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# High School Curriculum Study

Peter Ramsberger
*Human Resources Research Organization (HumRRO)*



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# Background

- Goals
  - Design a research study to:
    - Determine how ASVAB subtests align with content taught in high schools
    - Explore how ASVAB content is taught
    - Map ASVAB content to other relevant sources
  - Design should include:
    - Review of previous high school curriculum and high school assessment alignment studies with ASVAB content
    - Review of previous mappings between ASVAB and other tests
    - Review of any available National Assessment of Educational Progress transcript studies
    - Method for assessing if there are differences between course-taking patterns of military applicants and the general high school population

# Trends in Teaching Practices

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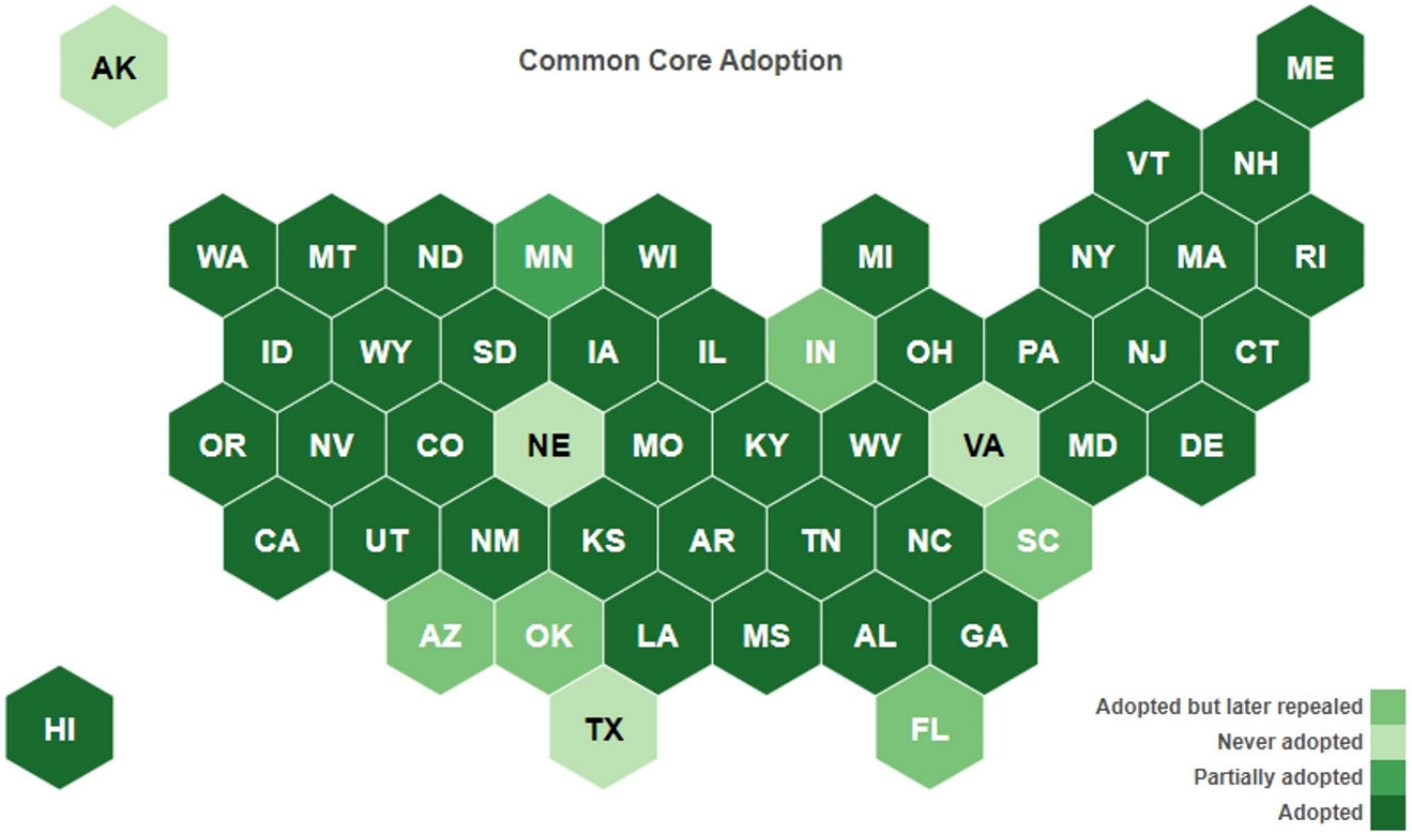
# Trends in Teaching Practices

- Most significant (relatively) recent development was the introduction of the Common Core State Standards (CCSS) in 2009 and the Next Generation Science Standards (NGSS) in 2011
- CCSS recommended (a) regular practice with complex texts and writing assignments involving the use of evidence and (b) practices that support gaining a conceptual understanding of mathematical principles
- Partnership for Assessment of Readiness for College and Careers (PARCC) and Smarter Balanced Assessment Consortium (SBAC) formed to develop assessments aligned with CCSS
- CCSS initially adopted by 46 states (MN ELA only) but have since been replaced by several states

# Trends in Teaching Practices

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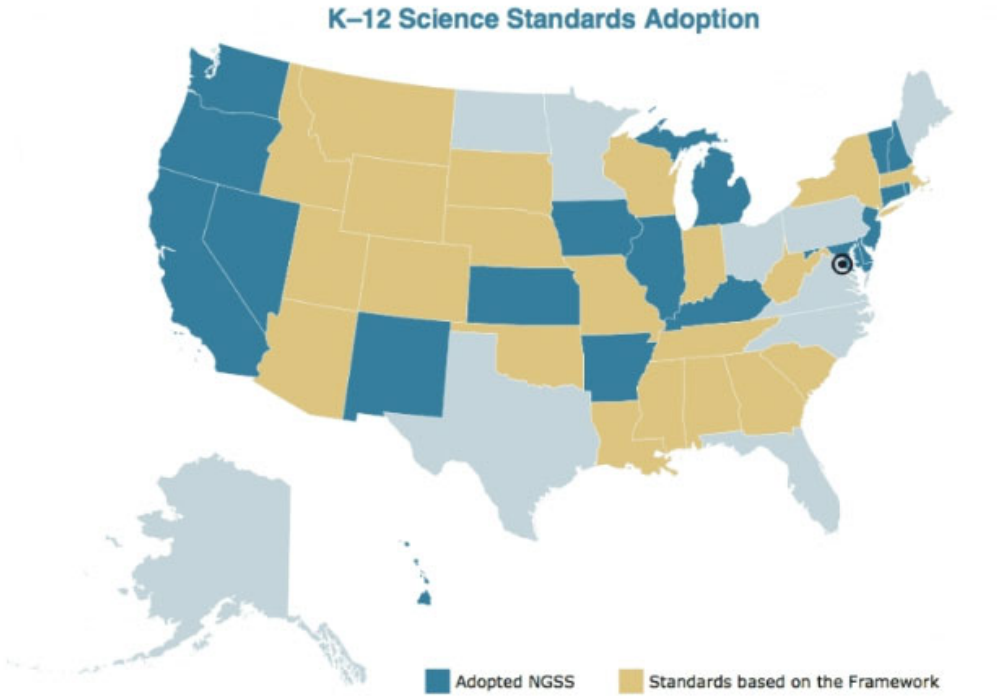
# Trends in Teaching Practices

NGSS recommends emphasis on in-depth development of core explanatory ideas, using ideas to generate and apply models to various phenomena, and treating science as a coherent progression over the course of K–12 education with knowledge built over time and across disciplines.

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# Trends in Teaching Practices

- Impact of the CCSS
  - Kane et al. (2016)
    - Teachers report employing methods recommended by CCSS
    - Found relationship between classroom observation feedback, professional development and student performance on PARCC and SBAC math test results
  - Loveless (2014, 2015) found small, positive relationship between adoption of CCSS and the National Assessment of Educational Progress (NAEP) math and reading scores
  - Song et al. (2019) found negative effects of CCSS adoption on 4$^{th}$ grade reading and 8$^{th}$ grade math scores with some positive effects for math subscales

# Trends in Teaching Practices

- Impact of the NGSS
  - Gao et al. (2018, 2022) surveyed science teachers and administrators in CA high school districts
    - Over three-quarters of districts implementing standards
    - More progress in implementing standards in elementary and middle schools
    - Issues reported included lack of instructional resources, lack of credentialed teachers, and lack of teacher training
    - Negative impact of COVID
  - Other studies relying on self-reported data indicate positive effects of NGSS adoption, including increased quality of science learning and student engagement

# Trends in Teaching Practices

- Integrated Instruction
  - Blending content within or across disciplines
  - Several states have adopted some form of integrated instruction in math or science
  - Difficulties reported include lack of teacher preparation and supporting materials
  - Meta-analysis of evaluation studies done on integrated STEM curricula found mixed results with positive results more likely in elementary schools (Becker et al., 2011)
    - At the post-secondary level integrated approaches are often not aligned with standardized tests, the need for collaboration among teachers can be problematic, and instructional materials are not geared toward this approach
  - Literature review of 36 articles on integrated science curricula found some benefit, but difficulties finding teachers with integrated science backgrounds (Winarno et al., 2020)

# Trends in Teaching Practices

- *Learning Progressions* is a research-based method for developing instruction
  - Identify ultimate objective of instructional unit/sequence and work back to identify all prerequisites
  - U.S. Department of Ed project identified seven reading/writing and six major math strands (Hess & Kearns, 2011a, 2011b)
- *Microlearning* involves breaking material into small chunks and including assessments to gauge incremental understanding
  - Recent review of publications found microlearning was driven by mobile technologies and largely being done in higher education (Leong et al., 2021)
- *Flipped instruction* moves the presentation of content to outside the classroom so class time can be devoted to more in-depth discussion
  - One study found students in the flipped instruction group scored lower on the final exam (He et al., 2019)

# Trends in Teaching Practices

- *Project-based instruction* assigns students real-world issues to work on individually or in groups
  - Investigate the issue based on instructional content and individual research to develop solutions
  - Finkelstein et al. (2010) provided professional development to high school economics teachers who then implemented the practice in their classrooms
    - Students in the treatment group outperformed those in traditional classes on a test of economic literacy and performance tasks
- *Use of technology in instruction*
  - Gray et al. (2021) found that 47% of schools reported employing self-contained instructional packages to a moderate or great extent
  - 84% of schools reported using technology for activities normally done in the classroom, and 54% indicated use for activities that would not be possible without technology

# Implications for the ASVAB

- Given the largely decentralized status of public education, attempting to adapt to various trends would be difficult
  - Some states adopted then relaced CCSS
  - New York moved to integrated math curricula, then returned to traditional format
- Larger implication may be in the way student knowledge is assessed
  - Recent comparison of ASVAB and SBAC math items found the latter required students to demonstrate skills in a more diverse and language-intense context (Buckland et al., 2021)
  - Review of SBAC  items found them to often involve fairly lengthy reading passages with multiple questions related to each
    - Identify an inference that can be drawn from the passage, then select the portion of the text that supports your answer
  - SBAC items also often involve open-ended questions that require students to think critically and cite evidence in their response

## Implications for the ASVAB

- More complex types of items could be added to the ASVAB, for example
  - Present a passage that offers a particular point of view on a topic; ask the examinee to shorten the passage by selecting the most relevant points and arranging them in a cohesive order
- Implementation would involve challenges
  - Need valid and reliable automated scoring options for open-ended items, given the volume of testing
  - Likely increase in item development costs
  - Significant programming efforts to implement
  - Could result in increased testing times

# Prior ASVAB Alignment Studies

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# Prior ASVAB Alignment Studies

- Oppler et al. (1997) focused on technical tests and GS
  - Examined 1990 High School Transcript Study (HSTS) data
  - Conducted an Exposure-to-Content survey of recruits
    - Both indicated high levels of exposure to GS content, less so for technical tests
    - Recruit sample was “technically better prepared” than the HSTS sample, likely due to a selection effect
  - Results from a survey of military SMEs indicated that ASVAB content is relevant to military training/jobs
- Waugh et al. (2015)
  - Examined content blueprints of ASVAB subtests in relation to educational and assessment programs that address similar subject areas (e.g., NAEP, SAT, ACT)
  - Developed revised subtest taxonomies
    - Found a good deal of overlap between ASVAB and sources reviewed
    - Revised taxonomies provided more detailed breakouts of content domains that could increase the breadth of the subject matter covered

# Prior ASVAB Alignment Studies

- Summary
  - Results from Oppler et al. (1997) and more recent work (Adams et al., 2022) indicate that ASVAB science and technical tests are relevant to military jobs
  - Waugh et al. (2015) found a good deal of overlap between ASVAB test blueprints and other relevant sources, particularly those tests that address content regularly taught in schools (i.e., WK, PC, AR, MK, and GS)
    - Technical tests more questionable
    - Relevant comparison sources found for AI and SI, but not MC and EI

# High School Course Taking

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# High School Course-Taking

- Review of literature identified four broad categories of research
  - Course-taking and changes in course-taking over time
  - Impact of course-taking on future outcomes
  - Changes, in and impact of, Career and Technical Education (CTE) course-taking
  - Methodological studies
- Much of the research based on studies sponsored by the National Center for Education Statistics (NCES)
  - High School Longitudinal Study (HSLS: 2005, 2009)
  - High School Transcript Study (HSTS: 1990, 1994, 1998, 2000, 2005, 2009, 2019)

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# High School Course-Taking

- Overall results indicate that students earned more credits and pursued more challenging curricula in 2009 compared to 1990, especially in math and science (NCES, 2011)
  - However, there are findings that suggest course titles may not reflect actual level of course content
    - 2013 NCES study found that 73% of graduates who took an “honors” algebra class and 62% who took an “honors” geometry class received a curriculum ranked as intermediate based on textbook content
  - 2019 data suggest only 12% of students followed a rigorous curriculum and 23% of students followed a curriculum that was below standard (NCES, n.d.)

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# Impact of Course-Taking

- Results of several studies suggest
  - Students who do well in middle school math and science classes more likely to take advanced classes in high school
  - Students who take Algebra I before 9th grade are more likely to be proficient on standardized tests and more likely to go on to postsecondary institutions (NCES, 2019)
    - 67% who took algebra before 9th grade enrolled in 4-year college compared to 43% of those who took algebra in 9th grade, 25% in 10th grade, and 23% in grades 11–12

# CTE Course-Taking

- Results from a variety of studies yield the following general conclusions
  - Most students earn CTE credits while in high school
  - The percentage doing so has declined somewhat from 1990 to 2015
  - Course-taking patterns have shifted over time
    - Less focus on areas such as agriculture, architecture/construction, and business/marketing
    - Greater focus on engineering/technology, health care, hospitality/tourism, and human services
  - Consistent differences between males and females in areas of focus
    - A higher percentage of males earn credits in architecture and construction, engineering and technology, manufacturing, and transportation and logistics
    - Higher concentration of females in health care and human services
    - Some differences have diminished over time (e.g., business and marketing, agriculture)
  - Overall test scores and graduation rates for students taking CTE courses have risen over time
  - Limited data suggest no relationship between CTE course-taking and postsecondary pursuits

# Methodological Studies

- Rosen et al. (2017) examined data from HSLS:2009 comparing student reports of math courses taken to their actual transcripts
  - Overall self-reports were accurate regarding courses taken, with less accuracy about year taken and grade received
  - Greater accuracy in reporting grade received among higher performing students
- NCES (2020) compared courses students reported taking as part of the NAEP studies conducted in 2000, 2005, and 2009 with their high school transcripts
  - For all math courses except pre-calculus and unified/integrated math, a higher percentage of students reported taking the class than was indicated by their transcript
    - In all standard math classes (Algebra I, Geometry, Algebra II) higher percentages of students reported taking the class than was indicated by their transcripts, with differences ranging from 2 to 7 percent

# Proposed Approaches

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# Proposed Approaches

1. Explore HSTS:19 data to identify relevant results that have not been reported in the literature
2. Review sources cited in Waugh et al. (2015) to determine if significant changes have occurred in those sources that put them more or less in line with ASVAB test content
3. Conduct “pseudo-alignment” study
   - Assemble sample of high school course catalogs and short descriptions of various instructional methods (see next two slides)
   - Develop ratings spreadsheets for each subtest with links to ASVAB blueprint and relevant sections of each course catalog
   - Identify SMEs (e.g., internal HumRRO/DTAC personnel, ASVAB item writers)
   - Conduct alignment workshop in which raters are trained and then review materials and make judgments about the likelihood that ASVAB content is covered in the classes offered and given the type of instructional method(s) used

# Sample Pages from Course Catalog

## ENGINEERING AND TECHNOLOGY

**711 WOODWORKING I** — **1 Credit ♦ Full Year ♦ Level 2 ♦ Grades 9-12**

**Fulfills the Art requirement*

This introductory woodworking course introduces the students to the essential principles of woodworking. Topics include wood technology, use of hand tools, portable power tools, project estimating and basic machine operations. Emphasis is placed on proper technique, safety and shop policies for the woodworking facility. Students are required to complete a series of projects designed to develop primary woodworking skills.

**715 CONSTRUCTION TECHNOLOGY** — **1 Credit ♦ Full Year ♦ Level 2 ♦ Grades 10-12**

*Prerequisite: Woodworking*

This course provides students with an opportunity to explore the construction industry and its impact on society. Students are introduced to state and local zoning, building and planning/surveying codes. Topics include site selection and plot surveying, percolation testing, foundation, wood frame and steel construction. Other topics include insulation, heating, plumbing, and wiring systems. A working model will be required.

**720 ROBOTICS ENGINEERING TECHNOLOGY** — **1 Credit ♦ Full Year ♦ Level ♦ Grades 9-12**

**Fulfills the Technology requirement*

The Robotics Engineering Technology course is designed for students who have an interest in robotic systems and pursuing an Engineering and/or STEM career. The course concentrates around the design, building and programming skills required in order to perform real world tasks. Students will focus on the application of the engineering design process, utilizing hardware and software to problem solve. Students in this course will also be expected to participate in the FIRST Tech Challenge robotics competition during the course of the year.

**724 COMPUTER-AIDED DESIGN** — **1 Credit ♦ Full Year ♦ Grades 9-12**

**Fulfills the Art or Technology requirement*

This course will focus on basic and advanced Computer-Aided Design skills using the latest release of CAD software utilizing 2D & 3D drawings to create virtual and solid models. Content will include file management, edit commands, coordinate systems, drawing set-ups, drawing aids, layer usage, drawing geometric shapes, editing objects, array, text applications, and dimensioning. 3D Parametric Modeling will be performed through the use of SolidWorks® and other software. A design portfolio with an animated design will be required. Real World problem solving and Critical Thinking skills will be developed and expanded upon using the Engineering Design Model. Upon completion of this course, students will qualify to enroll in Pre-engineering. Students will set-up and properly utilize 3D printers, laser cutters, vinyl cutters and CNC machines to create working models.

**419 ALGEBRA 2** — **1 Credit ♦ Full Year ♦ Level 2 ♦ Grade 11**

*Prerequisite: Algebra 1 and Geometry*

Building on their work with linear, quadratic, and exponential functions from Algebra 1, students extend their repertoire of functions to include polynomial, rational, and radical functions. Students work closely with the expressions that define the functions, and continue to expand and hone their abilities to model situations and to solve equations, including solving quadratic equations over the set of complex numbers and solving exponential equations using the properties of logarithms. The Mathematical Practice Standards apply throughout the course and, together with the Common Core content standards, prescribe that students experience mathematics as a coherent, useful, and logical subject that makes use of their ability to make sense of problem situations. The critical areas for this course, organized into six units, are as follows: Sequences and Functions, Polynomial and Rational Functions, Complex Numbers and Rational Exponents, Exponential Functions and Equations, Transformations of Functions, and Statistical Inferences.

This course is appropriate for students who wish to cover algebra 2 at a standards-based level. Additional support is provided to students.

**421 ALGEBRA 2** — **1 Credit ♦ Full Year ♦ Level 2 ♦ Grades 10-11**

*Prerequisite: Algebra 1 and Geometry*

Building on their work with linear, quadratic, and exponential functions from Algebra 1, students extend their repertoire of functions to include polynomial, rational, and radical functions. Students work closely with the expressions that define the functions, and continue to expand and hone their abilities to model situations and to solve equations, including solving quadratic equations over the set of complex numbers and solving exponential equations using the properties of logarithms. The Mathematical Practice Standards apply throughout the course and, together with the Common Core content standards, prescribe that students experience mathematics as a coherent, useful, and logical subject that makes use of their ability to make sense of problem situations. The critical areas for this course, organized into six units, are as follows: Sequences and Functions, Polynomial and Rational Functions, Complex Numbers and Rational Exponents, Exponential Functions and Equations, Transformations of Functions, and Statistical Inferences.

This course is appropriate for students who wish to cover the standards for algebra 2 at a typical pace and level of rigor.

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# Sample Course Descriptions Indicating Use of Instructional Methods

| Instructional Practice | Sample Course Descriptions |
|---|---|
| Project-based learning—description includes references to using concepts learned to address real-world problems | • In Environmental Systems students conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving.<br>• Automotive Basics—This study allows students to reinforce, apply, and transfer academic knowledge and skills to a variety of interesting and relevant activities, problems, and settings.<br>• Students study the engineering design process, applying math, science, and engineering standards to identify solutions to a variety of real problems. |
| Modeling—description includes references to developing/using models to solve problems, reach conclusions, etc. | • Mathematical modeling is the process of examining a given situation or problem and then developing an equation, formula, or graph that correctly represents the main features of the model. |
| Integrated instruction—description suggests that subject matter is taught in an integrated fashion (i.e., combined algebra/geometry, combined biology/chemistry) | • The focus is on statistical ideas and reasoning and on their relevance to such fields as medicine, education, environmental science, business, psychology, sports, politics, and entertainment.<br>• Combined studies in a team-taught course in United States Government and Politics and literature.<br>• This is an entry level course that pulls key standards & topics from the four strands of science: Biology, Earth Science, Chemistry, & Physics.<br>• This course is the entry level Mathematics course. Along with Math II and Math III students will complete the equivalent of coursework in Algebra I, Geometry, and Algebra II.<br>• Algebra and geometric ideas are tied together.<br>• Earth Science is an integrated science course which focuses on the theme of systems. |
| Evidence-based arguments—description indicates that students will be expected to make evidence-based arguments grounded in material read or projects carried out | • Writing emphasis will be on the critical analysis of literature through in class writing prompts and extended essays.<br>• Students will build an argument using a strong thesis and support. |
| Collaborative learning—description suggests that students work in small groups to complete projects | • Group and individual activities engage students in creating ideas, developing innovations, and engineering practical solutions.<br>• Students in engineering teams apply technology, science, and mathematical concepts and skills to solve engineering design problems and innovate designs. |

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# Proposed Approaches

4. Work with Joint Advertising, Market Research, and Studies (JAMRS) to include questions in their *Futures Survey* on course-taking behavior
   - Survey conducted tri-annually
   - Stratified random sample of U.S. 16–24-year-olds weighted to the general population on gender, age, race/ethnicity, educational attainment, and region
   - Survey includes questions about propensity to enlist in the military
   - In addition to reporting frequencies and comparing results to recent NCES studies, carry out comparisons between subgroups with varying propensity levels
   - Assuming survey space is limited, include course-taking question in two iterations, followed by question on non-classroom activities of interest

4a. Alternative would be to include items on the New Recruit Survey administered to all non-prior service enlistees entering the Delayed Entry Program for the first time and compare results to HSTS:2019

# Sample Course-Taking Question

We are interested in learning more about the high school course-taking patterns of students today. Please indicate which of the courses listed you have taken or plan to take and in what year(s) of school. If you have or will take a course in multiple years, please mark each one.

| ***Courses*** | ***Year(s) Taken/Plan to Take*** | | | |
|---|---|---|---|---|
| | Freshman (9th grade) | Sophomore (10th grade) | Junior (11th grade) | Senior (12th grade) |
| **English** | ○ | ○ | ○ | ○ |
| **Social Studies/History** | ○ | ○ | ○ | ○ |
| **Math** | | | | |
| Algebra I | ○ | ○ | ○ | ○ |
| Algebra II | ○ | ○ | ○ | ○ |
| Geometry | ○ | ○ | ○ | ○ |
| Calculus | ○ | ○ | ○ | ○ |
| **Science** | | | | |
| Biology | ○ | ○ | ○ | ○ |
| Chemistry | ○ | ○ | ○ | ○ |
| Earth/Environmental Science | ○ | ○ | ○ | ○ |
| Physics | ○ | ○ | ○ | ○ |
| **Career and Technical Education** | | | | |
| Agriculture/Natural Resources | ○ | ○ | ○ | ○ |
| Business/Finance/Marketing | ○ | ○ | ○ | ○ |
| Communications | ○ | ○ | ○ | ○ |
| Computer and Information Science | ○ | ○ | ○ | ○ |
| Construction (wood working, shop) | ○ | ○ | ○ | ○ |
| Engineering, Design, Production | ○ | ○ | ○ | ○ |
| Mechanical Repair and Operation | ○ | ○ | ○ | ○ |
| Public Services | ○ | ○ | ○ | ○ |
| Electronics, Circuitry | ○ | ○ | ○ | ○ |
| Drafting, Mechanical Drawing | ○ | ○ | ○ | ○ |
| Auto Mechanics | ○ | ○ | ○ | ○ |
| Consumer Sciences | ○ | ○ | ○ | ○ |
| Health Care | ○ | ○ | ○ | ○ |
| Hospitality/Tourism | ○ | ○ | ○ | ○ |

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# Sample Extracurricular Activities Question

We are interested in learning more about interests that students pursue outside of the classroom either through school-sponsored programs, programs outside of school, or on their own with family or friends. Please indicate which of the following you have participated in in the past two years.

| ***Program/Activity*** | |
|---|---|
| Sports/Cheerleading/Drill Team | O |
| Academic Clubs | |
| Mathematics | O |
| Biology | O |
| Chemistry | O |
| English/Creative Writing | O |
| Debate | O |
| History | O |
| Foreign Language | O |
| Other (please specify) | |
| Special Interest Clubs | |
| Cooking | O |
| Film | O |
| Photography | O |
| Chess | O |
| Art (Painting, Pottery) | O |
| Other (please specify)_____ | |
| Music (Band, Orchestra, Choir) | O |
| Social Service (Animal Welfare, Food Bank) | O |
| Computers/Electronics (Assembly, Repair, Programing) | O |
| Automobiles (Repair, Restoration) | O |
| Construction (Buildings, Furniture) | O |
| Boy/Girl Scouts | O |
| Agriculture (4-H, Future Framers of America) | O |
| Other (please specify)_____ | O |
| Other (please specify)_____ | O |
| Other (please specify) | O |

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# Progress Made and Next Steps

- Sampling approach:
  - Randomly selected one state from each of the 9 Census Regions
    - RI, PA, MI, MN, VA, TN, AR, MT, and CA
  - Created an extract of Common Core of Data public school directory for each state
  - Sorted schools by level and eliminated Pre-K, elementary, and middle schools
  - Sorted schools by type and eliminated special education, unknown, and alternative schools
  - Generated random numbers to select 5 schools from each state

# Progress Made and Next Steps

- Sampling approach:
  - Compared distribution of jurisdiction sizes to national data
    - Significant underrepresentation of City/Large (national 15.08%, sample 8.41%)
    - Three states in sample have no City/Large jurisdictions (AR, MT, and RI)
    - MN had two City/Large schools randomly chosen
    - PA, MI, VA had none, CA one
      - Randomly chose one City/Large school from each
  - Logged on to school websites and sought course catalogs
    - Found detailed course descriptions for 30 of 49 schools
    - Schools lacking tended to have small student populations (e.g., < 250)
  - Drew additional samples within state/size jurisdiction groups where necessary until catalogs located
    - Implication: Smaller schools may be underrepresented

## Progress Made and Next Steps

- Reviewing HSTS:19 data and determine if there is a need for a formal data request
- Reviewing Waugh et al. report and sources used
- Carry out alignment study
  - Selected schools and collected course catalogs (see next slides)
  - Create ratings databases
  - Identify SMEs
- Coordinating with JAMRS regarding possibility of including survey item(s)
  - Reviewing course catalogs and other sources to ensure course/activity listings are comprehensive and will “resonate” with respondents

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## Questions for DAC Consideration

- Do you have any input on the proposed approaches?
- Are there additional avenues we might pursue to assess secondary school coverage of ASVAB content?

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# Thank you!

For more information
please contact:

Peter Ramsberger
pramsberger@humrro.org
703.706.5686

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