handle more hands on deeper learning.
- Never too early to learn the basic concepts. From there we have a scaffold on which to build in later grades.

Can be done if integrated into literacy and math lessons
- It can be done as long as teachers can incorporate part of the science into the alloted literacy and math time.

- Teachers need to be creative and incorporate Science during the literacy and math part of the day. Otherwise there is not enough time. This is true for all the standards.
- We need to provide a larger array of ideas for developing investigations and learning experiences.

PK2 ESS

- No pun intended, but most of this material is concrete. A closer alignment with Benchmarks for Scientific Literacy / Atlas would be an improvement, but it is fairly sound overall.

PK2 LS

- The current life science Foss kits we have seem to allow for a reasonable curriculum and time enough to cover that.

PK2 PS

- Again, well thought out for this age group. Greater clarity than is given to regular classroom teachers grades 3-5.

PK2 TE

- In fact, you could ask for more.

PK2 SKILLS

- In fact, the "inquiry skills" are well-described, but are not taught because they can't be tested.

Grades PreK-2 INCOMPLETE

Suggestions for additions to the PreK-2 standards (this section includes all suggestions; also see specific suggestions for revising the PreK-2 standards)

PreK-2 ESS

- Needs an emphasis on Global Climate change as it pertains to Massachusetts
- In our school, it seems the children have very little background knowledge in this discipline. They are not prepared for the complexities of the 3-5 standards.
- Please add more about oceans. Examples may be found here: http://www.coexploration.org/oceanliteracy/documents/OceanLitChart.pdf

PreK-2 LS

- I believe we could add some depth/breadth at this level. Perhaps add more of human physiology and issue of nutrition and health.

PreK-2 PS

- More phenomena, please. Teachers should get the idea that they can spend more time with physical phenomena, but not be so concerned about "covering" everything. Don't leave physics for later, or it'll be too late, as it always has been.

PreK-2 TE

- I believe it is reasonable to have the range you cite, but you are missing two key elements; Definitions of what Scientists and Engineers do and you need to have a section on thinking skills, (creativity thinking, critical thinking, questions and meta-cognitive reflection) that model for teachers the foundation of tools needed to do science and engineering.
- Your chart that shows the design process needs to be changed to show the iterate nature of the process. Although the design process has defined sections, the process itself needs to show that thinking skills are being used, mistakes are occurring, learning is happening and sometimes you need to go back and start again.
- There is not enough on current technology topics

PK2 SKILLS

- More design skills are needed at this level.
- K-8 should focus on Scientific Inquiry and Literacy.
- Need to add inquiry standards
- Need more specifics at each grade level and build on it from year to year
- Please add Inquiry into the frameworks!
- I teach 1/2 multi age class. I have felt somewhat held back by the standards. Kids at this age should be engaging in hands on experimentation, making predictions, and learning scientific process.
- Inquiry skills is just good scientific teaching, and for kindergartners, they are the most inquisitive of them all! I think that all of these skills are valuable and are more important even than content for our youngest learners! Let them ask and then let them find out!
- I would like to see the Inquiry Skills in the Front Matter integrated into the standards
- more science skills measurement life and earth sciences in earlier grades
- Yes, I feel that there is no emphasis given to "writing in science" which is different than writing for ELA. There needs to be more emphasis on writing using notes and research information (from books and editorials and not only the internet).
- We should include inquiry skills in the science discipline standards.
- I would like to see the Skills Of Inquiry incorporated into the content standards and not placed several pages away. They should be included in the strands like they are in the high school standards

Scope of grades 3-5 standards

Gr. 3-5	Responses	Too Much	Reasonable	Incomplete
Grade Span	**237**	**62 (26%)**	**153 (65%)**	**22 (9%)**
ESS	215	49 (23%)	146 (68%)	20 (9%)
LS	213	38 (18%)	161 (76%)	14 (6%)
PS	200	40 (20%)	145 (73%)	15 (6%)
TE	210	49 (23%)	136 (65%)	25 (12%)
Skills	209	18 (9%)	165 (79%)	26 (12%)

**Please note: bulleted quotes are directly from survey responses. Quotes are *representative* of themes, perspectives and suggestions, not fully inclusive of all individual comments.

Grades 3-5 TOO MUCH

Lack of time to teach science due to focus on reading, writing, and math

- It seems we need more time in the school day to do science justice. ELA and mathematics consume large blocks of instructional time. Middle and high schools have the luxury of content specialists, the classroom teacher often does not have the level of expertise to teach science as well.
- Time needs to be allocated to reading, writing, and math. Not enough time for in-depth science.
- Not enough time devoted to science work in classrooms to accomplish this

Some standards are not developmentally appropriate

- We are trying to teach students material that is above their developmental level as well as too much material.
- Some of the standards expect understandings beyond the developmental level. Can a 3-5 student really understand evolution in a way that does not lead to misconceptions.
- The range and depth for the fifth grade is much too much. Much of the information and vocabulary are way above grade level and interest for this age.

Too much to address results in focus on breadth of coverage rather than depth of understanding

- Due to additional science units added to each grade level to better align our district with state standards, we are unable to reach the depth of material that we used to be able to accomplish.
- It is not possible to cover all of the topics, especially while trying to use the Inquiry Approach
- Students should focus on less material and apply a more in depth look at specific subjects. Master a concept over being generally exposed.
- For ELL students who come at different grade levels, expect them to master the content from three grade levels seems a bit too much, especially when language also plays a major factor in learning the concent.

5th grade teachers need to both teach and review standards from the full grade span.

- As a fifth grade teacher, we need to cover what is expected that year, plus review everything that was covered previous years for MCAS. A guideline should be given on what is expected on the test. There is simply not enough time to do this.
- Due to the MCAS testing in grade 5, it is VERY difficult to cover all our standards and review or teach (reteach) past standards
- It is the combination of all the disciplines/content areas of which science is one piece when range becomes a problem. Greater communication between content areas is needed. Fifth grade often is so content heavy in relation to 3 and 4.
- Grade 5 must not only cover their own science topics about also review all of the topics from grades 1-4 in order to help prepare the students for the 5th grade science MCAS.

3-5 ESS

- Moon seems to overwhelm teachers and students in this grade range
- There are a lot of standards and they address a number of topics. Considering that Earth and Space Science is only one of four strands, it seems excessive.
- I feel that children are not conceptually ready for these standards at gr. 3 yet.
- Global patterns such as the jet stream and ocean currents as influences on weather are more appropriate for the ""big picture"" of middle school. Statement of standards related to the water cycle is awkward.
- Teaching some aspects of the solar system in elementary school is not developmentally appropriate. I agree that there should be knowledge and content taught in this area, but think it needs a major overhaul.
- We have found some of the weather standards (global patterns, ocean currents) difficult to present to elementary students.

3-5 LS

- evolution beyond the students at grade 3.
- Life Science includes an incredible range of very important topics. It's impossible to do them all justice
- As mentioned earlier, some of the content here is best presented in late 4th or 5th grade based on developmental analytical and reasoning skills. Too much really ends up falling on 4th and 5th grades.

3-5 PS

- Again, some may master these standards, but many are developmentally sophisticated for students at the grade level I teach (fourth grade).
- Physical science is the most difficult for elementary students to grasp. Since 5th graders have to take a science MCAS, there is a lot of pressure on fourth and fifth grade students to master a lot of difficult content.
- The electricity component makes it seem like too much.

3-5 TE

- Too much along with other sciences
- Specifying "workbench" tools is a problem. Schools don't have them and can't afford them to address one standard. Three standards relate to the engineering design process--should be combined??
- grade 5 standards need revision to address technology weaknesses

- The tools requirements do not seem appropriate.

3-5 Skills

- Difficult to test predicitions. Time, space, and resources, does not allow for multiple trials to test a predicition. Children have difficulty in interpreting data. Many are not developmentally ready for this. This is really something which requires more advanced math and reasoning skills.
- Prediction requires a higher level of abstraction than children in Pre-K through grade 5 possess.

Grades 3-5 REASONABLE

The standards at this level are reasonable

- It is reasonable, but it is a stretch.
- Reasonable, but experience helps! You do need to keep moving on you standards, and it can be difficult for some learners.
- Though the expectations are reasonable I often find myself giving the students more information to give them a better understanding of concepts. The range is fine as long as the students arrive with a base knowledge from previous years.
- Could use more focus on big ideas. Not that it is too much material, but it appears fragmented to anyone who doesn't have a science background.
- This might work although incorporating Science and Tech with literature may be the best option.

3-5 LS

- Our particular school does not teach a life science in grade 4, but I believe grade 3 has a reasonable life science curriculum/kit.
- I teach animal adaptations. It is well suited for third grade students
- Yes, you can "touch" these standards when you teach them.

3-5 PS

- The numer of standards is good the focus of the standards could be changed to reflect the wider scope of physics.
- Electricity and magnetism are very manageable for third graders
- This is fine for gr. 3.

3-5 TE

- Reasonable, however, many teachers report not knowing how to teach tech/engineering. Never heard of universal design, for example, so they can't teacher it.
- Simple machines and tools are age appropprate
- I think the technology and engineering framework is decently managable in grade 3-5.

3-5 Skills

- It is reasonable for students to learn the range of Inquiry Skills, but with adult assistance. For example, students at my grade level need support still with conducting experiments, asking questions, developing hypotheses, recording and analyzing data, etc. Often times

I have to guide students after they create a question to evaluate whether or not it is a "testable" question or not.

- These are mostly reasonable, though the skills should be at the lower end of the continuum.
- Reasonable, however, having the inquiry skills set apart of the standards results in teachers ignoring them. Teachers in my district don't understand that they need to weave inquiry throughout the way they address the content standards.

Grades 3-5 INCOMPLETE

Suggestions for additions to the 3-5 standards (this section includes all suggestions; also see specific suggestions for revising the 3-5 standards)

3-5 ESS

- there are areas covered but that do not get followed through in grades 6-8.
- Please add more regarding oceans and climate.
- Too much emphasis on rocks and minerals rather than the big picture of the changing landscape of earth.
- Dinosaurs has been eliminated and was a wonderful entry point for young students into basic scientific skills such as classification, inquiry, and experimentation.
- Needs an emphasis on Global Climate change as it pertains to Massachusetts

3-5 LS

- an introduction to inheritance of traits and genes/DNA
- Why are butterfly and frog the only choices? This is an example of taking something scientific (study metamorphosis) and dumb it down to knowledge (learn to parrot the stages of a frog or a butterfly's life, because one of those will be on the test). And where are the cells? How do veteran teachers who write these standards come to think that students grades 3-5 are too stupid to start learning about cells? Don't make the sequence follow history; it's assuming that mankind gets smarter as it gets older, and that so do children. Nothing could be further from the truth.
- Entire blocks of life science are ignored. Specifically Microbiology, botany and zoology
- There should be a standard related to All grades should incorporate appropriate content on human interconnections with natural world planetary and life suppport systems are changing as a result of human impacts (climate change, biological diversity, ocean changes (acidification)

3-5 PS

- Needs some explicit links to Earth and Space Science, such as gravity. More explicit concepts about measuring, like precision. Introduce the elements--Why can't a student start to investigate how aluminum is different from gold, from graphite? Are there some standard-writers who think that kids grades 3-5 are too stupid to study the elements? It seems that way to me.
- Please add standards about albedo - dark surfaces absorbing, and light surfaces reflecting. Add standards specifically about salinity and water density. Add a standard about thermal expansion.

3-5 TE

- More Tech/engineering should be brought into the class room at this grade level.
- Some introduction to the engineering design process, and how to systematically approach a problem seems missing here.
- There is not enough on current technology topics

3-5 Skills

- More design skills are needed at this level.
- K-8 should focus on Scientific Inquiry and Literacy.
- Something about society, ethics? Kids don't know enough about scientists; we need to counter stereotypes from media tothese kids are exposed, especially on Saturday morning.
- Should be more connected to content standards.
- Need to add inquiry standards
- certainly basic math operations and also measurement is critical
- I would like to see the Inquiry Skills in the Front Matter integrated into the standards
- The language of science is the metric system, yet mcas deals mainly in the english system.
- more science skills measurement life and earth sciences in earlier grades
- Yes, I feel that there is no emphasis given to "writing in science" which is different than writing for ELA. There needs to be more emphasis on writing using notes and research information (from books and editorials and not only the internet).
- We should include inquiry skills in the science discipline standards.
- I believe it is reasonable to have the range you cite, but you are missing two key elements; Definitions of what Scientists and Engineers do and you need to have a section on thinking skills, (creativity thinking, critical thinking, questions and meta-cognitive reflection) that model for teachers the foundation of tools needed to do science and engineering. In addition, your chart that shows the design process needs to be changed to show the iterate nature of the process. Although the design process has defined sections, the process itself needs to show that thinking skills are being used, mistakes are occurring, learning is happening and sometimes you need to go back and start again.

Scope of Grades 6-8 standards

Gr. 6-8	Responses	Too Much	Reasonable	Incomplete
Grade Span	**249**	**73 (29%)**	**156 (63%)**	**20 (8%)**
ESS	221	45 (20%)	158 (72%)	18 (8%)
LS	212	47 (22%)	148 (70%)	17 (8%)
PS	208	44 (21%)	146 (70%)	18 (9%)
TE	213	87 (41%)	103 (48%)	23 (11%)
Skills	221	23 (10%)	167 (76%)	31 (14%)

**Please note: bulleted quotes are directly from survey responses. Quotes are *representative* of themes, perspectives and suggestions, not fully inclusive of all individual comments.

Grades 6-8 TOO MUCH

Too much to address results in focus on breadth of coverage rather than depth of understanding

- Standards are mile wide/inch deep. Prevent inquiry and exploration and lasting and meaningful understanding of key concepts in the discipline.
- It is impossible to teach any of the topics in depth and still teach all of the standards.
- The breadth of content is impossible to "teach" within the context of a school year. We are simply covering the mateial instead of allowing students to "uncover" and discover. We currently should but do not teach technology in addition.
- The breadth of topics over the three years takes 3 years to cover. Consequently, students in grade 8 may not see have seen some standards since grade 6 at the time of MCAS, and may not have had a full understanding during grade 6.
- While we manage to cover the frameworks, we don't have the time to uncover the conceptual deep understandings and appropriately develop and reinforce true learning, with hands on learning experiences. The frameworks don't match 21st century learning and teaching expectations.

Lack of time to teach the range of subjects due to the large number of standards

- Without an additional course past a basic science one, it is impossible to cover both the Science AND technology frameworks.
- Time must be REQUIRED to cover the standards. Because it is "recommended" many systems shortchange their students with limited T/E time or by not having a licenced T/E teacher teaching the material
- I think that we cannot do a good job at presenting so much material in such a short time period. We only see students 90 minutes every other day. Therefore in the 90 times that students they get less content than if they were seen every day. Also, they are being tested too much between the MCAS, Stanfords, District Mid-terms and Finals - One only need do the math to see taht there are NOT 90 teaching days.

Students often do not have the mathematics, reading and writing, language, or lab skills needed to succeed

- In my district, many students can't even read at a 7th/8th grade level, and they don't have basic math skills. Much of the content is over their heads and Science does not receive SPED support.

- More math less trivia
- Again, many students in my district need help with basic skills; reading, writing, math.
- Students are unable to complete labs that allow them to master the concepts.
- For ELL students who come at different grade levels, expect them to master the content from three grade levels seems a bit too much, especially when language also plays a major factor in learning the concent.

6-8 ESS

- I believe that some of the earth science standards are too advanced and too specific for the development level of middle school students.
- The earth/moon/sun relationship is very difficult for kids to grasp quickly as they are still very concrete learners. More time is needed, but pile on top of that the HUGE section of heat movement within earth and earth's atmosphere, and there simply isn't enough time.

6-8 LS

- The actual content standards are not so broad, but to teach this is a project based / inquiry way makes for a tight fit. If one were to teach straight from a text book with limited labs, it could be covered. I work on large projects such as a Biodiversity study and tend to run short of time and not make it to part of the frameworks each year.
- Middle school students in my experience are enthusiastic about Life Science and the speed of presentation is not allowing us to feed their great interest and curiosity!
- These standards are incredibly long. Several aspects of Genetics could be moved to high school biology, even though I love the subject, as can systems of the human body. Students should be focused on ecosystems and our interactions within them as they are becoming aware of their places in society and their affects on the world.
- Some standards are too advanced in my opinion, especially the connection studnets are expected to make between sexual reproduciton and evolution.
- I believe the 6-8 standards should be more focused on the physical and earth science and then go study biology topic at a greater depth in 9th and 10th grade.

6-8 PS

- the science content should focus on life and earth in middle school with focus on matter more intro type and 'not' too much chemistry, ...as this is higher level thinking and fewer students really comprehend this study which is age appropriate in high school/college.
- Kids at this age are very concrete learners. Most of the physical science strands are very abstract (ie. Density or Atoms). They require an inordinate amount of time to try to teach kids to understand these concepts when their brains aren't even ready to process that level of information.
- Physical Science is so abstract for middle school students, the amount of information to be covered is intense concurrent to teaching them to think abstractly to understand concepts.
- The depth of the physical science (including motion graphs) assumes a level of math that many students don't have. The chemistry standards dealing with atoms are very abstract and difficult to master.

6-8 TE

- I would focus on engineering design and materials/tools and leave communication, manufacturing, construction, transportation, bioengineering for HS or for a different

MCAS test such as "Technology/Engineering." I would prefer more focus and time for Life, Earth, Physical Sciences as preparation for HS courses.

- Adding technology to Science makes the expectations for each year too great...you need a separate course for the tech material
- Students should not be required to learn about the business aspects of technology in a STE curriculum.
- These standards are the worst, by far. There is simply too much irrelevant information for adolescents to grasp. Construction of a house? Communication technology?? While students understand they live in the "Information Age", learning what an "encoder and a decoder" are are absolutely ridiculous. Also, transportation technology should be adjusted to fit with manufacturing, or the best way to get from point A to point B. Take the forces of flying out. What should stay? The GENERAL workings of manufacturing (which can align with social studies and the industrial revolution, and child labor), the engineeering design and universal systems model (although students fail to see the relevance, as do I; they are not engineers, they are 13 year old students), BASIC tools and approaches to solving everyday problems (not heavy duty machinery or power tools most of these kids have never seen or used). Bioengineerred devices are relevant, although some of the issues, like crop rotation, could be moved to the life science standards in the ecosystems section.
- There are too many standards. The students are expected to master only two areas in k-5, then there is a big jump to 8 areas in the 8-6 level. The standards are fragmented.
- Power tools in a science classroom? Many of the standards appear as though they were designed for a shop teacher. Some systems have done away with that position and the tech/engineering standards are taught by the science teacher. Many strands are not met in that case. Strands need to be more general in order for all to be met. Need to alter these by deciding what is most important information for students to know in middle school. The design process/testing and re testing through problem solving should be more of a focus
- The technology questions on building materials and tools such as skill saws etc. seem only fair for a tech school that offers courses in building and tool use not a middle school.
- What silly material you have here! Assistive technologies - under the umbrella of bio engineering? Construction? We can do far better than this in Massachusetts. Let's dig in to how "stuff" works - the stuff that we use everyday.
- 6-8 Manufacturing technology standard 4 strands 1-4 are ludicrous! Let me repeat, they are ludicrous as a component of a basic science course!
- Construction and communication technologies in 6-8 seem inappropriate at this age level. Additionally, I think it is important to choose the Engineering Design Process for each grade over the Universal Systems Model. Together many students find difficulty differentiating between the two and also with using them together.

<u>6-8 Skills</u>

- Students are just beginning to understand the scientific method.
- Inquiry takes time. Students need time to explore. True science is fostered through inquiry. Perhaps the frameworks could be written so that inquiry drives the student learning and perhaps the amount of state standards could be reduced so students could gain confidence in their science learning with the use of highly developed inquiry skills.

- Most students at these grade levels are not cognitively ready to understand the full skills needed to design their own experiment in physical science.
- These are a bit ambitious for the grade level. I am especially concerned about the last four skills. These are truly at an introductory level.
- too much emphasis on lab based inquiry- variables not enough on design/prototype inquiry- trial,error, and learn

Grades 6-8 REASONABLE

The standards at this level are reasonable however articulation between grade levels is needed

- With a full share of teaching time devoted to science, it is possible to cover this material with reasonable understanding and retention by students.
- However, specific grade articulation may be a clearer means to identify standards and objectives as well as simlpy assessment practices in all districts.
- There is a greater need for articulation between grade levels.
- Reasonable if assessed yearly.

<u>6-8 ESS</u>

- Kids at this age are very concrete learners. Earth science and life science can be learned relatively easily so you can teach more standards in these 2 strands.
- Earth science standards are a little more concrete (no pun intended) and seems to be mastered more readily than some of the other strands.

<u>6-8 LS</u>

- Kids at this age are very concrete learners. Earth science and life science can be learned relatively easily so you can teach more standards in these 2 strands.
- The life science standards are reasonable and appropriate for the age group.

<u>6-8 PS</u>

- These topics are within reach, if teachers do not take too much time out to do inquiry or a science fair with their classes.
- These are the most reasonable compared with the other three science standards.

<u>6-8 TE</u>

- But only if you have a technology/engineering course for your students.
- The scope of the technology is fine; integrating it more with science is a local issue.

<u>6-8 Skills</u>

- These are fairly good. I would really like ways to "overlay" inquiry, the way the frameworks do with technology.
- The inquiry standards work well when integrated into the other standards.

Grades 6-8 INCOMPLETE

There needs to be greater alignment between 6-8 standards and other grade span standards

- While the integrated approach to science education is appropriate to k-8, the requirement for a competency determination in discipline specific course is putting an increased pressure to have a more in-depth study of science at least for grade 8.
- needs to be aligned with more specifics, age appropriate topics that review what was taught in grades 3-5.
- I like freedom in teaching, but there should be more unity between middle school and high school frameworks. The middle school are very basic and the high school are very in depth.

Suggestions for additions to the 6-8 standards (this section includes all suggestions; also see specific suggestions for revising the 6-8 standards)

<u>6-8 ESS</u>

- I'd like to see "climate change" introduced as a key concept.
- Would like to see more focus on earth science subtopics, such as oceanography, weather, and local geology incorporated.
- Needs an emphasis on Global Climate change as it pertains to world conditions
- Could use more depth.
- I think that Geology should be added. We normally teach it, even though its not a framework because it is important for students to get before they reach high school.
- This span really loses out on weather, oceanography, and rock/mineral sciences. Standards should also include detailed info. re: volcanoes, earthquakes, glaciers, tsunamis
- Not enough modern earth science. The "Ideas for developing investigations and learning experiences" show how old-fashioned this section is. They sound like those hokey kits you can buy at the toy store instead of real science. Grades 6-8 kids are not dumb, they're just weird.
- Add climate change concepts. Add a thread of historical/social/personal context.
- Please add more about Ocean Literacy. The current learning standards could be improved by including more about weather and climate. Some Suggestions from: The Essential Principles and Fundamental Concepts of Ocean Sciences
  3. The ocean is a major influence on weather and climate.
  a. The ocean controls weather and climate by dominating the Earth's energy, water and carbon systems.
  b. The ocean absorbs much of the solar radiation reaching Earth. The ocean loses heat by evaporation. This heat loss drives atmospheric circulation when, after it is released into the atmosphere as water vapor, it condenses and forms rain. Condensation of water evaporated from warm seas provides the energy for hurricanes and cyclones.
  c. The El Niño Southern Oscillation causes important changes in global weather patterns because it changes the way heat is released to the atmosphere in the Pacific.
  d. Most rain that falls on land originally evaporated from the tropical ocean.
  e. The ocean dominates the Earth's carbon cycle. Half the primary productivity on Earth takes place in the sunlit layers of the ocean and the ocean absorbs roughly half of all carbon dioxide added to the atmosphere.
  f. The ocean has had, and will continue to have, a significant influence on climate change by absorbing, storing, and moving heat, carbon and water.
  g. Changes in the ocean's circulation have produced large, abrupt changes in climate during the last 50,000 years.

6. The ocean and humans are inextricably interconnected.
a. The ocean affects every human life. It supplies freshwater (most rain comes from the ocean) and nearly all Earth's oxygen. It moderates the Earth's climate, influences our weather, and affects human health.
b. From the ocean we get foods, medicines, and mineral and energy resources. In addition, it provides jobs, supports our nation's economy, serves as a highway for transportation of goods and people, and plays a role in national security.
c. The ocean is a source of inspiration, recreation, rejuvenation and discovery. It is also an important element in the heritage of many cultures.
d. Much of the world's population lives in coastal areas.
e. Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (such as point source, non-point source, and noise pollution) and physical modifications (such as changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.
f. Coastal regions are susceptible to natural hazards (such as tsunamis, hurricanes, cyclones, sea level change, and storm surges).
g. Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all."

- There is very little in the 6-8 standards dealing with climate change and other environmental issues. In this time of increased environment crisis, there needs to be more focus on it.
- I would like to see oceanography and weather included in the middle school strands. We live right on the ocean and yet do not study living and non living things in the ocean at this middle level where students could begin to understand the impact on their lives. The same goes for weather. It is a part of our every day lives and yet students do not develop an understanding of how and why weather changes and the impact on their lives.
- I have a strong belief that Global Warming should/could be integrated into the cirriculum. The students have a innate interest in this topic as well as their role in the movement towards change.

<u>6-8 LS</u>

- Though would like to see a greater requirement for most human body systems to be covered.
- It is necessary to introduce students of grade 8 to some of the strands in high school biology eg. Chemistry of life so that 1.They have some background for high-school biology and are exposed to a new field of life science.
- no anatomy, or body systems taught here...they should be.
- Start more chemistry of life in these grades, or it'll hit them in HS like a ton of bricks. More genetics. More modern.
- Add projected impacts of climate change on living systems. Add a thread of historical/social/personal context.
- For grade 8, an environmental or biotechnology strand would help prepare students for a discipline specific course in grade 9.
- Add standards about invasive species. We need to look at population studies.

- I think it would be helpful for students to spend more time on the life sciences in the latter part of middle school rather than the beginning.
- In living things and their environment, can't the connection be made to global climate change?
- Life Gr 6-8 - should revisit topics in "classification" such as subgroups of plants, subgroups of animals, etc.
- Biotechnology is part of modern biology and I would like to see it threaded into the life science(6-8) and biology standards.
- Entire blocks of life science are ignored. Specifically Microbiology, botany and zoology
- There should be a standard related to All grades should incorporate appropriate content on human interconnections with natural world planetary and life suppport systems are changing as a result of human impacts (climate change, biological diversity, ocean changes (acidification)

6-8 PS

- introduce valence electrons with periodicity ; bonding - ionic and covalent
- I would like to see students revist all forms of energy, not just heat and potential/kinetic.
- I feel that students need to get into the content in greater depth...ie. calculating speed, distance, velocity rather than just learning about potential and kinetic energy. Take it to the next level.
- A review of electricity should be included. It is only present in the Standards once. It should include both static and current electricity at this level, and develop a greater understanding of electromagnets.
- Connect albedo to positive and negative feedback loops relating to ice melt. Connect thermal expansion to sea level rise.
- This is a age of action of building of designing. I think that more emphasis could be put on the physical sciences at this level.
- Forces?
- There are gaps in the frameworks. For instance, electricity is not taught, the electromagnetic spectrum in missing. Tyere are other missing pieces that are on the MCAS but not in the frameworks.
- The range is fine however where is the climate change as it relates to heat? density? ocean chemistry?
- More emphasis on the physics aspect and a little less on the chemistry aspect would be nice.

6-8 TE

- Integration of the technology and engineering strand with discipline specific focus would support science learning and understanding of science in society.
- Add CAD and more interesting fun experiments like construct a contraption that holds a raw egg such that the egg dose not break if the contraption is thrown off the highest point of the school building.
- Simple machines and tools expanded curriculum mechanical advantage, power are age appropriate What about SYSTEM DESIGN? Individual parts make up a whole. the system cannot function without each part. 1e: water systems resevior to the faucet, road systems into and out of a hub, transportation systems, create the idea that a car is

composed of many systems. An engineer may design a small part, of one piece, of one system.

- Technology Education or Technology/Engineering is the application of ingenuity and invention/innovation of transportation and material science, of energy & flight, and of agriculture. It is not Physics, Chemistry, earth & Space Science, or Life Science. A Science teacher is not qualified to teach Technology Education or Technology/Engineering. Students at this age level need to work on machines and do a totally diffeent style of learning. It is the best age to teach tool safety and how to use power tools. Making stuff with cardboard, gum-drops, toothpicks is not the same as using and learning about machinery. Acturally growing plants hydroponically and setting up a hydroponic green-house or forensics is not the same as being a life science teacher. One is doing, making with you hands, and the other is conceptual learning.
- Everyone thinks that bridges are fun, but having a learning topic specifically for them seems unnecessary. Please add an electrical piece for this level. Middle school students "LOVE IT."
- There is not enough on current technology
- I believe the Engineering standards should start focusing more on today's technology demands and less on manufacturing.
- The Bio-Engineering strand is very general and barely explained well. With MA. having an excellent level or biotech in the private sector, more should be done to educate the kids as to what is going on.
- There should be standards developed to address the biotechnology/bioengineering areas in the technology/engineering strand.
- Need to include energy issues as part of the Technology/Engineering standards.
- I think an added technology/engineering standard should incorporate alternative energy sources; i.e. solar power, wind power, hydrogen fuel cells
- Systems design. it can be a good unit for the teacher as well as the student.
- I wish they were called Engineering standards. The pervasive interpretation of Technology as computers adds to the difficulty of getting teachers to be willing to address these standards.

<u>6-8 Skills</u>

- Repeat from 3-5: record data...Add: Make a plan for solving a problem.
- Dump the trivia and have them learn to do science!
- This is the way students learn and make meaning out of new ideas. I believe most of science needs to fall into this area. I am a special education teacher with many kinesthetic learners and this model is great for most students, except the extremely low functioning.
- More design skills are needed at this level.
- would like to see more specific indstruction standards for scientific method
- Most schools reteach "scientific method" at the beginning of each school year and then continue to incorporate those skills. It is difficult not having a specific guideline- so that there is continuity between grade levels/spans- about what they really should know and be able to do. I'm not looking for a "how to do a report" but more specific skills- that all middle level teachers, no matter what school,can say that yes- they are doing this. Also so that there are specific skills learned from elementary that middle level can have them recall.

- k-8 should focus on Scientific Inquiry and Literacy.
- need to add inquiry standards
- Inquiry is for Science, Design is for Technology Education and Technology/Engineering
- Students need to understand Inquiry to have a complete science experience.
- Please add Inquiry into the frameworks!
- Should add standards on the scientific method, not currently covered in the middle school standards
- The language of science is the metric system, yet mcas deals mainly in the english system.
- more science skills measurement life and earth sciences in earlier grades
- We should include inquiry skills in the science discipline standards.
- I would like to see the Skills Of Inquiry incorporated into the content standards and not placed several pages away. They should be included in the strands like they are in the high school standards
- The use of models that is mentioned as a high school skill could be moved down to grades 6 - 8. The content on astronomy requires a lot of modeling. Students also start to work with models of molecules at the grade 6 - 8 level.
- I think the Inquiry and Design skills should become specific expectations for grade levels. Too many teachers are not teaching inquiry skills. Science is not memorization of rote facts!

Scope of high school course standards

HS Courses	Responses	Too Much	Reasonable	Incomplete
ESS	153	28 (18%)	103 (66%)	24 (16%)
Biology	210	96 (46%)	100 (48%)	14 (6%)
Chem	167	50 (30%)	111 (66%)	6 (4%)
Intro Physics	164	37 (23%)	113 (69%)	14 (8%)
Tech/Eng	169	29 (17%)	116 (69%)	24 (14%)
Skills	228	26 (11%)	182 (80%)	20 (9%)

**Please note: bulleted quotes are directly from survey responses. Quotes are *representative* of themes, perspectives and suggestions, not fully inclusive of all individual comments.

EARTH AND SPACE SCIENCE (HS)

TOO MUCH

Too much to address in one year results in focus on breadth of coverage rather than depth of understanding

- I used to teach it as a course for those entering freshmen who needed a conceptual course. However, in order to cover the standards I felt that it became to rushed a course for these students. I do incorporate these standards into an upper-level oceanography course (where applicable).
- I suppose that all topics could be covered in a school year, but not to the depth they deserve.
- Too much breadth, not enough depth
- Way too much, no room for constructivist science. This is just a review of everything that is ""cultural literacy"" in earth science, a laundry list. … Oh, and you gotta love ""Explain the Big Bang Theory."" Shout-out to all the Stephen Hawkings out there in high school.

REASONABLE

Reasonable, but suggest high school ESS MCAS test to emphasize importance

- The standards are reasonable but a test should be offered for this content area
- Because there is no high-stakes test attached to the earth science strand, administrators don't feel the need to warp the curriculum to promote their own careers, and the standards can be helpful as an actual teaching resource.
- Only a limited number of students access this curriculum.
- WE NEED EARTH SCIENCE MCAS FOR HIGH SCHOOL. ALREADY OUR SYSTEM IS CONSIDERING DROPPING EARTH SCIENCE TOPICS BECAUSE THEY ARE "NOT ON MCAS".

INCOMPLETE

Suggestions for additions to the ESS standards (this section includes all suggestions for additional topics; also see specific suggestions for revising the ESS standards)

- Should we develop a framework that includes the environmental physics of earth science.
- We should develop environmental science standards.
- More emphasis on applied Earth Science.

- I taught earth science courses previously, and found the standards to be a bit spotty. They cover energy and resources, but left out most of my meteorology and astronomy courses. The parts left out of the standards really needed to be included or the students could not understand the parts left in the standards. The standards seemed to have been written for students who had already mastered many of the concepts that I was teaching and found new to them. I think these standards should be revised with a more realistic approach to the actual level of the learner.
- Add climate change concepts. Add a thread of historical/social/personal context.
- I have a strong belief that Global Warming should/could be integrated into the cirriculum. The students have a innate interest in this topic as well as their role in the movement towards change.
- Again, at every level teachers are too invested in the learning standards and not the skills of inquiry, experimentation, and design. They continue to deposit information to students and follow the many different standards, rather than apply the skills within the content areas.

BIOLOGY (HS)

TOO MUCH

Too much to address in one year results in focus on breadth of coverage rather than depth of understanding

- There is too much content to teach the material effectively and in depth in a one-year course.
- I currently teach all of the standards in my biology classes, however, my colleagues and I constantly feel rushed to complete one topic and move on to the next. As a result, some of the depth of content is sacrificed to accommodate the breadth of the standards.
- We are forced to cover a lot of information but not to cover it in depth, especially with the inclusion of the human body.
- The sheer volume of standards makes it impossible to teach them at a depth that will promote understanding and not just memorization.
- The standards cover important topics in biology but cannot be covered completely or in any depth in a first year biology course

Amount precludes laboratory experiences

- Due to the amount of material that needs to be covered by the MCAS date does not allow time for students to design and execute original experiments within the school time line.
- According to educational research, depth rather than breadth is more beneficial and help students get into long term projects and labs that require higher order thinking skills.
- Having so much in terms of material to cover takes away from the essence of teaching science - to question and wonder about the world. We, as teachers are forced to get through content over a true understanding or appreciation of science.
- Even the most time efficient teachers are struggling to complete all of the high school biology curriculum standards before the Bio MCAS in early June. Opportunities to conduct labs and other enrichment extensions have to be left out in order to ensure complete coverage of the standards.
- Again, at every level teachers are too invested in the learning standards and not the skills of inquiry, experimentation, and design. They continue to deposit information to students

and follow the many different standards, rather than apply the skills within the content areas.

Anatomy and Physiology standards are too much and too vague

- The A&P standards are far too vague and span the scope of an entire additional course. I would rec. that they become the basis for A&P standards (a course which nearly all high schools offer) or be simplified for an introduction to biology course.
- The human anatomy standards are too comprehensive to cover within the life science curriculum
- Anatomy and physiology is so extensive that it can be devoted to a full year course. I am struggling with fitting a good anatomy into the curriculum that we already need to teach.
- Even with very few labs, I have a hard time getting through the standards. The worst one is standard 4: Anatomy and Physiology. This is often a whole course on its own and there is very little guidance on how much detail we are expected to cover. There are MCAS questions from this strand at the molecular, cellular, tissue, organ, organ system, and organismal levels. There's no way to cover it all. The other strands are more clear-cut.
- Human Anatomy should not be included in the General Biology Frameworks, it is it's own entity. The inclusion of Human Anatomy just makes the frameworks impossible to teach in a one yeatr course.

Need better articulation between middle and high school standards

- Depth and breadth of the course content is high and needs support at the middle school level for students to develop mastery.
- There are too many standards and many of them are not aligned through the grade levels, mostly in the anatomy and physiology
- Greater articulation with lower grades is needed.

Big ideas are not emphasized due to lack of time and MCAS prep focus

- Sadly, the onset of the Biology MCAS has lead to a systematic reduction of the discipline to drivel in low-income schools. Each standard bullet fragment is disposed of with vocabulary reviews and drill activities at the lowest-common-denominator level. The overarching ideas (lacking bullets) don't get addressed.
- Biology has become a vocabulary language class. As a special ed, ELL and regular ed inclusion teacher, I spend so long trying to get kids to know words so they can look at the test. Biology Frameworks should be more focused on what would be required for general participation in life. Cellular Biology and Physiology are NOT necessary for real life. Especially since it is a high stakes test for graduation!

<u>REASONABLE</u>

- These standards are reasonable and appropriate.
- Although I believe that if the test remains a course test then it should be given later in June since most schools go until the last week (use as a final exam)

<u>INCOMPLETE</u>

Suggestions for additions to the Biology standards (this section includes all suggestions; also see specific suggestions for revising the Biology standards)

- It will be nice to have current research integration in the strands. There is also a need for introduction to Pathology and Immune system in physiology section.
- More specific standards for Anatomy ... human? vertebrate? both?
- Should include biotechnology standard under genetics.
- More history, less laundry list, more about the mystery of science, more about unanswered questions.
- Add projected impacts of climate change on living systems. Add a thread of historical/social/personal context.
- We have a germ phobic society. Please include standards that teach how bacteria is necessary.
- Too much is spent on the molecular level and not on just observing and analyzing the world around them on the macrolevel.
- Biotechnology is part of modern biology and I would like to see it threaded into the life science(6-8) and biology standards.
- Entire blocks of life science are ignored. Specifically Microbiology, botany and zoology
- There should be a standard related to All grades should incorporate appropriate content on human interconnections with natural world planetary and life suppport systems are changing as a result of human impacts (climate change, biological diversity, ocean changes (acidification)

CHEMISTRY (HS)

TOO MUCH

Too much to address in one year results in focus on breadth of coverage rather than depth of understanding

- Excellent and important topics are chosen but there is not enough time to teach the depth. If no depth is taught then why bother with the material, students will forget it before they go to college. Too much for first year chem students.
- Students need time to grapple with each big idea. Classrooms need time for constructivist approaches like Spencer's POGIL. To cover the breadth of topics in the standards, time is necessarily short for in depth exploration of the key ideas. The MA frameworks are old fashioned -- education is moving to a depth over breadth approach and the MA frameworks should follow suit.
- The frameworks is perfect for my honors class and we have time to go more in depth. However, it's too much for a college prep level and both the students and I feel rushed.

Need to account for time to develop mathematical skills

- To teach by reasoning, the number of standards are overwhelming. One problem is that the mathematics necessary is not being introduced to the student as specified in the standards mathematics prereq.. Time has to be taken to get the students up to par.
- Additional time during the school year must be allowed to teach (or review) the metric system, scientific notation, dimensional analysis, and significant figures.
- I think that the range of topics students are expected to master is too wide, particularly for students whose math skills need to be supported when learning the new concepts.

Amount precludes investigation and laboratory experiences

- The other important thing the chem frameworks should have is a lab component. The college board is smart to have 20 required lab experiences. The state frameworks should have the same. The great thing about chemistry is that kids can experience what they do on paper in a lab setting the state should require some basic labs to make sure students get a proper education. The frameworks include math skills students should have, but not lab skills. That is why the frameworks should have a lab component.
- The number of standards could be reduced to provide basic understanding for increased investigation.
- Once students pass biology MCAS they are free to elect any science of their choice. Once the high stakes hurdle has been overcome, science can become 'fun' and exploratory again. Exploration/inquiry science takes TIME! I have instructed my teachers to take the time and teach fewer standards/topics in favor of increased exploration. Remember - science is what really makes our high tech society run. We need to encourage more students to take up the interest.

Need better articulation between middle and high school standards

- The Chemistry standards seem to have a very large number of standards which are not supported in the k-8 curriculum. Perhaps the number of standards should be revised and focus on those topics which have begun at the earlier grades.
- Our students are coming to us unprepared for chemistry so that we need to teach all the beginning frameworks. As a result, we do not get to the later frameworks (kinetics, equilibrium, etc.)
- There are too many standards and many of the high school standards are not scaffolded through out the years. The standards are not well developed through elementary and middle levels.

<u>REASONABLE</u>

- 11th graders are ready for this material
- General chemistry is an elective course and as such, the coverage is sufficient

<u>INCOMPLETE</u>

Suggestions for additions to the Chemistry standards (this section includes all suggestions; also see specific suggestions for revising the Chemistry standards)

- Areas such as fact to label and sig. figs. should be done in the math curriculum and/or freshmen science where we just reinforce these concepts in chemistry. I do think that the significance of figures should be presented in chemistry.
- The standards regarding thermodynamics only focus on entropy, not enthalpy and free energy, both of which are covered in college chemistry.
- 7.4 requires a knowlege of molality, but molality isn't part of the concentration standard (7.2)
- Energy is desperately shortchanged in the Chemistry framework. Kilojoules and even calories have fallen into a crack between the bullets. What, in God's name, are you thinking?!
- Would like to see the Chemistry standards address the societal problems related to Chemistry. Global warming, Acid Rain, Fossil Fuels, to name a few.
- Just a laundry list from history, instead of focusing on the process of science. Again, too much of the useless stuff, not enough of real science. We have to do a better job than this

at reconciling "skills" with content standards, because you know a students could do too well based on mere memorization of these content bullets.

- Again, at every level teachers are too invested in the learning standards and not the skills of inquiry, experimentation, and design. They continue to deposit information to students and follow the many different standards, rather than apply the skills within the content areas.
- Many students enter a high school chemistry course in need of review of the basic concepts and also the scientific method, lab techniques and apparatus, etc.

INTRODUCTORY PHYSICS (HS)

TOO MUCH

Too much to address in one year results in focus on breadth of coverage rather than depth of understanding

- It is impossible in a ninth or tenth grade physics course to teach such a large number of standards in any kind of depth. If we truly want our students to understand the content rather than being able to spit back vocabulary and formulas at us, we need to be able to focus on fewer standards.
- Too many topics, therefore no depth can be taught. Students at this grade level struggle with the required mathematics and that eats up lots of instruction time. Therefore the actual physics is not covered as well as it should be.
- It is difficult to cover all the topics to an appropriate high school depth. It would be great if we could have the students choose 2 of the last three units (Waves, E&M, Heat)
- By covering such a broad ranfe of topics in a limited time frame it is necessary to give a more general view, breadth not depth of each topic.

Adequate mathematical skills are needed

- Sometimes the math is difficult for students.
- Too much for an "introductory" course that is often being taught to freshmen who need more attention to learning the math skills required by the course.
- This particular strand is not too much time wise, but includes math concepts that most of the ninth graders taking this course have not yet been introduced to. This slows the course, and leads to frustration. Then, as a Physics Teacher, I am expected as an upper level course to apply these standards, even though they were meant for an Introductory course. When I add the optics units, vector addition with trig, and other units needed for the students to compete at a reasonable level in college, I don't have time to teach the Thermodynamics unit. I think one important change would be to have a Physics standard for the Grade 11-12 course in addition to the Introductory Physics standard, and to make it realistic time wise.

Scope and content present implementation issues

- If a weekly lab is incorporated to demostrate a physics concept. It means rushing through to acheive all the frameworks. Many students learn best with labs & demonstrations.
- 9th graders are NOT ready for this material, it is too complicated and causes frustration very early in a child's high school career
- With special needs inclusion a mandate, the amount of stanards to cover does not allow for differentiated instruction strategies

- Introductory Physics' current standards leaves no time to introduce fun topics in depth ie. why the sky is blue. grade 9

REASONABLE
- Perfect
- The quantity of standards is reasonable. However some standards need to be clarified and fleshed out more.

INCOMPLETE
Suggestions for additions to the Introductory Physics standards (this section includes all suggestions; also see specific suggestions for revising the Introductory Physics standards)
- Linear optics is missing, simple physics of fluids and gases - See Technology and engineering- used there, harmonic oscillator? why not? Simple quantum mechanics?
- Should include nuclear reactions (at a minimum) and using nuclear fuel as an energy source.
- Nuclear reactions should be presented here instead of chemistry. Also, I think quantum concepts of probblility should be reinforced in physics.
- HELLO! IT'S 2009! Or at least it was 2006 when this was written. Why then was the curriculum pulled out of a time capsule from 1920? Too much baggage, not enough science. No room for inquiry when we boink kids over the head with kinematics, not enough solid state physics, astronomy, etc. Why do the Earth and Space Science standards include cosmology but Physics doesn't? Do we want Massachusetts to be the stodgiest state in the nation, world? This is where the achievement gap between us and the rest of the world is grandest. Kids don't like it either, no wonder none of them want to be a physics major, why only 18% of physics majors are female, etc.
- Please add more about physics and climate change.
- Standard 1.2 Distinguish between and solve problems involving displacement, distance, velocity, speed, and acceleration. Why are there kinematic formulas listed that don't ever seem to be tested?
- Add alternative sources of energy - green energy

TECHNOLOGY/ENGINEERING (HS)
TOO MUCH
Too much to address in one year results in focus on breadth of coverage rather than depth of understanding
- The number of standards is too great to cover them in depth.
- The range of topics/standards is appropriate, but overall, there is more content than can be taught thoroughly and effectively in a one-year course. Some standards should be reduced (see notes below).
- I think if you are looking for a traditional academic HS to cover these, that is impossible.

REASONABLE
- The number of standards is good.
- As a separate course it is not a problem.
- We have developed a full year course that will count as "science" credit for graduation

INCOMPLETE

Suggestions for additions to the Technology/Engineering standards (this section includes all suggestions; also see specific suggestions for revising the Technology/Engineering standards)

- There should be standards developed to address the biotechnology/bioengineering areas in the technology/engineering strand.
- Some of the strands need clearly state a project should be built
- Add CAD, look and coordinate with physics when constructing a rocket
- Expand on systems design and introduce the fields of engineering to include more than the most common, (mech, elec, software). Thermal systems are only useful for home heating situations. there is very little use for it (thermodynamics) at the high school level!
- 9-10 Communications should address graphic design, multimedia, photography, video production and information technology.
- I believe the Engineering standards should start focusing more on today's technology demands and less on manufacturing.
- Need to include energy issues as part of the Technology/Engineering standards.
- I think an added technology/engineering standard should incorporate alternative energy sources; i.e. solar power, wind power, hydrogen fuel cells
- Systems design. it can be a good unit for the teacher as well as the student.
- High School T/E Should incorporate more hands on use of tools and machines in the manufacturing and construction strands. "Describing" or "explaining", how a tool or machine is used, is a poor substitute for building or manufacturing with actual tools.

Integrate technology/engineering with the other science strands

- The technology/engineering standards should be embedded throughout the other strands.
- I would like to see more integration between sciences and Technology/Engineering. Project lead the way could also integrate more science.
- Technology/Engineering is an extremely important subject for students to learn. As a former engineer myself, I never learned these specific topics in the technology/engineering strand at the high school level and I wish I did. I was taught THEORY only which I believe to be a mistake. Why isn't technology/engineering a mandatory science course? The best way to describe technology/engineering is: "where math and science meet real world applications". … Technology/engineering teaches students PROBLEM SOLVING. This is a skill that we must cultivate in our society if we, as a country, are to maintain our position in the world as innovators, inventors and technology leaders. How can our students go out into the world and improve the world in which we live if they don't understand how the existing technologies work? The technology/engineering course teaches students these important skills. As Theodore von Karman once said "Scientists study the World as it is. Engineers CREATE the World that never has been."
- I wish they were called Engineering standards. The pervasive interpretation of Technology as computers adds to the difficulty of getting teachers to be willing to address these standards.

SKILLS (HS)

TOO MUCH

Time needed to address content standards preclude addressing inquiry standards

- The science inquiry standards represent what I value most about science teaching, but I find myself sacrificing those to cover all the content standards needed in order to help our students pass the MCAS. By requiring students to pass a test for graduation that focuses on the content standards, the state has sacrificed the inquiry standards.
- Too much in combination with the excessive number of learning standards in each discipline.
- Inquiry skills compete with content for time. The Biology frameworks include so much content that the inquiry skills are sacrificed.
- While I think inquary skills are by far more important than even the content standards, there isn't time to complete them if the standards remain the way they are. This is the section I have to give up each year t get to all the strands covered in the frameworks. I do this because it isn't tested. I think this is rather unfourtunate.

Lack of skill development as lower grades makes this very difficult

- It depends so much on whether the lower grades address the inquiry skills. If they come to high school never having had any inquiry experiences, it is very difficult to get students to the high school expectations.
- Chemistry is too dangerous a subject to give students chemicals and to 'think' of an experiment.
- Lower grades need to focus much more on inquiry and less on content and I think we could see an overall improvement in student learning

REASONABLE

Appropriate and important; needed for development of 21st century skills

- These standards should be covered in each science discipline being taught at the high school level.
- Crucial to link Inquiry and Design skills to 21st Century Skills (see Nov report to Board of Ed from Task Force on 21st Century Skills)
- This is what our learning standards should be focused on. This points us in the direction of 21st century skills.

INCOMPLETE

Suggestions for additions to the Inquiry Skills standards (this section includes all suggestions; also see specific suggestions for revising the Inquiry Skills standards)

- The standards are reasonable for all the grades, what I am not sure is how we convey that the Inquiry standards are integrated in all of the all science standards and are not a stand alone standards.
- More design skills are needed at this level.
- Add educational technology standards.
- Since Tech. Engineering has an Eng. Design Strand, why couldn't Intro. Physics have an Inquiry and Design strand of its own !!!

Inquiry skills need to be added to the assessable standards

- Because the inquiry skills are not measured on the MCAS, they are often not taught due to the need to "cover" the other standards that are on the MCAS exam.

- While inquiry is addressed, students don't have to demonstrate the scientific process in answering the MCAS questions because there are no open-ended experimental design questions.
- Please include more lab based questions.
- We want the students to have these skills and teachers to teach them, however they are not assessed on MCAS thus they are not stressed in the class. They should be at the foundation of Science teaching and learning.

Assess skills at the state level or locally?

Responses from:	All respondents (459)	Who teach K-5 (151)	Who teach 6-8 (176)	Who teach HS (200)
State assessment	134 (29%)	33 (22%)	64 (36%)	59 (30%)
Local assessment	239 (52%)	84 (56%)	84 (48%)	106 (53%)
No opinion	86 (19%)	34 (23%)	28 (16%)	35 (18%)

**Please note: bulleted quotes are directly from survey responses. Quotes are *representative* of themes, perspectives and suggestions, not fully inclusive of all individual comments.

THEME EXPRESSED IN BOTH CATEGORIES

Assessment of skills should be done both at the state level and locally

- State assessment lends clout and priority. Some inquiry and design skills can be assessed via a test. For instance, students can be presented with two or more experimental designs and asked to judge which is better and to explain their reasoning. However, use of equipment needs to be assessed locally. It does not lend itself to paper/pencil assessment.
- I don't see why they can't be assessed both ways. That would be best.

THEMES FROM THOSE RESPONDING VIA "State assessment"

Would provide alignment to state standards

- If they are part of the state standards, then they should be part of the state assessment.
- If the state is going to assess standards then they must include the inquiry and design components.
- Inquiry and design skills are essential to the learning of science and technology and should be assessed the same way the standards are.

State assessment allows for consistency across districts; many challenges for local assessments

- If it's worth measuring then it's worth measuring consistently; not district by district
- More direction statewide more cohesion and less difficulty with transient students
- Districts will not work to incorportate these skills into their curriculums if they only will be assess at the local level.
- The level of assessment will be all over the place which will give it little or no value or validity it the assessments are determined locally

State assessment as long as it does not add to the overall scope of the standards

- Yes, but only if the number of content standards can be reduced.
- Only if it does not make a long test longer!
- I have no problem with the skill being assessed by the state but specific information regarding expectations will be required by the state. For example, you will use specific scientific method terminology. REAL RUBRICS will be provided, not vague (never used rubrics) like are published with the open response questions!

If costs and time to support inquiry can be provided

- If it is state mandated, then the school system must provide the time and resources to accomplish this.
- Only if schools are guaranteed the time to teach these standards. Without our extra lab block, it is tough to cover both the Inquiry and Design Skills and the content.
- I DO NOT RECOMMEND OR DESIRE A PRACTICAL COMPONENT ON THE MCAS. I THINK THE LOGISTICS, TIME REQUIRED AND MANDATORY COST ASSOCIATED WITH THESE LABS WOULD BE AN INCREDIBLE CHALLENGE.

Suggestions for possible assessment formats

- Portfolios and projects would be ideal. Better than MCAS!
- A formative assessment is best
- Since science is a process -rather than a recitation of facts- I believe it would be more beneficial to ask the student to solve a problem. For example if the student is given a certain scenario (such as an unknown organism) the student should be able to describe the process they would use to determine the type of organism they have.
- In AP Chemistry and Biology, there are a defined set of labs. I would like to see a small set of required (or strongly recommended) labs from which you could base 1-2 open ended questions on the MCAS. I would think many teachers (especially new teachers) would like having more guidance with respect to lab skills. I think this could reasonably be done in all 4 areas for high school STE.
- One possibility is districts submit their own plans to the State on what they will test, but the MCAS has the most weight due to the published results from the test.
- Maybe a science fair for every student in the state?
- Students are not required to produce evidence of their inquiry skills. A laboratory practicum would be a useful assessment of student inquiry skills in chemistry.

THEMES FROM THOSE RESPONDING VIA "Local assessment"

Local staff know the context of what is taught and what students know and can do

- Locally could give a school system more freedom to challenege its student population better since it knows it better. There will be necessary restriction if done at a state level.
- This needs to be taylored to the individual community as it should relate directly to the individual student's life if it is to have meaning to them.
- Many studnets have not yet reached the point of development where they are able to master these skills; it would be better to locally assess where the students are and where they need to improve, rather than holding them responsible for mastery.
- Makes sense to do it locally so each school/district can tailor the assessments.

The best assessments of skills are based in the classroom as students are doing them

- These skills are assessed more effectively through actual laboratory experience in the classroom.
- Performance based assessment is appropriate for design skills, not a paper and pencil test
- Inquiry and design skills are judged best in projects and experiments.

A very difficult task to assess at the state level

- Difficult to test Inquiry and Design Skills on test questions. I question the validity of measuring these skills on a paper and pencil exam.

- This is what our learning standards should be focused on. This points us in the direction of 21st century skills. It should be assessed locally. How is the state able to test a hands-on component?
- I believe it is difficult and costly to assess these skills on a state assessment. These assessments can and should be done very effectively at the local level.

Differences is district resources may preclude fair opportunities

- Not all students have the same access to equipment and materials. It wouldn't be fair to assess on a state level.
- Locally. The state should not assume that all schools use the same equipment (or have it) and labs ... unless more funding is given to all schools. Some of the questions are lab specific and not all schools teach these labs thus some students are at a disadvantage
- Also, where does the funding come from to do this? If the funding comes from local resources, then the assessment should be completes locally.
- Due to our location and types of communities (more rural) we are not exposed to same conditions as larger cities. A state assessment would not be equitable.

Assessment of skills should be directly related to teaching and curriculum

- Inquiry comes in all sorts of levels and is extremely difficult for new teachers to present. Assessing it locally will let each teacher play to their strengths and level.
- Greater flexibility in varied assessment practices.
- I believe everything should be assessed locally with assessments appropriate to what is taught.

There is already enough being assessed

- There is enough information to test already. To test the inquiry process which is inherent in all learning of science at high school level would be the wrong focus.
- Why would you add more to an already bloated testing system? My 5th graders take every test that you give.
- Enough testing already!! The actual application of problem solving skills requires years of practical hands-on work that frankly simply does not fit the school day. We cannot be all things to all people. The well intentioned people creating the continually expanding array of measurements and standards are not here in the trenches doing the work.
- The NEASC accreditation review addresses the inclusion of the inquiry process in instruction. High stakes testing has no place in this, and is really more of a marketing strategy than an educational tool. Leave us alone, and let us teach the sciences.

THEMES FROM THOSE RESPONDING VIA "No opinion"

No opinion

- I have no opinion on this.
- I am not familiar.

Depends on how it is done

- I would need more details of how they would be handled at the different levels.

- Would be difficult to assess. I'm not sure how these questions would be designed. Inquiry skills require observations of student performance and is ongoing. Adding it to the test would be great, but I don't know what it would look like.
- Either one would be acceptable, provided that it was uniform across districts.
- Either would be okay if one standard was optional on the state test and could be covered after the state assessment.
- It depends on the type of assessment, these kinds are already tested to death. Adding one more set of questions to a given MCAS exam might be reasonable , but not a separate test.

Would be very difficult to carry out well either way

- I don't see how it could be assess on a state level, other than by submitting student devised lab work. The trouble with having it assessed locally is when are teachers held accountable for having their students do inquiry based work.
- This would be difficult to assess and articulate to districts what this should look like if done locally.

Framework resources

Organization and Use of the Framework
Question 22 asked: How could we **improve the format and organization** of the *Science and Technology/Engineering Framework*?

Overall:
Among the 173 responses to this question, many (34) respondents thought the organization of the Framework was "Fine as is." Seven (7) respondents thought that Technology/Engineering should be separated entirely from science, stating that "The Engineering aspect is difficult because most science teachers do not have experience with Engineering." One (1) respondent thought the language of the Framework could be more "student-friendly."

Standards:
Many (30) respondents stated that the standards should be clustered or grouped by grade or grade-span, not strand. Some (4) stated that the standards should link to each other by concept or topic (Topic Maps) at the state and national level. One person stated, "Another good tool to add would be showing table connections between the different standards. If you teach them as individual standards, then students fail to see the connections between the units." Other suggestions for the organization of the standards included: Spiraling the Grades 6-8 standards; Separating the standards themselves from everything else (their own separate book); Organizing the standards by essential or central concepts; and Prioritizing standards.

Support for Instruction:
Several (7) respondents thought that the standards should be linked to possible lesson plans and or include more suggestions for teaching. One respondent stated, "Give more examples on how a certain standard should be taught. For example, the standard on classification of life listed an example of single-celled protists and how they move. This gave us direction and is very valuable in our teaching. Now we know where (you think) the lesson should focus." Other suggestions were to link the standards online to appropriate websites with resources.

Appendices and Resources:
The suggestions for the Appendices included: Keeping Appendix I as is (5) – "I find using Appendix I as it allows a teacher to see the broader picture of the scope of the standards."; incorporating Appendix II into the standards themselves; and sorting the Appendices by grade level (1). Three (3) respondents suggested including a calendar to show what should be taught when. One comment was "I think the format should be done by month. If the state sets it up that xyz was to be done in September our kids would do better because of the high mobility that our state has." Two (2) respondents suggested including a Vocabulary Section, perhaps at each grade-span.

Linking to other content Frameworks:
Some (4) respondents thought that the STE Framework should be specific about where mathematics needs to be addressed. One (1) suggested that the format of the state Frameworks be standardized across content areas.

Formatting:
Three (3) respondents suggested that the STE Framework keep the same format throughout. One comment was "Keep the formatting the same between grade spans. High school is formatted different from the younger grades.

Frequency and Use of the Framework
The Framework is used as a guide for:

	Frequently	Fairly Often	Rarely	Never	N/A
Classroom Instruction or Planning	242	122	35	5	26
Classroom Assessment	193	120	68	14	30
District Curriculum	251	96	23	11	40
District Assessment	185	94	40	20	70
Professional Development	160	135	77	14	35
Teacher Preparation	224	108	41	8	44

Comments:
Comments were primarily centered on using standards to align district or school documents, including: curricula, assessments, and accountability plans. In some cases the standards were also said to be used to develop MCAS guides and curriculum maps. Many stated that they used the standards as a guide for designing yearly thematic units, daily lesson plans and objectives, essential questions, and supplemental student activities. A few respondents were emphatic about using the standards to drive their instruction and posted the standards in their classrooms for their students to see. One person mentioned showing the alignment of the state standards with the national standards as a guide for new and or immigrant teachers from other states.

Usefulness of **Mathematical Skills** at the end of each **high school** course: (345 responses)

- Very useful: 76 (22%)
- Somewhat useful: 126 (37%)
- Not Useful: 16 (5%)
- Not Familiar: 29 (8%)
- Too Many Skills: 10 (3%)
- Some Skills Missing: 9 (3%)
- No Opinion: 103 (30%)

"Too Many Skills"
Most of the comments within this category were about the inappropriateness of some of the mathematical skills (particularly those regarding scientific notation and significant figures) in the Biology section. Respondents felt that they were beyond the scope of an introductory course and were more appropriate for an AP level course, or for Chemistry and Physics. Some stated that they just did not have enough time to cover these skills thoroughly.

"Some Skills Missing"
One comment in this category was that the calculation of pH, though beyond Algebra, should be listed. Other mathematical concepts that were considered missing included calculating rates, determining minima and maxima in Physic, and overall basic Algebraic skills.

Useful to include **Mathematical Skills** in **PreK-8** as well: (382 responses)

- Yes: 249 (65%)
- No: 63 (17%)
- No Opinion: 70 (18%)

"Yes"

Among those that chose Yes the primary comment was that science is naturally linked to math and should also be so in the Framework. Skills such as graphing and analyzing data were mentioned as mathematical skills that were necessary in science and that should be enforced. Many also felt that they were already doing cross curricular work and that the integration of mathematics into science would foster and support more such work. One concern, however, that came through was that the connection to the math standards should be presented as a guide for teachers and not just another set of standards that teachers would be responsible for teaching.

"No"

Two-thirds of the respondents that chose No are associated with the PreK-8 grade levels. Among those respondents, for the most part their comments were that:

- PreK-5 is too early to introduce math into science.
- Math isn't really necessary for science in the early grades.
- They were already teaching math for the purpose of teaching math. To bring it into science would be too much for students.

Others that said No also thought that addressing math in science at the lower grades would be redundant and that it was already being taught by a math teacher. Some also expressed that teaching math should solely be the math teacher's job.

"No Opinion"

The comments for those that chose No Opinion were about not understanding the math standards and that they would probably therefore not use them.

Useful to include **Vocabulary Lists** in the Framework: (426 responses)

- Yes: 378 (89%)
- No: 25 (6%)
- No Opinion: 23 (5%)

"Yes"

Most respondents were very supportive of having vocabulary lists available at each grade, grade span, or strand. The reason most listed was the need for consistency across the state even though many districts or schools had already developed some list or another on their own. Some felt that vocabulary lists would help facilitate vertical planning from grade to grade, unit or lesson planning, and cross curricular collaborations. Vocabulary lists would help clarify what needed to be taught and to what degree or depth. One person stated that vocabulary lists would be especially helpful for elementary teachers.

Many thought including vocabulary lists would help support student understanding and their ability to use appropriate vocabulary. Having vocabulary list available was also seen as helpful for the support of ELL and SpEd students, particularly for developing education plans.

Many comments also included directives for the possible vocabulary lists. Some felt they should align with vocabulary used in MCAS, particularly biology, and should include student-friendly alternative terms as well.

"No"
Most that said No to including vocabulary lists were primarily concerned with how the lists might be used. Some felt that if included the lists may be used simply for memorization without helping students to develop a full understanding of concepts. Some were concerned that the lists would either be too broad or incomplete.

Usefulness of **Sections of the Framework:**

Section	**Very Useful**	**Somewhat Useful**	**Not Useful**	**I am not Familiar**
Purpose and Nature of Science and Technology/Engineering	87	213	59	37
Inquiry, Experimentation, and Design in the Classroom	123	206	41	27
Guiding Principles	102	212	50	31
Ideas for Developing Investigations and Learning Experiences	99	171	47	53
Suggested Extensions to Learning in Technology/ Engineering	100	143	72	58
Vignettes	94	165	86	47
Standards Organized by Strand and Broad Topics	192	165	86	47
Additional Learning Activities for Gr. PreK through Gr. 8	84	148	60	74
Historical and Social Context for Science and Technology/Engineering	51	148	115	65
Safety Practices and Legal Requirements	145	162	40	48
General Science Safety Checklist	138	154	45	52
Dissection and Dissection Alternatives	65	117	55	123
Curriculum Review Resources	76	168	59	72
Criteria for Evaluating Instructional Materials and Programs	72	164	71	74
Glossary	83	162	73	62
Bibliography	53	141	104	80
Websites	101	143	62	64

Suggestions for **Supplementary Resources**

- List and description of 21st Century Skills; and resources for supporting them
- A comprehensive list of labs, activities, or science fair projects requiring inexpensive equipment
- Many more web-sites; particularly some that contain simulation or animations, lesson plans, assessments, free/low cost field trips or resources
- Websites linked to standards
- A charted alignment of state standards to national standards and benchmarks
- Any resources to help teachers accommodate curriculum for special education students
- Concept maps for all of the strands to show connections between concepts/standards from grade to grade
- Ideas on how to differentiate very vocabulary dense topics for students with reading comprehension and working memory deficits
- List of actual standards in ELA and Mathematics Frameworks that connect to STE
- If math and science literacy become incorporated into the science frameworks, identifying the learning standards from the corresponding frameworks would be helpful and essential tool.
- MCAS preparation guide
- List of common student misconceptions
- Useful graphic organizers specific to science
- Parent Tips - how to help your child prepare for the MCAS
- More vignettes or “What it looks like in the Classroom” scenarios
- Useful sites or templates that might help students write scientifically

Responses were submitted from

Abington, Frolio Middle School
Acton Boxobrough Regional School District
Acton Publoc Schools
Agawam Public Schools
Alternative Education
Amherst Pelham Regional Schools
Andover
Assabet Valley Technical High School
Atlantis Charter School
Atlantis charter school
Ayer Public
Barnstable
Bedford Schools
Bellingham
Berkshire Hills Regional School District
Berlin/Boylston Regional School District (Tahanto)
Beverly School District
Billerica - Locke Middle School
Billerica Public Schools
Boston
Boston Public Schools
Boston University
Bridgewater-Raynham Regional S. D.
Bristol Plymouth Regional Technical School
Brockton Public
Brookline
Burlington Public and Cambridge College
Burlington Public Schools
Cambridge
Cambridge Community Development Dept.
Cambridge Public Schools
Carver Public Schools
Central berkshire regional school district
Chelmsford
Chelsea Public Schools
Chicopee
Christa Corrigan McAuliffe Center for Education an
Concord Public Schools
Concord-Carlisle Regional School District
Danvers High School
Danvers Public Schools
Dartmouth
Dennis-Yarmouth
Douglas
Douglas High School
Duxbury Public Schools
East Bridgewater Public Schools
Easthampton
EnergyTeachers.org
Engineering Lens
Fairhaven High School
Fall River - B.M.C. Durfee High School
Fall River Public Schools
Fitchburg
Fitchburg High School
Foxborough High School
Foxborough Public Schools
Framingham Public Schools
Franklin
Freetown-Lakeville Regional School District
Gardner High School
Gardner Public Schools
Gateway Regional School District
Gloucester Eduction Foundation
Greater Lawrence Regional Technical School
Haverhill
Holbrook Junior-Senior High School
Holyoke Public Schools
Ipswich Public Schools
King Philip Regional High School
Lawrence
Lawrence - Butler Middle School
Lenox
Leominster
Lexington High School
Lexington Public Schools
Littleton High School
Littleton Public Schools
Longmeadow Public Schools
Lowell Public Schools
Lowell, Wang School
Lunenburg - TC Passios Elementary
Lunenburg High School
Lunenburg Public Schools
Lynn Public Schools
Malden
Mansfield High School
Mansfield Public Schools

Marblehead Schools
Marlborough Public Schools
Masconomet Regional School District
Mass Audubon
MassTEC
Maynard
Medford
Medway High School
Melrose
Mendon-Upton School District
Methuen Public Schools
Middleborough
Milford Public Schools
Millbury Public Schools
Minuteman Regional High School
MITS
Museum of Science, Boston
Nantucket Public Schools
Narragansett Regional School District
Nashoba Regional School District
New Bedford - Hathaway School
New Bedford High School
New Bedford Public Schools
New Bedford Public Schools, Normandin Middle School
New England Aquarium
Newton Public Schools
North Brookfield Jr / Sr High School
North Brookfield Public Schools
North Middlesex Regional School District
North Reading
Northeastern University
Oxford School District
Pembroke Community Middle School
Pentucket Regional School District
Pittsfield Public Schools
Plymouth Public Schools
Quincy Public Schools
Randolph
Revere Public Schools
Rockport High School
Sabis International Charter School
Salem (Saltonstall School)
Salem Public Schools
Saugus school district
Scituate
Seekonk Public Schools
Sharon High
Sharon Public Schools
Shawsheen Valley Technical High School
Sherborn Public Schools
Shrewsbury Public Schools
Somerville Public Schools
Southeastern Regional School District
Southwick-Tolland -st Regional sd
Springfield - Commerce High School
Springfield (High School of Science & Technology)
Springfield Public Schools
Sudbury Public Schools
Taunton Public Schools
Tufts Center for Engineering Education & Outreach
Tufts University
Tyngsborough middle school
Tyngsborough Public Schools
Uxbridge public schools
Wachusett Regional High School
Wachusett Regional School District
Wakefield
Walpole Public Schools
Waltham
Wareham School District
Wareham Senior High
Wellesley Public Schools
West Bridgewater Public Schools
West Springfield Middle School
West Springfield Public Schools
Westborough public schools
Westfield Public Schools
Westford - Academy
Westford Public Schools
Weston Public Schools
Weymouth
Weymouth High School
Whitman-Hanson Regional High School
Whitman-Hanson Regional School District
Whittier School District
Wilmington Public Schools
Winchester
Winchester High School
Worcester - Doherty Memorial High School
Worcester Public Schools
Wrentham Public Schools