Supplemental Material

CBE—Life Sciences Education

Jackson *et al*.

Appendix Table A1

Summer Research Institute learning objectives for students

Major Learning Outcomes:

Students will have the ability to:

M1. Review and synthesize research literature orally and in writing

M2. Communicate and present (orally) scientific information fluently and in an organized way

M3. Define the purpose of a research proposal and demonstrate this understanding by generating a team-based proposal

Specific Learning Outcomes:
Bolded items are new for 2016.
Section I. Introduction to Health and Health Research: (5)

1.1.2. Explain and demonstrate the fundamentals of group dynamics and how to be a productive member of a small working group

1.1.3. Define different types of health research

1.1.4. Recognize and explain with examples the different areas of science, social science, medicine and technology that contribute to improving health.

2.1.5. Perform social networking in group

2.1.6. Connect research to bio-medical and/or social science issues relevant to society at large

Section II. Basic Research Methodology: (12)

1.2.1. Name and discuss historical examples of breakthroughs in health relevant research and their significance for today's health research and conditions.

1.2.2. Formulate a testable research question (learn how to formulate a hypothesis)

1.2.3. Discuss examples of ethical considerations in health research:

1.2.4. Demonstrate the ability to identify appropriate scientific information

1.2.5. Demonstrate appropriate use scientific terminology in written and oral presentations

1.2.6. Provide proper citation for literature used

1.2.7. Collect, organize, and enter data into a database

1.2.8. Analyze and interpret data in various formats

1.2.9. Distinguish different types of variables (independent vs. dependent categorical vs. continuous, etc.

1.2.10. Differentiate different types of study design (observational vs. experimental and other details)

1.2.11. Synthesize and integrate new scientific information into written and oral assignments

2.2.12. Effectively communicate research findings in oral and written scientific formats

SECTION III. How to Choose a Topic: (11)

1.3.1. Critically read/listen to and interpret research studies

1.3.2. Define the overall goal and specific objectives of a research study

1.3.3. Identify the conceptual framework of a research study

1.3.4. Identify and describe core study design concepts and explain some of the advantages and disadvantages of each

1.3.5. Explain alternative interpretations for study outcomes

1.3.6. Choose appropriate research designs for different topics/goals

1.3.7. Describe a research question/problem clearly and be able to argue why it is important

1.3.8. Understand and be able to discuss the skills necessary to be engaged in a good mentee-mentor relationship

2.3.9. Create research questions and hypotheses that address real world problems

2.3.10. Explain how the focus of the group's research contributes to new knowledge

SECTION IV. How to Write a Proposal: (10)

1.4.1. Apply the components and structure of a research proposal

1.4.2. Propose appropriate ways to measure research variables and define their characteristics

1.4.3. Propose some very basic statistical methods

1.4.4. Demonstrate the knowledge of sound ethical research principles and responsible conduct in research

1.45. Harness the necessary resources to edit written assignments and produce grammatically and typographically correct English language documents

2.4.6. Analyze and critique research studies (papers & oral)

2.4.7. Evaluate research topics using a proposal rubric (peer review)

2.4.8. Synthesize proposal elements into a competitive project

Appendix Table A2

Constructs measured within ASCEND Summer Research Institute

Research skills/Science self-efficacy

SRIPre: Research Skills- Please indicate your level of confidence in your ability to: (on a 1-10 scale, with 1 being not at all confident and 10 being absolutely confident)

SRIPost: Research Skills- As you think about what you have learned this summer in the SRI, how would you rate your ability in the following areas?

SRIReflective: Research Skills- Now think back to what your skills were like right before the SRI started. How would you rate yourself and your skill levels at that time, compared to today?

	Original List (Cohorts: 1-4, 2015-2018)	Additional List (Cohort 4, 2018)
Science self-efficacy	Ability to choose a research topic	Use technical science skills (use of tools, instruments, and/or techniques)
Science self-efficacy	Ability to choose the right research methodology	Generate a research question
Science self-efficacy	Ability to write a research proposal	Determine how to collect appropriate data
Science self-efficacy	Ability to analyze data	Explain the results of a study
Science self-efficacy	Ability to work with others in a group	Use scientific literature to guide research
Science self-efficacy	Knowledge of biology	Integrate results from multiple studies
Science self-efficacy	Knowledge of psychology	Ask relevant questions
Science self-efficacy	Knowledge of public health	Identify what is known and not known about a problem
Science self-efficacy		Understand scientific concepts
Science self-efficacy		See connections between different areas of science and mathematics

Science Identity

Indicate the importance to you personally of each of the following:

	Original List (Cohorts: 1-3, 2015-2017)	New List (Cohort 4, 2018)
Science identity	How important is it to you personally to make a theoretical contribution to science?	I have a strong sense of belonging to the community of scientists
Science identity		I derive great personal satisfaction from working on a team that is doing important research
Science identity		I think of myself as a scientist
Science identity		I feel like I belong in the field of science

Academic Adjustment

Since becoming at student at Morgan State University, how has it been to . . .? -

Academic	Develop effective study skills

Adjustment	
Academic Adjustment	Adjust to the academic demands of college
Academic Adjustment	Manage your time effectively
Academic Adjustment	Develop close friendships with other students

University Contribution

This university has contributed to my ability to conduct research.

Academic and Scientific Self-Efficacy

Please rate yourself on each of the following traits as compared with the average person your age: (We want the most accurate estimate of how you see yourself.)

Academic Self-Concept (1/4)	Academic ability
Academic Self-Concept (2/4)	Drive to achieve
Academic Self-Concept (3/4)	Mathematical ability
Academic Self-Concept (4/4)	Intellectual self-confidence

Belongingness

Please rate your agreement with the following statements: -

Sense of belonging	I see myself as part of the campus community
Sense of belonging	I feel a sense of belonging to this campus
Sense of belonging	I feel that I am a member of this college
Sense of belonging	I feel valued at this institution
Sense of belonging	If asked, I would recommend this college to others

Note: The critical thinking construct items are not included as the CAT is a proprietary instrument.

Appendix Table A3

Cohort differences descriptive data by construct

Cohort / Year	Construct	N	Median	Range
1 / 2015	academic self-concept 2015	28	0	7
	belongingness 2015	28	1	13
	CAT 2015	17	18	14
	science self-efficacy Reflective 2015	28	0	43
	university contribution Reflective 2015	28	1	3
2 / 2016	academic adjustment to college 2016	24	0	12
	academic self-concept 2016	25	0	9
	belongingness 2016	25	0	14
	CAT 2016	24	-1	19
	science self-efficacy 2016	24	6.5	43
	science self-efficacy Reflective 2016	25	20	62
	university contribution Reflective 2016	25	2	3
3 / 2017	academic adjustment to college 2017	27	3	11
	academic self-concept 2017	27	1	11
	belongingness 2017	27	1	26
	CAT 2017	27	3	19
	science self-efficacy 2017	27	13	59
	science self-efficacy Reflective 2017	27	15	51
	university contribution Reflective 2017	27	1	6
4 / 2018	academic adjustment to college 2018	21	2	15
	academic self-concept 2018	21	-1	8
	belongingness 2018	21	-1	9
	CAT 2018	21	0	16
	science self-efficacy 2018	21	9	46
	science self-efficacy Reflective 2018	21	22	43
	science identity 2018	21	8	7
	science identity Reflective 2018	21	3	12
	university contribution Reflective 2018	21	1	4

Appendix Table A4

Hands-on research modules

Module/(time)	Discipline	Study Protocol/Design
Photo Voice (week 1)	Public Health	On a 60 min. walk, Identify Images in your community that are indicative of a health issue
Biometrics (week 2)	Life Sciences	Measurement of weight/height/blood pressure/heart rate & demographics – what relationships would you predict? Test your hypotheses!
Stress (week 3)	Behavioral and Life Sciences	Measurement of hair cortisol levels and completion of Perceived Stress Scale and the Hassles Assessment Scale For Students In College – what relationships would you expect? Test your hypothesis!
Water Analysis (week 4)	Environmental Science & Chemistry	Collection of water samples from faucets and water fountains across campus; testing for 15 different contaminants including lead.; what contaminants would you expect and why? Test your hypothesis!
Cancer (week 4 & 5)	Biomedical Sciences	Demonstration: How to culture cancer cells; Experimental intervention: drug application (e.g. tamoxifen) what effects on cell growth would you expect? What proteins might be upregulated in a Western blot? Test your hypothesis!
Brain Imaging (week 6)	Physical / Life Sciences	Collaboration with Northwestern University; long distance analysis of fMRI mouse brain images using MR Scanner (7.0T)
Mindset (week 6)	Social Science/Entrepreneurship	Reviewed curated short videos. In groups discuss growth & fixed concepts, personal experiences, and listed what makes successful people and their attributes, beliefs, skills, talents, and behaviors.
Proposal Preparation (weeks 6 to 8)	As applies	Students work in groups (with near peer mentors) to identify their specific research questions and develop their specific proposals
Proposal Presentations (week 8)	As applies	Students practice (peer and instructor feedback) their project presentations and assemble their proposal papers

Appendix Table A5

Proposal listings by cohort

Cohort	Number of people in group	Proposal Titles
1	4	The Correlation between Fast Food and Migraines amongst Women in Low-Income Located in Food Swamp Areas
1	2	**Association between Family Structure and the Health and Academic Performance of College Students Attending an HBCU**
1	1	Examining the role of gender in knowledge, attitude, and sexual behavior towards STD's: Implications for Intervention at an HBCU.
1	5	**Assessing the Effectiveness of an Alcohol Reduction Intervention in first year students residing on or off campus at a Historically Black College/University in 2015-2016**
1	2	**Students' perception of a smoke-free campus policy in a historically black college and university (HBCU)**
1	5	**The Correlation Between Sexual Assault and Academic Success Among College Students Attending an HBCU**
1	3	**Diabetes Detection Sensor Testing**
1	6	**Identifying sources of stress among first generation traditional college aged students in a Historically Black College or University (HBCU)**
2	6	**African-American Childhood Experiences of Parental Divorce and their Possible Effects on Stress Levels as College Students**
2	5	**Bactericides and Algaecides: Dead Zone Prevention in the Chesapeake Bay**
2	6	**Anti-Cancer Drugs Target B-RAF V600E Mutation Found in Glioma Cells**
2	3	**Non-medical Stimulant Use and Risky Behaviors in African American College Students**
2	6	**Prenatal Sleep Deprivation and the Development of ADHD Symptoms in Offspring**
3	6	**"The Effects of Inconsistent Sleep Patterns Versus Chronic Sleep Deprivation on Memory and Learning"**
3	5	**The Prevalence of Depression and Anxiety in Collegiate Athletes within Historically Black Universities in Washington D.C, Maryland and Virginia**
3	3	**Childhood Trauma and Social Interactions among College Students**
3	5	**The Effects of Tetrahydrocannabinol (THC) on the Hippocampus and the Amygdala of Adolescents & Adults Rats.**
3	4	**College African American Male Freshmen and Their Media Influenced Perceptions of Female Sexual Objectification**
3	4	The Effect of Fluoxetine Use in Pregnancy on Fetal Cardiovascular Abnormalities in Rats
4	4	**Assessing the Presence of Community Violence Exposure in Minority College Student**
4	2	**Identification of Salinity Genes in Crassotrea (Oysters)**
4	1	**Perceived Distress and its Relationship to Cognition and Food Choice in College Students**
4	4	**Solvent-Free Microwave Synthesis of Metal Organic Framework (CAU-10) with Anti-Cancer Drug (Gemcitabine)**
4	4	**The Effects of Different Modes of Marijuana Use on the Brain**

Note: Titles in **Bold indicate acceptance for further development and execution**.

ASCEND SRI 2018 Pretest Survey

Q4 How often in the past year did you look up scientific research articles and resources?

[Scale: 1=Not at all; 2=Occasionally; 3=Frequently]

Q5 Since entering college, have you worked on a professor's research project?

[1=No; 2=Yes]

Q6 Since entering college, indicate how often you have worked on a professor's research project:

[Scale: 1=Not at all; 2=Occasionally; 3=Frequently]

Q7 Since entering college, have you worked on an undergraduate research program?

[1=No; 2=Yes]

Science Identity/Researcher Identity

Please indicate the importance to you personally of each of the following:

[Scale: 1=Not important; 2=Somewhat important; 3=Very important; 4=Essential]

Q8 Becoming an authority in a scientific field

Q9 Obtaining recognition from colleagues for scientific contributions

Q10 Making a theoretical contribution to science

Q11 Please indicate your level of agreement with the following statement: **This university has contributed to my ability to conduct research**

[Scale: 1=Strongly disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly agree]

Academic and Scientific Self-Efficacy

Please rate yourself on each of the following traits as compared with the average person your age: (We want the most accurate estimate of how you see yourself)

[Scale: 1=Lowest 10%; 2=Below average; 3=Average; 4=Above average; 5=Highest 10%]

Q12 Academic ability

Q13 Competitiveness

Q14 Computer skills

Q15 Cooperativeness

Q16 Creativity

Q18 Mathematical ability

Q19 Intellectual self-confidence

Q20 Social self-confidence

Q21 Self-understanding

Q22 Writing ability

Q23 Emotional health

Q24 Physical health

Q25 Ability to conduct research

Peer Support

Please indicate the number of friends (peers or near-peers) you have for each item listed below:

[Scale: 1=0-1; 2=2-4; 3=5-7; 4=8-10; 5=>10]

Q26 I have ___ friends who can help me if I have a question about my research

Q27 I have ___ friends who are ready to work with me on my research

Q28 I help ___ friends with their research

Q29 I have ___ friends who encourage me to do research

Q30 I have ___ friends who encourage me to apply to graduate school

Q31 I encourage ___ friends to engage in research

Q32 I have ___ peers who have the same goal of getting into graduate school and becoming researchers

Belongingness

Please indicate your level of agreement with the following statements:

[Scale: 1=Strongly disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly agree]

Q33 I see myself as part of the campus community

Q34 I feel a sense of belonging to this campus

Q35 I feel that I am a member of this college

Q36 I feel valued at this institution

Q37 If asked, I would recommend this college to others

Satisfaction with Faculty Mentorship, Perceived Level of Faculty Support/Mentorship

Please indicate your level of agreement with the following statements:

[Scale: 1=Strongly disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly agree]

Q38 Faculty show concern about my progress

Q39 Faculty empower me to learn here

Q40 At least one staff member has taken an interest in my development

Q41 Faculty believe in my potential to succeed academically

Q42 Staff encourage me to get involved in campus activities

Q43 Staff recognize my achievements

Q44 Faculty encourage me to meet with them outside of class

Research Skills

Please indicate your level of confidence in your ability to:

[Scale of 1=Not at all confident to 10=Absolutely Confident]

Q45 Use technical science skills (use of tools, instruments, and/or techniques)

Q46 Choose a research topic

Q47 Generate a research question

Q48 Choose the right research methodology

Q49 Determine how to collect appropriate data

Q50 Write a research proposal

Q51 Analyze data

Q52 Explain the results of a study

Q53 Use scientific literature to guide research

Q54 Work with others in a group

Q55 Knowledge of biology

Q56 Knowledge of psychology

Q57 Knowledge of public health

Faculty Relationship (Addition)

Since you became a student at Morgan State University, how often have you felt … ?

[Scale: 1=Not at all; 2=Occasionally; 3=Frequently]

Q58 That faculty provided you with feedback that helped you assess your progress in class

Q59 That faculty encouraged you to ask questions and participate in discussions

Since entering college, how often have you interacted with the following people (eg, by phone, email, text, or in person)?

[Scale: 1=Never; 2=1 or 2 times per term; 3=1 or 2 times per month; 4=Once a week; 5=2 or 3 times per week; 6=Daily]

Q60 Faculty during office hours

Q61 Faculty outside of class or office hours

Q62 Academic advisors/counselors

Q63 Graduate students/teaching assistants

Satisfaction

Please rate your satisfaction with Morgan State University on each of the aspects of college life:

[Scale: 1=Very dissatisfied; 2=Dissatisfied; 3=Neutral; 4=Satisfied; 5=Very satisfied; 6=Can't rate/No experience]

Q64 Amount of contact with faculty

Q65 Racial/Ethnic diversity of faculty

Q66 Racial/Ethnic diversity of student body

Q67 Class size

Q68 Interaction with other students

Q69 Relevance of coursework to everyday life

Q70 Relevance of coursework to future career plans

Q71 Overall quality of instruction

Q72 Respect for the expression of diverse beliefs

Q73 Availability of campus social activities

Q74 Your social life

Q75 Overall sense of community among students

Q76 Overall college experience

Well-Being

What is your best guess as to the chances that you will … ?

[Scale: 1=No chance; 2=Very little chance; 3=Some chance; 4=Very good chance]

Q77 Transfer to another college before graduating

Q78 Be satisfied with your college

Q79 Participate in volunteer or community service work

Q80 Seek personal counseling

Self-Efficacy/Self-Regulation

Since becoming at student at Morgan State University, how has it been to … ?

[Scale: 1=Very difficult; 2=Somewhat difficult; 3=Somewhat easy; 4=Very easy]

Q81 Develop effective study skills

Q82 Adjust to the academic demands of college

Q83 Manage your time effectively

Q84 Develop close friendships with other students

Q85 Develop effective study skills

Q86 Adjust to the academic demands of college

Q87 Manage your time effectively

Q88 Develop close friendships with other students

Manage Academic Environment

What is your best guess as to the chances that you will … ?

[Scale: 1=No chance; 2=Very little chance; 3=Some chance; 4=Very good chance]

Q89 Work full-time while attending college

Q90 Make at least a 'B' average

Q91 Need extra time to complete your degree requirement

Q92 Get tutoring help in specific courses

Q93 Take courses from more than one college simultaneously

Participation/Professional Interest

Please indicate which activities you did during the past year:

[Scale: 1=Not at all; 2=Occasionally; 3=Frequently]

Q94 Was bored in class

Q95 Tutored another student

Q96 Studied with other students

Q97 Felt overwhelmed by all I had to do

Q98 Felt depressed

Q99 Performed volunteer work

Q100 Asked a teacher for advice after class

Q101 Socialized with someone of another racial/ethnic group

Q102 Came late to class

Q103 Performed community service as a part of a class

Q104 Skipped school/class

Q105 Fell asleep in class

Q106 Failed to complete homework on time

Q107 Used an online instructional website (eg Khan Academy, Coursera) as assigned for a class

Q108 Used an online instructional website (eg Khan Academy, Coursera) to learn something on your own

What is your best guess as to the chances that you will … ?

[Scale: 1=No chance; 2=Very little chance; 3=Some chance; 4=Very good chance]

Q109 Get a job to help pay for college expenses

Q110 Work full-time while attending college

Q111 Communicate regularly with your professors

Q112 Participate in student clubs/groups

Race/Diversity

How would you rate yourself in the following areas?

[Scale: 1=A major weakness; 2=Somewhat weak; 3=Average; 4=Somewhat strong; 5=A major strength]

Q113 Ability to see the world from someone else's perspective

Q114 Tolerance of others with different beliefs

Q115 Openness to having my own views challenged

Q116 Ability to discuss and negotiate controversial issues

Q117 Ability to work cooperatively with diverse people

Q118 Ability to manage your time effectively