COMMONWEALTH OF MASSACHUSETTS
BOARD OF EDUCATION
*****SPECIAL MEETING*****
FITCHBURG HIGH SCHOOL
740 RICHARDSON ROAD
FITCHBURG, MASSACHUSETTS
MONDAY, NOVEMBER 27, 2000
4:30 p.m. - 6:00 p.m.

MEMBERS OF THE BOARD OF EDUCATION PRESENT:
Mr. James A. Peyser, Chairman, Dorchester
Dr. Roberta R. Schaefer, Vice-chairperson, Worcester
Ms. Patricia Crutchfield, Southwick
Ms. Jody Kelman, Chair, Student Advisory Council, Concord

Dr. David P. Driscoll, Commissioner of Education
Secretary to the Board

MEMBERS OF THE BOARD OF EDUCATION ABSENT:
Mr. Charles D. Baker, Swampscott
Dr. Edwin J. Delattre, Boston
Mr. William K. Irwin, Wilmington
Dr. Judith I. Gill, Boston
Dr. Abigail Thernstrom, Lexington

ALSO PRESENT:
Maryellen Coughlin
Registered Professional Reporter

CHAIRMAN PEYSER: I'd like to call this meeting to order. The purpose of this session this afternoon is to provide a review of the revised curriculum frameworks in science and technology/engineering which are going to come before the Board for formal consideration in December, at the December 20th board meeting. The purpose of today's session is to provide enough time for full discussion of what's new and different in this framework, and perhaps some discussion of assessment issues that are implied or specifically addressed by this new framework so that Board Members will be sufficiently prepared to make a decision at the December board meeting. With that, I'll just turn it over to the Commissioner.

COMMISSIONER DRISCOLL: Thank you, Mr. Chairman. What we would like to do is divide the discussion into three parts: first to talk about science, then to talk about technology / engineering, and finally to talk about the assessment changes that we feel would be necessitated as a result of the changes that we are making. In addition to our staff, which I'll introduce in a second, we have three school district people here. Let me begin by introducing Yvonne Driver , our sabbatical teacher in technology; Susan Cote, our sabbatical teacher in science; Sandra Stotsky, who I'll turn it over to in a minute; Tom Noonan who heads our math and science office; and Barbara Libby in charge of curriculum in our math and science office. Sandy, if you could walk us through the major changes starting with the science part of the framework, and then perhaps we'll hear from our three guests from our school districts.

DR. STOTSKY: Thank you very much. Let me begin by mentioning that we had a very extensive teacher-driven process for revising the document that had been presented last August. We received many comments, and various teacher groups met during the course of the year to work at the high-school level, in particular, to develop sets of comprehensive full-year standards for the four major science disciplines. Another group met for the technology / engineering standards. We had teacher working groups that went from K to 3, from 3 to 5 and from 6 to 8, which means we had teacher groups working at all of the different levels of the document as well as for the different science disciplines at the high-school level.

Several major changes were made from what had been in the original document and to some extent what was in the August document. First of all, we have more specific standards, which is something that the field wanted, and we believe that this has been addressed quite satisfactorily in this document according to public comment that we received over the course of the response to this particular draft that we have before us. We also have the four standards that are content standards in the document. This is probably one of the biggest changes in this document. This is similar to the mathematics document that we approved in July in that the strands are all content strands. And we have technology / engineering as one of the content strands, and earth science, life science and physical science.

We then have some standards that have been moved up or down for developmental appropriateness. We've added the topic of genetics, and we have added earth science back in, which was not in at the high-school level in the August document. We also have a different format in the document. For K-5 we have a four-column grid that shows the topic, learning standards, and activities for developing inquiry-based learning experiences and then extensions to technology. We want to make this document as teacher friendly as possible. And we also have some rewritten appendixes.

For the final document, which we will be presenting in December, the document that you have before you will be fleshed out even more. There will be more examples added; we will be reformatting it, as well. We'll have the content more worked out for what we think is a better layout. Those are the major changes.
Before we get into any questions you might have, I thought I would like to have our people who are here come forward and speak a few minutes about their experience in helping to develop these new standards, particularly at the high-school level. Would you like to introduce them, Commissioner?

COMMISSIONER DRISCOLL: We have with us Howard Dimmick who is the science coordinator from the Stoneham Public Schools, Peter Nassiff who is the science coordinator and a teacher from the Burlington Public Schools, and Rosanne Franco who is she here from Greater New Bedford Regional Vocational Technical High School.

DR. STOTSKY: Why don't we begin with Peter.

MR. NASSIFF: Actually, I'm not a science coordinator. I'm the head of the high school science department at Burlington High School.

COMMISSIONER DRISCOLL: Well, you should be the coordinator.

MR. NASSIFF: I've been involved in the process from the beginning. We first met together back in December. At that time, we looked over the standards and decided that if we were going to do one for chemistry we wanted it to be very well done, and we looked at all of the different types of science standards that other states had concerning chemistry, and then we met together with a group of teachers, and we met several times. We came up with what we would consider standards for a college preparatory course in chemistry, and from those standards -- we realized of course that all of those would be testable by all of the students in the state, but from those standards we then made up a document which was sent out to all of the teachers in the state for public comment.

Now, I'm president of the New England Association of Chemistry Teachers. We have about 700 members from high school and college teaching. The majority of them are from Massachusetts, and we have had a big portion in that group to comment on the standards and things like that. For example, during our summer conference, which is held in Rhode Island, we had a seminar in which about 30 teachers got together and discussed what the standards were, what they were like and so forth, and from that we also wanted them to make public comment, and we had a lot of public comment back from those teachers as well as others throughout the state. From the public comment and from the comments from experts in the state, we then decided upon which of the standards we considered core, that is, essential standards for high school students to

know in order to have the knowledge in science and chemistry, and those were the ones which were starred in the document. There have been lots of teachers involved, lots of comment involved, but it's been, you know, very much give and take, no one person pushing one direction or the other but very much a collaboration of all of the teachers in the community and throughout the state.

DR. STOTSKY: Could I just make a comment here? We changed the format we were using. And so if you look at the chemistry standards, those that are in bold are the core standards for full-year courses, and the asterisks now indicate those that are going to be for integrated courses. I want to make sure we're all on the same page. Roseanne?

MS. FRANCO: Thank you. I was a member of the biology team. I'm also on the MCAS biology team as well. A lot of the input that I had from the frameworks I brought to the MCAS group, and it seemed very important to them that teachers were involved in writing the frameworks. As we were doing the MCAS questions, when I explained the standards that we had written and the choices we had made, it made more sense in terms of writing the questions, and the teachers themselves felt they could better accept the frameworks for what they were based on our explanations. The frameworks that you have before you represent the major topics of biology that we felt must be covered. You'll find that many of them are starred. We felt that the majority of the curriculum we had written was core. There are some comprehensive standards there, but if you look at them they get into much greater detail than those that are starred for the core.

Some of our concerns as we were part of this group were some of the things that are happening in genetic technology, DNA technology and that. We tried to include that. Without going into too much depth, it's something that is more regional, and we were really concerned that if we got into too much depth at this level it would be too soon, and that's something that they can have at a higher level, maybe in AP biology in their senior year or junior year. We had at least 20 teachers and one or two college professors when we started out. As time went on the group got a little smaller, but it became much more meaningful because we all had quite a bit to say, and our voices were heard throughout the process.

I helped write these words and not much has been changed from our original thoughts. The public comment was very helpful in that for the most part it basically restated what we had said. Some of the concerns that we had put into this document were restated through the public comment period. After public comment in October, we did not make any major, major changes as a result of that. We basically fine-tuned the document, added a few smaller parts, and broke it down so it wasn't such a huge portion. My being from a vocational school was a very important part of my being on the committee. I was very concerned that my students would not have time in their 90 days of class to cover all the biology. I obviously was on the committee, so I had a say

there. I wanted to make sure that my vocational students could pass this test, that was my personal mission, to give it a word, my objective. And in bringing it back to the school, my school has asked me to become the curriculum coordinator for the biology section of our science department, and I will take it back and use it wisely. Thank you.

COMMISSIONER DRISCOLL: May I ask a quick question on that point? Would you say that, currently, many of the students in your school would take biology in their sophomore year?

MS. FRANCO: Future students take it their freshman year, and it really was based on the information that I brought back to my school. It was based on many of the recommendations that I made.

COMMISSIONER DRISCOLL: So that would be generally most of the kids would take biology in Grade 9?

MS. FRANCO: All of the freshmen are required to take biology.

COMMISSIONER DRISCOLL: So what do they do thereafter?

MS. FRANCO: We're waiting to see what you do.

COMMISSIONER DRISCOLL: Okay. Is there other science taught?

MS. FRANCO: We have what we call physical science. It's really not a very strong science but . . . We'll probably lean towards the chemistry.

COMMISSIONER DRISCOLL: Well, we're hopeful we're going to do what you asked us to do.

MS. FRANCO: Thank you.

MR. DIMMICK: I'm Howard Dimmick. I'm the program supervisor of science in Stoneham, and I teach two earth science classes there too. I'm a past president of National Earth Science Teachers Association. I was asked to become involved in this program back in March. I know we spent many long hours in Worcester and in Westford and several other places with a group that started with 20 people or so, the same as the biology people, and gradually we worked it down to probably about six or eight people did the final polishing up of this back last month. We started by canvassing as many of the other states as we could for the earth science program.

The general feeling that we had is that earth science is an area that has major economic impacts on people's lives in terms of major decisions they make, where do you buy a house, how do you locate your home in places like this, what happens in terms of flood damage and people living along the coast, so we tried to bring some of those in. We spent a good amount of time writing this, and the document was finished in June. We had not reached a point where we were able to make core standards. We had spent so much time working on it and polishing it and matching the national frameworks and some others, so ours went out without any core standards.

We put a major emphasis, in September, on looking over a lot of the comments that came from teachers and other people in the public comment period on what they felt were important comments, important core standards. We used some of that, and we made some changes here.

I've worked for the past three summers with the U.S. Geological Survey in Menlo Park. We're working on a teachers' guide on plate tectonics. And in June, when we finished this, I asked Susan for permission to take this out and have some of the geologists look at it there. We had five geologists who commented and sent back things which helped us also in terms of the strength of the program and making changes. We feel we have a program that can be worked with very well and will be very meaningful to students in that earth science would not be the little brother, so to speak, as far as science courses go. We feel that there's a lot in there that can be taught and can blend very well with the other sciences.

CHAIRMAN PEYSER: If I may, I'd like to raise an issue that touches on the work you did. This process of sifting through the standards to identify the core is interesting in that it's been my observation that there are advocates for every standard, and getting some agreement on what's core and what's peripheral is awfully hard to do. How difficult has it been to build consensus on any process-oriented or content-oriented guides?

DR. STOTSKY: Perhaps I could give some overview, and then Sue might be able to give more details because she was handling the responses. We had a large number of people respond, as you can see from page 1 of the summary of public comments which gives you the details of how many in each field at what grade level responded. We had about 700 science people responding overall, and then you see the breakdown for the high school level here. The standards went out, and they were all asked to indicate those that they felt should be core. They were asked to circle those and were basically voting on which ones they thought would be core.

It seemed, from the results, that 23-25 standards in each area were subscribed to as core by about two-thirds of all the teachers. Statistically this would be a very high agreement--that is, two-thirds of the teachers hitting upon a core of 23 or so out of 35

across all of the science disciplines. I think we were able to tap into what teachers across the Commonwealth feel are the core standards of their courses. Do you have something more you'd like to add because you were --

COMMISSIONER DRISCOLL: So we don't have to have a recount?

DR. STOTSKY: Hopefully not.

CHAIRMAN PEYSER: But the methodology was the survey of teachers to identify core, as opposed to having a smaller number of people sit around a table and sort of argue for what's core and what isn't?

DR. STOTSKY: Right. We felt the teachers that teach the subject probably know best what is the core for that subject. Now, there will be review by higher education experts in each of the science areas to make sure that there are no inaccurate standards and by others to see if we have a good balance, but we ended up with approximately the same number across. It met with what the teachers who teach at those levels feel is core, so we just felt it was a good match.

COMMISSIONER DRISCOLL: Sue may be the one to comment on this. In addition to the high-school standards, could you describe the involvement at the other levels, the elementary and middle school level, of teachers and how that coincides or builds towards the senior high school, sort of that articulation?

MS. COTE: The teacher working groups had about 65 teachers in all. We met in April for several days, and then again this past October for several days. We had a preK to 2 group, a 3 to 5, and a 6 to 8 group in April writing the standards. When we got back together after the public comment period, we decided to put those groups together. We actually worked with a preK to 8 group because we found through public comment that there was some problems with the articulation. We wanted to spiral topics through grade 8 to give them the basis that they needed for high school, and we found that there were some gaps, so in April we actually met as a preK to 8 group.
We split part of that time, but we met together for a good part of the time, and really focused on that articulation, in trying to make sure those topics were introduced at one point, reinforced again, and then expected to be mastered at another.

I think you see that we have found a real good spiraling of topics. Things are reinforced and mastered as we work our way through. Right after our working group I e-mailed all of the high school groups the preK to 8 standards to look at and asked them to look at the standards to see if they found anything missing. I heard some comment from them, some adjustment was made, but for the most part our high school teachers felt

that the preK to 8 was very solid and there was a very good articulation and spiraling of the topics.

CHAIRMAN PEYSER: With respect to this core sheet, can you give some insight as to how the choices were made in some other areas? Under biology, for instance, none of the human anatomy / physiology standards in the 9 or 10 full-year course are considered to be core. I was curious why that is.

MS. FRANCO: That was a major discussion that started at our first meeting. It was our biggest discussion, and we all left unsatisfied with the fact that it wasn't even here. It wasn't here to begin with. We added it in at the second meeting because it was very important that it be there. There was a concern that students weren't learning this information, and understanding their own body was something that they weren't leaving high school with. This goes back to your original question of how some of these have been chosen as core at the expense of others. This is a perfect example of that. You can't get to that level of understanding anatomy and physiology until you have covered numbers 1, 2, and 4. You must cover 1, 2 and 4 in order to have the understanding required to get into number 3, which is anatomy and physiology.

It was included more because of public comment than anything else, public comment not just from our group but the entire state. As teachers in a group and a couple of professors that we had there, there was a concern that it was not included to begin with, and then with the public comment the concern was greater, so it was included as a result of the public comment. It was not placed as core only because if you look at a typical textbook this covers at least half of the textbook, so you're talking about a Biology 2. If you decided this had to become core, we believe as a group that there would have to be a second year of biology. It's just too in-depth at the freshman level understanding concepts or chemistry of life, structure and function of cells and genetics. Those alone take at least a half to two-thirds of the year. If you look further at 5 and 6, evolution, biodiversity and ecology, this goes back to what Susan said about spiraling, spiraling up from the 8th grade. So the level of understanding at this point is a deeper understanding of evolution, biodiversity and ecology. It's still a concern, and it was a major -- if you counted the number of public comments based by the people, anatomy and physiology was definitely one of the bigger ones.

COMMISSIONER DRISCOLL: I just want to interrupt for one second. The mayor of the city is with us, and she's going to greet us tomorrow, Superintendent Fallon as well. They're going to give us the formal greeting tomorrow, but I did want to note that the mayor is on duty giving tours. It's part of her job apparently. So welcome Madam Mayor and Superintendent Fallon. Sorry to interrupt.

CHAIRMAN PEYSER: Another question on this specific point, was there some expectation that some of this might be covered, for instance, in the health curriculum?

MS. FRANCO: It's also a major concern. As far as biology teachers, my work, my research, my publication, all of this information that we brought into it, and I'm just one of the group -- all the information we brought into it, our understanding of human anatomy and physiology and the way we would teach it and the way a health teacher might teach it. I mean, you're talking about gym class and biology. You know, that was the concern that we had.

CHAIRMAN PEYSER: We won't tell the health teachers.

MS. FRANCO: No, and I don't mean it as a slight at all. I'm just saying as a group, that was the major concern that we came away with. We were concerned that if it wasn't here, it would be left to health.

CHAIRMAN PEYSER: So what message should teachers in the field take away from this in terms of the importance of human anatomy and physiology or the way in which it should be taught or the sequence in which it should be taught or the grade level in which it should be taught?

MS. FRANCO: You mean in terms of what you have in front of you right now?

CHAIRMAN PEYSER: Right.

MS. FRANCO: I actually spoke to Susan about the sequence. It's something that we need to talk further about the sequence that is written here. This is not how we had proposed it. This is slightly different. It's not a major problem. It's just a difference. The sequence that you have you really need to get through 1, 2 and 4 before you get to 3, that's just the biology of it. If you are teaching biology, I can tell you for a fact -- well, I just did -- it takes half to two-thirds of the school year to get through 1, 2 and 4.

CHAIRMAN PEYSER: What would the recommendation be, and I'm using the term recommendation a little loosely here, for someone trying to faithfully interpret this and apply it in the field? Should they be offering two years of biology in high school or offering accelerated biology courses for some of the students?

MS. FRANCO: Well, human anatomy and physiology is very often covered in a senior level human anatomy and physiology course. As far as an academic school, this is something that's very often offered in the senior year. So it will be offered in the curriculum, but it will not be covered by MCAS. There's something else I would like to say. When I explained this to my fellow teachers, our interpretation was that when you get through all of this material that's core, please try to cover what's comprehensive.

But again, I work for a vocational school. I'm only on number 2, and it's going to be December.

MR. NASSIFF: At Burlington High School we have a one-year biology course and anatomy and physiology the second year as an elective, and we also have AP biology which is an elective, but we recommend anatomy and physiology before students take AP biology. The standards that we have listed, the core concepts we expect students to know and be tested on, but the other concepts listed are ones that a teacher who is teaching an honors course, an accelerated course should cover. For example, we felt that knowing what atomic numbers were about and quantum numbers and things like that would be stuff that would be covered in an honors chemistry class but not necessarily important to somebody just taking a basic chemistry course. So those standards are listed as core and comprehensive, and it's up to the teacher -- the teacher must cover the core concepts but also include the other concepts which would be included in an accelerated course if an accelerated course were given.

CHAIRMAN PEYSER: Maybe it's just through language in the framework itself urging schools and districts to behave in a certain way, but are there other sorts of things we ought to do with respect to the assessment or the framework or some other component of this process? What can we do to ensure that by specifying core as a subset of the entire framework that we aren't driving schools to do the minimum necessary to satisfy the requirements or to satisfy the Board of Education in the state?

DR. STOTSKY: That was the major concern that led to spelling out what we call a full first year course in these subjects. We wanted to make sure that we just didn't have core standards for each of the science areas with nothing else in sight so that a school committee might just see only those core standards as consistent of courses for any kind of student at any level. And so spelling out what we think is a full first year course does make it clear that for many students we would expect far more than just what is in bold for a course. And as Peter just explained, an honors course or other courses you would expect to be covering perhaps everything that's there. Sue, why don't you add a little more to that.

MS. COTE: When Dr. Stotsky first wanted to structure the framework this way, I was a little skeptical for a couple of reasons. But looking at all of the other states and their standards, most states identify a set of core standards and that's all, and that to me is telling teachers that this is all we expect you to do. After really thinking about it and talking to Dr. Stotsky and the working groups, we really have shown through our framework what a good rigorous solid first year course should look like. I think we've gone above and beyond most other states in the country by doing this, by saying this is not all we expect. We expect that all students should know and be able to do this, which I think is going to help.

Coming from the district where I was the science coordinator, we had students that were lower level students in a science classroom, but they didn't get a quarter of what we see in our core right now. I think our core is really rigorous, to be honest with you, but I think we've gone one step further. By showing not only the core, but by expecting teachers and students to go above and beyond the core whenever possible, we are giving them guidance on what a really solid rigorous college prep course might look like.

DR. STOTSKY: Let me add one more comment too. The idea would be that as you increase academic expectations and have a well-developed K through 8 science curriculum, you should be able to get more accomplished at the high school level. So the number of standards that are considered core should increase over time. This is what we hope to do in math. We hope to do the same thing in science. We would be showing what more we could go to, they're here, they're spelled out. Then we know where we can go in the future as we want to up the ante.

MS. FRANCO: I wanted to add something to that comment as well. If you look through the biology, we were concerned that -- we had this very concern, that people would only cover core and that was it. We tried to keep the comprehensive in as part of the core, where if you're explaining and teaching students the chemistry of life for the first set of standards you really can't get past organic molecules without discussing dehydration synthesis and hydrolysis. It's part of the understanding of those molecules. It's not listed as core because it won't be tested. These are advanced chemical reactions. Without an understanding of chemistry, you really can't take this to the depth that you would test on the MCAS test. However, the teacher will cover them simply because in order to understand organic molecules you have to. So we were very careful to make comprehensive that were core -- the standards that were core but left as comprehensive, we tried to keep them so that they were continuous, so it's something that you couldn't go past without touching on it. So even though you see it as comprehensive, as a biology teacher I see it as core. I just know that my students aren't going to be tested on dehydration synthesis.

DR. SCHAEFER: K through 8 as preparation for high school? A couple of people I've been in touch with have suggested that that is not happening in this document at the lower grades and that there are some important topics that have been omitted which then make it difficult to teach a 6th grade. I'm not an expert at this, but I'm just suggesting that you look at that again. I can give you the list. I mean, for example, they're saying that in K through 2 that what's left out is the word gas, describing properties of air.

MS. COTE: That has been included in this new document.

DR. SCHAEFER: Well, they looked at this recent draft. These are comments on the recent draft.

MS. COTE: It's in the earth science section preK to 2.

DR. SCHAEFER: Okay. Well, I'll provide this.

MS. COTE: I feel like I've memorized every one at this point. We had some very good consultants preK to 8. We had DGA, which was one of the companies that did some work for us on the original document, the last August document, and we used about almost 70 percent of the comments that they had originally. Then we brought their comments back to the April working group and had them reused, and hopefully -- we will look at them again. They had some absolutely wonderful comments, and they were very helpful for us.

DR. SCHAEFER: Okay, good. I will share this with you.

MS. KELMAN: I have a technical question. Why do you have biology, physics, and earth science all being grades 9 and 10?

DR. STOTSKY: As opposed to chemistry?

MS. KELMAN: I'm asking partially because I'm a 12th grader taking physics.

DR. STOTSKY: Because there are differences for physics in particular. Biology -- we were trying to give the committee a sense of for what grade level or levels were you developing a full-year set of standards. Biology is quite often taught as a first full-year course in either 9 and 10, earth science as well, and for chemistry usually the first full-year course in chemistry is 10 or 11, from what we can gather from most schools in Massachusetts. With physics, there is a different wrinkle to it.

If it's begun in grades 9 and 10 as an introductory physics course, there is less math background that students bring to it, so it's more of a theoretical physics course, and it's certainly a lower level kind of physics course, but it's all right for introducing what needs to be done. You have a different model of where you develop your science curriculum, so it goes from physics to chemistry to the same elective biology. But if you begin -- if you have no physics as an introductory 9th grade course, then the physics that's introduced in 11 or 12 is going to be a higher level full-year physics course -- you can tell me if I'm right in what I'm saying about this -- because there's more math background that can be brought to bear by grades 11 and 12. So you have developing standards for one of those -- first of all one of those two physics courses. In a sense this is for MCAS and at this point it's grades 9 and 10, we had to gear everybody

to 9 and 10. However, as you noticed, we are hoping that the Board of Education, and I'm glad you raised this, will inquire and follow up on the question of our being able to have assessments in science that cover 9, 10 and 11, so that we can then cover three years of whatever the sciences are that students are taking as opposed to just 9 and 10.

MS. KELMAN: Has anyone looked at doing end-of-course assessment rather than kind of the comprehensive integrated science?

DR. STOTSKY: These will be end-of-course or discipline-based assessments, but we are also planning to have an integrated assessment as well for those schools that have an integrated sequence for 9 and 10. Could Jeff join us?
COMMISSIONER DRISCOLL: Well, again, we wanted to hear the science first, then The technology engineering and then the assessment.

DR. STOTSKY: Fine. So we do plan to have all of them offered as options at the high-school level. But the ones that we're talking about for the single discipline science course are all being planned as end-of-course, and what you see as the star or the asterisk indicates core standards for the integrated courses, and it means that for the tests that will be for a 9-10, two-year sequence, that's where those standards will come from.

MR. NASSIFF: We do offer a 9th grade physics course, and the national standards indicate what students' comprehension or knowledge should be all along the way. The reason we teach a 9th grade physics course is because we think physics is a very important science that should be introduced early to a student, and often times in the old sequence that we had some students never even had a course in physics, so that's why we included it. And as you said, it's more conceptual in nature, more conceptual physics.

And also, in terms of mathematics, in the mathematics test that was just given, in our 9th grade science courses we've introduced a lot of the mathematics, we've talked about a lot of the mathematics that were on the MCAS math exam, functions and things like that, so there's a close tie-in with the science and math standards also.

CHAIRMAN PEYSER: Sandy, I wonder if you could just briefly discuss what happened in the skills of inquiry from the prior draft and how they were handled in this one.

DR. STOTSKY: Sure. The skills of inquiry were set forth in the August 1999 draft as a separate strand. However, the description of them, which you have in this document, was the same description with the caveat in the description that they should not be taught or tested separately because they are intellectual process skills. They are not

substantive bodies of knowledge. And what we did was first of all to move it forward in this document so that it comes right after the introduction, as you will see, Knowledge and Inquiry in Science and Technology/Engineering, page 3. Skills of Inquiry, in science this is of course basic. But as in the mathematics standards document, the skills of inquiry -- the skills, the inquiry skills, the intellectual processes that were used, are not in a separate strand. They're not content.

And it didn't seem appropriate, and there are many scientists who actually do not believe that you should have a separate strand as a substantive strand for skills. What we did to make it clear was to say that they should be a part of what is taught with content, which is what these pages of description do make clear. When you have the four-column format for K-5, which is where you begin to make sure that young children understand that science involves a lot of inquiry, you have the inquiry-based learning experiences. This gives the teachers in K-5 something concrete to work with. Then there are the extensions to technology/engineering so that they can more easily see, as elementary teachers, how to do all of it at once because there are no specialists.

But to get back to your original point, we didn't want to isolate it as a strand implying that it was substantive in nature, because it isn't. It is built into everything that happens in any science course at any grade level. It should be. It should never be omitted, but it's not content. It's an intellectual process.

CHAIRMAN PEYSER: Does that have any implications for the way we have been, or will be in the future, assessing science? You know, there are certain MCAS questions, for instance, that we will no longer ask because of this change.

DR. STOTSKY: Would you like me to answer that or would you rather have Jeff answer that?

CHAIRMAN PEYSER: If you could, either way.

COMMISSIONER DRISCOLL: Jeff, do you want to comment? Do you see a change in assessment as a result of not having --

MR. NELLHAUS: I think there will be some changes, but I think there are some of the inquiry skills that we can continue to assess within various content strands. There are some things that are unique that we may want to continue testing even though they're not in a particular strand. I'll give you a very concrete example: being able to read a graduated cylinder and understanding that you read to the bottom of the meniscus in order to read the bottom of the liquid in the cylinder. We may continue to have some questions like that, which really could be common to whether it's earth science or physics or chemistry, you need to be able to show that type of skill. So there

are a few inquiry skills that we'll continue to assess. But there will be others where some of the inquiry questions that could be taught could be just as well assessed on the math assessment.

CHAIRMAN PEYSER: Is it your view that the current structure will give teachers enough guidance as to what might be asked on the assessment with respect to the skills of inquiry so that they can prepare their students?

MR. NELLHAUS: The framework will taken together with the fact that we'll continue to release test questions that will somehow include inquiry within the questions. I think it will be clear to the field that these things are still important and will be part of the assessment, although within a content area.

COMMISSIONER DRISCOLL: Why don't we move, Yvonne, to technology and engineering. Thank you very much, Sue. Sandy, did you want to give a brief overview?

DR. STOTSKY: Yes, let me give a brief overview of this strand in the document. This is one of the four strands. For engineering and technology, we had to work out a little bit of a different process in order to make sure that this would work out equitably at the high school level. What we did was to make sure that we had a good set of courses of syllabi to work with from existing schools that teach at the high school level a course in technology / engineering so that we would know what it was we were to base an end-of-course assessment on.

The standards that we've had in the past were really not as good of standards as we hoped. Many of them were more like group activities. We wanted to make sure that we could have a set of academic standards for technology / engineering that would be comparable to the other science standards so that we could then say we have end-of-course assessments that should be equal for any student who chooses any one of them. So we got people together -- Yvonne was very helpful in getting syllabi -- and with the committee and with the consultant's help, we have developed what we feel are a good set of standards for the technology / engineering.

K-5 for technology / engineering is still part of the elementary school teachers bailiwick, and we do have separate standards for them. We have a smaller number because three-fourths or more of the course time that they devote will be to science, but there will be the beginnings of technology / engineering. Grades 6 through 8 present a different set of issues because 6 to 8 has to be a separate course taught by someone who has been trained as a technology educator, technology / engineering educator or technology educator, or technology education educator. We had to work out the name of this person clearly ourselves. So 6 to 8 is a separate set of standards that will not be taught

by the teacher who teaches science in theory, although it might happen. It could be the same person, and it's a set of standards that could be taught in 6, 7 and 8 or in 7 and 8 or all at once in 8.

In other words, schools do it in various different ways. By grade 8 they are accountable for whatever they have worked out as their appropriate sequence or if it's all in one year. Then the technology / engineering course at the high school will be one of the options, and that has been the major difference. It's not required; it's simply an option, as are any of the other science courses. That seemed to be the best way to handle that. Perhaps we could have comments now from John Burns who is the coordinator of technology education in the Agawam Public Schools.

MR. BURNS: Thank you. Good afternoon. My name is John Burns, and I live at 107 Thalia Drive, Feeding Hills, Massachusetts, and I think that's important because I want you to know I do come from this state. We say this in all the meetings that we go to. I probably was invited here because I am the technology coordinator. We do have a technology education program in 6 through 8 which is where every student, both male and female, whether they are special needs or bilingual or any of the other things, every student gets it. At the high school we have an elective program that goes from grades 9 through 12. We do have one course that was already in existence, and our school system is one of the ones that submitted a curriculum for a course in existence which was close to what was finally arrived at. There will be changes in it.

Another reason I was asked to speak is that I was on the Board of Education's Advisory Committee for Technology Education and in the DOE working groups for writing the standards, so that I've been with this process for quite a while. Some of it was done at the behest of the advisory committee which said that there are certain things that we would like to see, and we would like to see things that do have basis in engineering, because this is something that's important. I regret to say that I teach one of the few courses that everybody is proud to say I don't understand. Oh, that's too tough for me. No, I hire somebody to do that stuff. But there has to be somebody out there that learns these things. I'm going to just go through a couple of things, and I hate to make this sound like I'm egotistical, but these are reasons why I feel that what I say does have meaning.

I'm a member of the Society of Manufacturing Engineers. I belong to the American Optical Society. I belong to the Society for the History of Technology. I do this because these are the things that you need to understand what's going on in the world. I also have -- you know, I throw in that with you. Also look at the fact that I've got a retiring card from the Bakers and Confectioners Union because I was baker, and this makes a difference because you understand how to work. Also, you understand what the tools and machines of work are. I belong to ASCD, so that I am competent in writing curriculum. I do feel that this is an important thing. I belong to the Connecticut

Robotics Society and Future Cities, and we can names these things all afternoon, but it doesn't help unless you have something that is able to be content driven. And the reason that I feel, when I speak about content, that I have an idea of what I'm talking about, is that I participated in several National Science Foundation projects. Most of them have been in the line of lasers and optics because I really feel that for the next century photonics is going to be the thing that drives us as far as an energy source and the thing for us to use.

You have a written list of the National Science Foundation projects that I've been in, but all of them have been mostly in the lines of some kind of energy and/or communications. I've also participated in -- and this is the one I'm most proud of because it's in my field only: I've participated in the Technology for All Americans Project right from the initial when they put out the first set of standards, and they call them national standards, but they're more content standards. They talk about what we think people should be able to know and do, and the part that made me proudest about this is that these people were the National Science Foundation, they were NASA, they were the Academy of Engineers. These are the people that I identify with most.

Before you today you've got a framework that says that we're going to take a chance that we will replace what the government did last month. And when I say a chance, it's because it's not mandated. I wish it were mandated, but it's a chance because we're hoping that every school system will do it. But last month they increased the number of H1V Visas so that we could have a high tech work force. We have the chance to do that ourselves. We've got students in our schools that if they're taught the right kinds of things they have this ability. For the most part we've let these kinds of courses go by the wayside because we've always said, well, they're too expensive and we don't have people that can teach them. I know that there's seven teachers in Agawam that teach these things every day, and Agawam isn't different.

I really would urge the Board to accept this framework the way it's written with the obvious corrections for the little things. There's a whole litany of reasons, and I wrote them out for you, and I'll go through every one of them if you want, but I think the biggest thing is that we've got to supply this country with a set of workers and users that understand the technology they have. The people that we're putting out there are the ones that are ruining the earth that the earth science people are trying to put together. We have ways to fix these problems. And I have to say that adding the word engineering to this standard has given us the one thing that we really need. We've got a thought process which is called the engineering design process, which is more than just a process because it can be evaluated. It's concrete in every single step of it. Even though every school of engineering has their own, that they're almost all exactly the same. And the other thing that we have in this framework that is really being pushed is systems thinking. One of the hardest things to do is to look at a system and say what's it suppose to do, what do I put into it, and what am I suppose to get out of it. And I

will say this, I've made more money on people that didn't know what went in or what they were suppose to get out, and I've never winced once when I took their cash. Thank you.

CHAIRMAN PEYSER: I've got a question concerning the full first year course in grade 9 and 10. One thing that seems to be missing, unless I myself am missing it, is any reference really to electronics. There's an electrical systems section. There's nothing like computer technology or software engineering, that general area. Could you comment as to why that's the case or point me in the direction where I might find either of those subjects?

MR. BURNS: That would mean there would have to be a full course, and that does not serve a large population. It serves a minor population. I personally spent all of last Monday afternoon trying to get the SYSCO Academy being taught in the Town of Agawam. I mean, we're out there, and we're looking and we're planning on it. But if you say that you want to have a full-year course that is to be tested and it's only for a select number of students, then I really don't feel that this is an economical thing for the state to do. What you have to do is provide them with the greatest number of core concepts. And if you look at the grade 9 and 10 course, it was sort of based on construction because construction workers are still -- and when I say construction workers, I'm not talking about just where's the hammer. We're talking about a whole range of construction workers that have specific skills, and at least this course would address many of the skills that would go to all different trades. Or, if you wish to go further, these are the same basic skills that you might find in a science course if you didn't take that particular science course but would give you the capability of succeeding in an Associates Degree, a Bachelor's Degree in an engineering type of situation. And what happens is that -- say electronics, you turn a lot of people off. But when you talk about the use of things, it's a little bit different. I don't know if that's clearer, but . . .

CHAIRMAN PEYSER: It raises several questions: whether there ought to be another alternative which is more oriented towards information technologies distinct from this; it raises your question as to whether, in fact, there's a sufficient demand to make that worthwhile investing in; and whether this is something that may be a grade 11 and 12 area, regardless of whether there's a lot of demand or a little.

One of my thoughts is that through computer technology there are a lot of young people who are interested in engineering and interested in it at an earlier age than would have historically been the case and in a much more diverse population than has historically been the case. It would be nice to give some encouragement to those young people and faculty members who would like to start introducing information technology courses into the regular high school, and maybe even earlier, curriculum.

I'm not advocating this as a requirement, as part of the assessment program, but I'm just wondering whether it would be worth our while to invest a little bit of time, not necessarily in time for December, but a little bit of time in developing a module or a set of standards around information technology that over time might become more and more useful.

MS. DRIVER: One of the challenges with technology education and engineering education is there are many divisions and branches. Especially when you look at a one-year course – which was probably one of the most difficult things for the teachers to decide. What is the core knowledge that every student should have? There is some basic electricity, electrical systems, fluid, mechanical systems, because you do build from that basic knowledge. And you hit it right on the head when you said this would be a course of continuation for schools to offer. A number of them do offer systems technology courses right now. We're starting to see a lot of collaboration with some of the software companies in order to bring in equipment, to have the teacher expertise and training, which a lot of companies are offering in the summer, as well as the equipment to do the work necessary. It is something that was discussed and looked at because they are addressed in the national standards under information technology and communication technology, but very briefly.

CHAIRMAN PEYSER: There is obviously the section on electrical systems, and it does get into the design of a circuit, all of which is foundational for understanding integrated circuits, understanding computer technology and software and the rest. However, in the context of a course which is more focused on construction, as an example, that may not be the pathway into which someone who's interested really in informational technology is likely to get exposed to. I'm not saying that this technology engineering course in 9 and 10 ought to include a computer science component, because I agree that it would be in many ways a non sequitur and certainly would require a whole other year of study at least. I am, however, raising the question as to whether we ought to be thinking about designing something similar to this course that is focused specifically on computer sciences. Again, not necessarily as part of a mandated or assessed program, at least in the near term, but it's clearly stating that this is an interesting and useful and productive pathway for students who are interested in technology engineering to
pursue some coursework.

DR. STOTSKY: This may be actually being addressed by the separate document that is coming out from the instructional technology unit. What we use to have in all of our standards documents was an appendix that had instructional technology standards, and that particular appendix doesn't appear in these documents. We're developing a separate document that will have the instructional technology standards all the way from elementary up through high school, and probably that high school set of standards is the kind of nucleus for the course you're talking about.

CHAIRMAN PEYSER: Well, no, I'm not talking about the use of computers in the curriculum. I'm talking about curriculum about the design and use of computers.

DR. STOTSKY: Right. I think the high school level gets into more of the detail of software construction.

MS. CRUTCHFIELD: I'm interested in whether or not Jim's question makes sense to you, because it's a question that I have as well, and I'm not quite hearing whether or not it makes sense.

MR. BURNS: I understand what you're saying, and in my prepared statement I had mentioned the fact that, yes, I am certified in that. I took my first course in the '60s. I learned Pascal to run the machines long ago because that was the thing I thought to have done, and I agree with you. The problem is that something as simple as the SYSCO Academy, which has its own test, it's a four-semester course, and it has five different pathways that it goes. You know, when you're given a charge to write a one-year course, you have to take one that will provide what would be the enduring knowledge. The stuff that's nice to know, and I agree that is nice to know, but we tried to with the core standards get the enduring knowledge, and the nice to know things are kind of there, but that's for a student to participate. I would love for you to say that, you know, it's required that everybody take these courses in 11th and 12th grade, because that would make my heart really light going home tonight, and it's a long ride.

COMMISSIONER DRISCOLL: I see two things. Once the framework is voted, the technology advisory committee will have some time on their hands. We understand your point about the fact that it's for a few kids, but it would be well worth looking at those standards and perhaps endorsing in Massachusetts the standards that would fit as the next level for grades 11 and 12. I think that's a natural extension. It's not the work of this framework right now. It's important to finally have technology as an integral part of the science frameworks such that the standards will be addressed by every school district with certified technology teachers. I think that is the most important part and we've done that. So I would say the next charge is to look at those standards beyond grade 10 and develop that course. No matter how many few kids there are, there may be that many more in the future. Relatively soon, we ought to get to the Board with a copy of the informational technology standards that we're talking about which will complement and certainly supplement what we currently have.

MR. NASSIFF: Can I make a comment on that? At Burlington we do have a course on informational technology, and we have about 30 students that are involved in that. They do stuff like looking at computer technology media, videos, and stuff like you're

talking about. I think there are a large number of students that are interested, rather than a small number, because that's what they're doing now, that's where the jobs are.

MS. KELMAN: I just wonder if we're antiquating ourselves by not putting computer technology into this framework. It seems strange, in this age when all the Mass Insight literature talks about how we need our students to be prepared for the next generation of technology, to not be including computers. I know it can't go in the 9-10 course, but shouldn't we, at least, start setting some sort of standard out?

MS. DRIVER: Well, there's several questions on the table.

COMMISSIONER DRISCOLL: Let me leave it this way, Jody: that's the document I'm talking about, and we need to share that with the Board. I think we should get that to the Board, Sandy.

DR. STOTSKY: It should be ready in another month or so I believe.
MS. CRUTCHFIELD: So there's another framework that's called what?

DR. STOTSKY: Instructional technology. It's a very small thin document.

CHAIRMAN PEYSER: That's not a framework.

DR. STOTSKY: It's a set of standards.

CHAIRMAN PEYSER: It's a set of standards showing teachers about how to use technology in the classroom, is that right?

DR. STOTSKY: No. It's standards for students.

CHAIRMAN PEYSER: For their use of technology. My question was not so much about the use of technology as it was about computer science and about the engineering behind the technology, which I think is -- a.) obviously of great importance economically and otherwise, and b.) an entry way into engineering for a lot of students, and many who otherwise would really have no means of getting exposed to engineering during the high-school years. And that is a loss. Obviously there are a lot of students who do this on their own, and have for many years, eventually becoming more exposed to it in college. On the other hand, there's no obvious reason why we shouldn't be introducing this into the curriculum at a much earlier age, because they're certainly capable of handling it.

MS. CRUTCHFIELD: That's a very important question in terms of addressing

issues that have to do with socioeconomic problems and in terms of opening up educational opportunities for kids across all classes of life. The question needs to be addressed.

MS. DRIVER: This document is a beginning. From this point, my vision sees endless possibilities in the area of informational technology and some of the things that John Burns has spoken about, things that he's done, bioengineering, photonics.

MS. CRUTCHFIELD: Well, you know, we don't have the infrastructure to support them. I get it.

MS. DRIVER: Right, and I see this as the infrastructure to build upon them. It is the foundation.

MS. CRUTCHFIELD: I get it.

DR. SCHAEFER: I'm confused about this course in grades 6 through 8, and what it's relationship is to science and whether any of this material is going to be on MCAS and, if not, why not. I mean, should some of this be included?

MS. DRIVER: The thought process is technology/engineering is its own discipline, and one of the best ways to handle the teaching of the concepts at preK to 5 was to connect them and integrate them with science which aided the elementary school teacher in connecting technology with something they're doing in science. In 6 to 8 the expectation is that a separate teacher, who is certified in technology education, would be teaching these concepts. The standards that you are looking at are in alignment with some of the national standards for technology education. It is in essence the real core foundation of a technology/engineering program, the very beginning, which can be built upon in the high-school course, this kind of one content course.

I don't want to give the illusion that this is the only course that is offered in most high schools. There are many courses offered in high schools. In my own district in Framingham we have computer technology and kids learn hardware and software and computer graphics. So this is just one course that would be a comprehensive foundation. 6 to 8 the standards and how most types of middle schools are structured, students have technology for half a year, quarter of a year, so the feeling was having a complete set of standards, but by the time a student reaches 8th grade they have completed and been able to address some of those content standards that will build upon knowledge that they will use in higher level technology courses, but also utilizing the content knowledge of science, because much of the technology is based on scientific principles.

DR. SCHAEFER: So it's a separate core course in middle school, but is it a course that everybody is taking?

DR. STOTSKY: Yes. Let me answer that because that was part of the information that we have something for, and we'll get more extensive information that Jeff Nellhaus' unit is collecting. The 6 to 8 course is not related to any great extent with what the sciences are that the kids are taking in 6, 7 and 8. They're really two different things. The 6, 7 and 8 technology / engineering is the basic course that feeds into the 9, 10 technology / engineering, but at the middle grades it isn't aligned in any substantive way with the science. There will be three years of science the kids are expected to take anyway. So it doesn't take any science time away from science. It's independent of science time. But by the time you get to high school and to the technology / engineering course, it does use physics and math.

COMMISSIONER DRISCOLL: Let's answer the question, yes.

DR. SCHAEFER: Is it a course that everybody is taking now in addition to science? In other words, you know, there used to be something called five subjects, major subjects, the kids are talking, are they now taking a sixth one in technology / engineering?

DR. STOTSKY: From what we can gather maybe 80 to 90 percent of the kids are taking it in middle grades because it is there. The one at the high-school level –

COMMISSIONER DRISCOLL: Roberta, the basic question is that all kids will be expected to have addressed these standards by grade 8. They will be taught by technology certified people. Whether they take them in a articulated course in 6, 7 and 8 or whether it's just 7 or 8 or whether it's just 8, they are expected to have these standards addressed in their middle school experience, and they will be held accountable for those in grade 8 as part of our assessment.

DR. STOTSKY: There is also a little bit of information on the Public Comment Form, the statistics that we have, but these are necessarily incomplete, but they do tell you, as far as those that replied to this document -- I was looking for the 6 to 8 standards -- is available. Number 18: "Coursework for addressing the grade 6 to 8 technology engineering standards is available to all students in my district." Here you have . . .

COMMISSIONER DRISCOLL: Okay, we'll find it. That's why we did it in November, because it's not before the Board until December.

MS. CRUTCHFIELD: This is helpful.

CHAIRMAN PEYSER: So are we going to do assessment now? Thank you very much. I appreciate it. You've been very helpful.

DR. STOTSKY: Here we can spend a little bit more time specifically on the assessment questions that Jeff has prepared the memo for, and I believe you all have the memo. Because we had to work out some of the issues you were thinking about, how many options at the high-school level and how to structure them because the integrated
sequence is different from the four singles plus the technology. So do you want to say a few words, Jeff?

MR. NELLHAUS: If you want, I can just explain very quickly some of the changes we're looking at in the assessment, especially at the high-school level. Basically, we'll be
expanding on the current MCAS program at the high school level in science and technology where we have an integrated test at grade 10 now, which covers physical science, life science, earth science and integrated science, so we'll be expanding on that by actually offering what you might call end-of-course tests or discipline-specific tests in earth science, biology, chemistry, introductory physics and engineering and technology. The integrated test will be restructured in that it will no longer cover the technology and engineering strand. It will just be exclusively covering the disciplines of science. So we're looking at expanding upon the program now.

The whole idea of this is to provide a little bit of flexibility to schools and to students in terms of the kinds of science curriculum they take at the high-school level. So if you were to be involved in an integrated sequence in grades 9 and 10, you would take one test at the end of grade 10 that was the integrated science test. If you took a sequence of discipline-specific courses starting in grade 9, you could take a test at the end of grade 9 and another test at the end of grade 10, and that would be tailored to the particular subject that you studied. So that's pretty much the design of the program.

What we're looking at is actually at the high-school level trying out questions for all of these new tests this spring, so there won't be any results at the grade 10 or grade 9 levels this spring for what we're doing. It's simply a tryout. Next year we can put together what will look like the operational test and administer it. But as school systems are aligning their curriculum with this new framework, we would just report item analysis results for the test in 2002, and by 2003 we can fully implement the program and report out scaled scores and performance levels and, you know, fully implement the program. So that's sort of it in a nutshell.

CHAIRMAN PEYSER: Is the expectation that students who are doing end-of-course assessments will take more than one during their high-school career?

MR. NELLHAUS: Well, I think what we're proposing here is that they would take two. Now, I think --

CHAIRMAN PEYSER: A minimum of two?

MR. NELLHAUS: A minimum of two.

CHAIRMAN PEYSER: Could they take more?

MR. NELLHAUS: I think that's a question. I think we would have flexibility in the program to allow students to take more than two. I think one question, which you don't necessarily have to address today is -- eventually when science and technology / engineering becomes part of the competency determination, I think a question that might arise is: how many science, how many discipline-specific courses will students have to pass to earn a competency determination in science, and that I think is a separate discussion. It could be one, two. It could be as many as we feel are appropriate at that time. But I think in terms of taking tests, right now the idea is students would take either one test at the end of grade 10 if they took the integrated sequence or they would take two tests, one in grade 9 and one in grade 10. There's some discussion about whether -- there are some students who take science courses in grade 9 now that we don't have an end-of-course test for. And I'll give you an example, physical science -- many schools systems have what's called a physical science course in grade 9 that covers both chemistry and physics. Now, we don't have an end-of-course assessment at this time for that particular course. Those students may go on to take biology in grade 10 and chemistry in grade 11, so one option that we could consider is those students who take a discipline-specific course in grade 9 for which we don't have an assessment would take discipline-specific tests in grades 10 and 11. That's something that could be an option as well.

CHAIRMAN PEYSER: Have you looked at other states who use end-of-course assessments to determine when they offer those assessments and how they might be used? I guess the question I'm really getting at here is, when I was in high school, I took New York state end-of-course assessments, and they were offered essentially as final exams for the course, and the results were used not only for whatever purposes the state may have had for them but also incorporated in my grade from my high school. Is that at all going to be possible with these assessments or would these be offered
at the same time that other MCAS tests are offered, which is a couple of months before the end of school?

MR. NELLHAUS: Well, we could offer these, you know, close to the end of the school year. I mean, even now the MCAS tests are administered in the latter part of May, so it's really just two weeks before the end of the school year even with the existing schedule. The question is whether you could use these tests as end-of-course tests and incorporate the student's performance on the test in the student's grade, for example, and that's where we run into a problem because we could never grade these tests in time. In New York with the Regent system, the tests were actually scored by the classroom teacher, and they were primarily multiple choice tests so that it could be done that way. I believe the Regent test might have had maybe one essay type of question on them. We're currently not designing the program to be scored by the classroom teacher, but it's an option. It's certainly something we could look at. It raises questions later on if you want to use this for the competency determination -- is that a viable way of running the program?

CHAIRMAN PEYSER: It might be, and I'm not even going to speculate about how it might be done, but it might be that there's some way to sort of do two things at the same time: to provide a student's work or answers in some real-time fashion to the teacher in the school so they could be graded locally and treated as a final exam for the course and at the same time send off the answer sheet to the state for sort of official MCAS grading. Obviously that can produce two different results and can be complicated, and I'm not even going to pretend that that's possible. However, I'm just throwing out the idea here that if these are end-of-course assessments that, a.)they probably ought to be as close to the end of the course as possible, and, b.) that it would be nice not to essentially force schools into a redundant testing exercise if in fact the end-of-course assessment is sufficient and acceptable at the local school level.

MR. NELLHAUS: Well, we certainly can explore some options around that idea. Involving science teachers in the state in that kind of an effort to actually use these as part of their courses would be, I think, welcomed by a lot of science teachers, at least the ones I have spoken to. The feasibility of it is something we need to look into.

CHAIRMAN PEYSER: On a somewhat related point, the Commissioner has spoken from time to time about having some local assessment component in science, in particular perhaps that is lab-related. Really the test itself may be designed by the state or the department, the rubrics for scoring may be all similarly designed centrally, but that the administration and scoring of the test might be done locally. Is that something that's sort of still on the table?

MR. NELLHAUS: Well, yes, and we're looking, not quite like that, but at the elementary level this year we're going to be piloting some what we call performance events, which are investigations that the teacher would conduct in the classroom

sometime just before the MCAS testing period, and then there would be questions on the test about the investigation, so that way we can, encourage the hands-on investigation in the classroom with science at the elementary level and then have it appear on the test somewhat later on. You're talking about something that's even more locally administered and locally scored, and I think that's another avenue we certainly can pursue.

CHAIRMAN PEYSER: But it is related to this notion of trying to make the test -- especially since they're end-of-course assessments, it goes to the more cumulative findings, assessments, that end-of-course tests to the extent possible be made useful and productive in the school as well as for state purposes. I know it's complicated but . . .

MR. NELLHAUS: No, I think we can look at that.

MS. CRUTCHFIELD: I rather like that approach.

CHAIRMAN PEYSER: One other possible small point, but is there -- how much of a disadvantage might a student be placed in, or school for that matter, if they offer a particular course in the 9th grade versus the 10th grade and are taking the same assessment as other schools which are offering that particular course in the 10th grade. So biology, one school offers it in the 9th grade, another offers it in the 10th grade, presumably those students are taking the same test even though one cohort is younger by a year than the other. Have you given any thought as to whether that introduces a certain amount of uncertainty or disadvantage or advantage into the process?

MR. NELLHAUS: I think it's why the chemistry standards were written with the idea that they would be -- students wouldn't be tested in chemistry until grade 10, and commonly it isn't taught until that grade. Whether students are a little bit more mature in grade 10 and possibly could do better on a biology test in grade 10 than grade 9, I think the possibility is there, but we'll hold the same standard whether they're in grade 9 or grade 10 when we administer the test. I think that students are getting to be that age, 14, 15 years old, where the differences aren't as great as they are when they're a lot younger.

CHAIRMAN PEYSER: This sort of leads into the last question I've got which has to do with how we would use end-of-course data as part of the overall accountability in the school evaluation system since it introduces a lot more variety and in different schools you have different mixes.

MR. NELLHAUS: Yes, it makes it a lot messier. It will make the school rating process a little bit more messy, but we're trying to develop an assessment program at the high school level here that really recognizes the variation and course sequences students are taking. I think our experience with having the one-size-fits-all tenth grade integrated test has not been as successful as we hoped it would be, and we need to be a little bit more responsive.

CHAIRMAN PEYSER: You know, I'm basically assuming that the equating process really doesn't hold across subjects.

MR. NELLHAUS: No.

CHAIRMAN PEYSER: And it's hard enough within subjects, but it doesn't really hold across subjects or across grades for that matter, so there's no sort of technical fix for this problem.

MR. NELLHAUS: We'll try as best as possible to have the standards be somewhat equal in the way we write the performance level definitions. And as we look at these standards -- the ones that we've identified as core, meaning the ones that will be assessed by MCAS -- we need to look across the science discipline to make sure that one discipline isn't, for example, really requiring a much higher conceptual level of understanding than another area. That's the best we can do in terms of equating the difficulty level of the tests, if you will.

CHAIRMAN PEYSER: So I guess my suggestion would be that you and Julianne and whoever might else be involved start thinking about how the rating system might be adjusted to take into account end-of-course assessments. It might be because we've only looked at English and math, for example, and that we just -- you know, we use the science and history to the extent that's in the course and other end-of-course assessments as supplementary data or something else. Even just in terms of how they're reported to the public raises all kinds of complications. As you know, the newspapers like to sort of aggregate things together and then print them in a list from top to bottom. And while that's misleading enough as it is today, it will be even more so once we start introducing a different mix of test-taking and courses across the schools.

DR. STOTSKY: It also should be kept in mind that there are students at different grade levels in a high school that take a science course. There are sophomores and juniors that could be taking what is called sophomore biology. There's often a lot of mixture in different high schools so that you don't get a pure grade level for a science course.

CHAIRMAN PEYSER: You're right, and that's a good point. I could end up taking biology or chemistry in my senior year. And by the way, this just raises other issues about the competency determination in terms of when you have to take these things in order to have enough time to . . . but anyway, my only point obviously was that there are a lot of ripple effects here by doing end-of-course, and I just want to make sure that we have them on the table and keep them in mind.

MR. NELLHAUS: There's one thing I want to add about the way we're at least looking at structuring the test. Up until now, most of our high school tests were administered in three 45-minute sessions. Our current thinking in terms of structuring these high school tests is that they'll be administered in two 60-minute sessions, trying to shorten the tests a little bit and make the administration of them logistically much more simple at the high school level. So we're trying to address a number of issues as we redesign this program.

MS. CRUTCHFIELD: If you're doing that, why are the tryouts 45 minutes? I don't mean to pick at things, but . . .

MR. NELLHAUS: We got a lot of flexibility. The tryout is just one session for a student as well. So rather than two 60-minute sessions, the tryout is only one 45-minute session, we can do the job.

MS. CRUTCHFIELD: Okay. I was just curious.

CHAIRMAN PEYSER: And all the sessions this spring are going to be 45 minutes, right, in all the other subjects?
MR. NELLHAUS: At the high school, level, yes. Actually, we're beginning this year to restructure the history test, if you remember, to be also two sessions long, two 60-minute sessions long, so that will be an introduction into that change even this spring.

COMMISSIONER DRISCOLL: Superintendent Fallon is going to provide a brief tour for those of us that would like to get a good look at this beautiful building, so that will occur in about three minutes.

CHAIRMAN PEYSER: Sandy, thank you very much. I know there's a lot of work, and there have been a few other things that you've been juggling at the same time, so thank you very much.

MS. COTE: I'd like to thank the teachers that came too, if I could. We've got a lot of the science and technology teachers here.

CHAIRMAN PEYSER: Thank you all very much. We're adjourned until tomorrow

morning.