# Supplemental Material

***CBE—Life Sciences Education***

**Hall *et al.***

## Supplemental Materials

| | Cohort 1 | Cohort 2 | Cohort 3 | Cohort 4 | Cohort 5 |
|---|---|---|---|---|---|
| **Number of Applications** | 30 | 75 | 108 | 112 | 113 |
| **Number Interviewed** | 10 | 12 | 13 | 13 | 14 |
| **Number Accepted** | 10 | 7 | 9 | 8 | 10 |
| **Acceptance Rate** | 33.3% | 9.3% | 8.3% | 7.1% | 8.8% |
| **Externally Funded Scholars** | 2 | 1 | 1 | 1 | 2 |

**Supplemental Table 1. Number of applications, interviews, and acceptances for UP during the first five years.** The NIH grant funding UNC PREP provided funding for seven scholars during the first four years, then for eight scholars during year 5. An additional scholar could be funded in Cohort 1 due to several months of funding prior to scholars starting the program. One scholar in Cohort 2 was accepted but then rescinded his/her acceptance a week prior to the program starting resulting in six grant-funded scholars. This slot was rolled over to the next year; therefore, there were eight grant-funded scholars in Cohort 3. Each year, there were additional scholars supported by institutional funds and faculty research grants.

| | Baseline | Post | | |
|---|---|---|---|---|
| | **Mean ±Std Dev** | **Mean ±Std Dev** | **Difference** | **P value** |
| **Overall** | 2.81±0.98 | 4.14±0.48 | 1.33 | <0.0001 |
| **Answering Questions** | 2.71±1.06 | 4.05±0.74 | 1.33 | <0.0001 |
| **Understanding Experiments** | 2.90±1.14 | 4.19±0.60 | 1.29 | <0.0001 |
| **Methods** | 2.83±0.66 | 4.05±0.59 | 1.21 | <0.0001 |
| **Interpreting Figures** | 2.71±0.96 | 3.90±0.70 | 1.19 | <0.0001 |
| **Understanding Basis for Paper** | 3.26±0.94 | 4.38±0.67 | 1.12 | 0.0001 |
| **Relating paper to the Big Picture** | 2.88±1.14 | 4.00±0.84 | 1.12 | <0.0001 |
| **Figure Legends** | 2.95±1.02 | 4.00±0.55 | 1.05 | 0.0005 |
| **Understanding Abstract** | 3.21±0.87 | 4.19±0.60 | 0.98 | <0.0001 |

**Supplemental Table 2. Scholar confidence in reading and interpreting scientific articles.** Scholars reported their confidence level for understanding various aspects of a research article given during the baseline (Pre) and post-assessment during the SES critical analysis module. Responses are listed from largest to smallest increase (top to bottom) in confidence from pre- to post-assessment. Statistical significance between groups was determined using paired *t* tests.

| N=34 | Very Poor | Poor | Fair | Good | Very Good | Excellent | Mean±Std. Deviation |
|---|---|---|---|---|---|---|---|
| What is your assessment of the overall progress of the PREP student's research in your lab? | 0% | 3% | 12% | 24% | **38%** | 24% | 4.68±1.07 |
| What is your assessment of the PREP students' growth as a researcher since being in your lab? | 0% | 3% | 9% | 21% | **35%** | 32% | 4.85±1.08 |
| How would you rate the level of communication between you and the PREP student in your lab? | 0% | 0% | 3% | 29% | **53%** | 15% | 4.79±0.73 |
| How would you rate the level of communication between you and the PREP staff? | 0% | 0% | 0% | 21% | 32% | **47%** | 5.26±0.79 |

**Supplemental Table 3. Faculty mentor experiences with UP.** At the end of the PREP year, faculty mentors were surveyed about their experiences hosting a PREP scholar in their lab. Responses were given on a 6-point scale (1, very poor; 6, excellent).

| Overall, how satisfied are you with the PREP program? (N=34) | |
|---|---|
| **1 - Very Dissatisfied** | 0% |
| **2** | 0% |
| **3** | 0% |
| **4** | 6% |
| **5** | 15% |
| **6** | 24% |
| **7 - Very Satisfied** | **56%** |
| **Mean±Std. Deviation** | 6.29±0.94 |

**Supplemental Table 4. Faculty mentor overall satisfaction with UP.** At the end of the PREP year, faculty mentors were surveyed about their experiences hosting a PREP scholar in their lab. Responses were given on a 7-point scale (1, very dissatisfied; 7, very satisfied).

| How likely would you be to host another PREP student in the future? (N=34) | |
|---|---|
| 1 - Not at all likely | 0% |
| 2 – Not likely | 0% |
| 3 - Somewhat likely | 9% |
| 4 - Likely | 26% |
| 5 - Very likely | **65%** |
| Mean±Std. Deviation | 4.56±0.66 |

**Supplemental Table 5. UP faculty mentor likelihood of hosting future UP scholars**. At the end of the PREP year, faculty mentors were surveyed about their likelihood of hosting a future PREP scholar. Responses were given on a 5-point scale (1, not at all likely; 5, very likely).

| | Baseline | | Post | | Wilcoxon | |
|---|---|---|---|---|---|---|
| | N | Mean±Std. Deviation* | N | Mean±Std. Deviation* | Z | P value |
| Writing a personal statement for a graduate school application | 44 | 3.34±0.71 | 44 | 4.20±0.73 | 4.710 | **<0.0001** |
| Preparing a scientific research poster/talk | 44 | 3.41±0.82 | 44 | 4.16±0.61 | 4.517 | **<0.0001** |
| Directing your own research project | 43 | 2.84±0.95 | 44 | 3.70±0.76 | 4.429 | **<0.0001** |
| Designing experiments to test a hypothesis | 43 | 2.74±0.82 | 44 | 3.68±0.71 | 4.410 | **<0.0001** |
| Writing a scientific research abstract | 43 | 3.19±0.79 | 44 | 3.86±0.63 | 4.376 | **<0.0001** |
| Communicating your research findings in writing to other scientists | 44 | 2.82±0.84 | 44 | 3.55±0.73 | 4.335 | **<0.0001** |
| Getting into the PhD program of your choice | 44 | 3.41±0.92 | 44 | 4.30±0.76 | 4.208 | **<0.0001** |
| Interpreting Data | 44 | 3.18±0.79 | 44 | 3.89±0.69 | 4.053 | **<0.0001** |
| Presenting data at a lab meeting | 44 | 3.18±1.02 | 44 | 4.00±0.75 | 3.967 | **<0.0001** |
| Working independently in a science research lab | 44 | 3.30±1.00 | 44 | 4.07±0.62 | 3.795 | **<0.0001** |
| Reading and interpreting scientific literature | 44 | 3.25±0.87 | 43 | 3.95±0.72 | 3.688 | **<0.0001** |
| Answering questions related to your scientific research poster/talk | 43 | 3.42±0.66 | 44 | 4.07±0.76 | 3.530 | **<0.0001** |
| Understanding the process of getting a PhD | 44 | 3.82±0.84 | 44 | 4.39±0.58 | 3.499 | **<0.0001** |
| Being at a large research institution | 43 | 3.67±0.97 | 44 | 4.30±0.59 | 3.296 | **0.001** |
| Communicating your research findings orally to other scientists | 44 | 3.27±0.92 | 43 | 3.86±0.64 | 3.261 | **0.001** |
| Talking to research faculty you don't know | 43 | 3.23±0.97 | 44 | 3.82±0.95 | 3.147 | **0.002** |
| Carrying out experiments (doing bench work) | 44 | 3.91±0.86 | 44 | 4.43±0.55 | 3.125 | **0.002** |
| Discussing your data with people in your lab | 44 | 3.68±0.83 | 44 | 4.16±0.61 | 3.089 | **0.002** |
| Analyzing a problem and formulating a solution | 44 | 3.20±0.73 | 44 | 3.68±0.74 | 3.020 | **0.003** |
| Formulating a research hypothesis | 43 | 3.19±0.76 | 43 | 3.70±0.94 | 2.920 | **0.004** |
| Organizing Data | 44 | 3.45±0.79 | 44 | 3.91±0.64 | 2.697 | **0.007** |
| Having a successful science career | 44 | 3.95±0.86 | 44 | 4.20±0.76 | 1.753 | 0.080 |
| Being a scientist | 44 | 3.98±0.82 | 44 | 4.25±0.72 | 1.732 | 0.083 |
| Working with other scientists in a group | 43 | 3.98±0.71 | 44 | 4.18±0.76 | 1.694 | 0.090 |

**Supplemental Table 6. Scholar Confidence Pre- and Post-program**. On the first day and during the last week of the program, scholars were asked**,** *"How confident are you in your current ability to do the following tasks?"* *Responses were given on a 5-point scale (1, very uneasy; 5, very confident). A higher mean response indicates a higher reported confidence level. Items are ordered by decreasing Z-value (top to bottom). A higher Z-value indicates a larger difference between Baseline and Exit means. Bold p-values are considered significant (p<.05, Wilcoxon Rank Sum Test).

| | Exit | | Alumni | |
|---|---|---|---|---|
| | N | Mean ±StdDev | N | Mean ±StdDev |
| Program staff | 44 | 4.68±0.71 | 33 | 4.73±0.72 |
| Research experience in mentor's lab | 44 | 4.64±0.72 | 23 | 4.78±0.67 |
| ABRCMS Conference | 41 | 4.39±0.97 | 30 | 4.70±0.53 |
| Social activities* | 44 | 4.39±0.89 | 30 | 4.41 ± 0.68 |
| Practice oral presentations in group meeting | 44 | 4.36±0.84 | 33 | 4.70±0.59 |
| Support during the grad school application/admissions/interview process | 44 | 4.25±0.97 | 33 | 4.76±0.50 |
| Final Symposium Presentation* | 24 | 4.17±0.92 | 30 | 4.63±0.56 |
| Personal Statement Workshops | 43 | 4.12±1.00 | 30 | 4.46±0.92 |
| Academic support in classes | 42 | 4.07±1.18 | 28 | 3.93±1.12 |
| Weekly group meetings (as a whole)* | 44 | 4.05±0.91 | 32 | 4.47±0.67 |
| Summer Paper Reading Course | 43 | 4.02±1.08 | 33 | 4.52±0.62 |
| Team building exercises on first day of program* | 44 | 3.95±1.06 | 30 | 4.40±0.72 |
| GRE Prep (summer) | 34 | 3.82±1.14 | 33 | 4.09±0.98 |
| Summer Session (bootcamp) as a whole* | 44 | 3.77±1.05 | 30 | 4.21±0.82 |
| Lab Skills Course | 44 | 3.64±1.28 | 32 | 3.53±1.29 |
| Individual Development Plan (IDP) meetings* | 43 | 3.51±1.28 | 30 | 4.32±0.77 |

**Supplemental Table 7. Benefit of specific program components**. During the last week of the program (Exit) and one year after participants left the program (Alumni), scholars were asked to rate how beneficial specific program components were to them. Responses were given on a 5-point scale (1, not beneficial; 5, extremely beneficial). A higher mean response indicates a higher reported benefit. Program components are listed in order of greatest reported benefit to least on the Exit Survey. *These items were administered in early 2016 for all alumni cohorts.

| N=33 | 1 - Not Very Well | 2 | 3 | 4 | 5 | 6 | 7 - Extremely Well | Mean±Std. Deviation |
|---|---|---|---|---|---|---|---|---|
| Overall, how well did UNC-PREP prepare you for success in graduate school? | 0% | 0% | 3% | 0% | 12% | 27% | **58%** | 6.56±0.65 |

**Supplemental Table 8. Preparedness for graduate school.** One year after leaving PREP, scholars were asked, "*Overall, how well did UNC PREP prepare you for graduate school?"* Responses were given on a 7-point scale (1, not very well; 5, extremely well).

**PREP Scholar Assessment and Individual Development Plan (IDP)**

**PREP Scholar's Name:** **Faculty Mentor Name:**

*Please assess the PREP Scholar based on their performance compared to your expectations of a BBSP rotation student at UNC.*

*(Place an "X" in the appropriate box.)*

| | **Below Target** | | **On Target** | | **Exceeds Target** |
|---|---|---|---|---|---|
| **Skill** | **1** | **2** | **3** | **4** | **5** |
| Scientific Writing | | | | | |
| Presentation Skills | | | | | |
| Work Ethic (time spent in the lab, effort while in the lab) | | | | | |
| Time Management | | | | | |
| Gets along with other lab members | | | | | |
| Informal discussion of science in the lab | | | | | |
| Critical Analysis of Scientific Literature | | | | | |
| Background knowledge in relevant subject area | | | | | |
| Bench work, Carrying out experiments | | | | | |
| Interpreting results, Analyzing data | | | | | |
| Responds well to feedback | | | | | |
| Research Progress | | | | | |
| Preparedness for Graduate School | | | | | |

**PREP Scholar Assessment and Individual Development Plan continued…**

1. What are the PREP Scholar's strengths?

2. For skills that are below target (1-2), describe activities that would enable the student to enhance these skills.

3. Other Comments

**Paper Reading Baseline Analysis**
**UNC PREP Critical Analysis Course Summer 2015**
**PARP-1 regulates the expression of caspase-11**
**Yoo et. al. BBRC 2011**

1. What is the main question/hypothesis being addressed in this paper?

2. What technique is being used to "knockdown" PARP-1?

3. Describe the control used in the PARP-1 knockdown experiments? What is the importance of this control?

4. The authors do a western blot (immunoblot) in Figure 1A to determine if there is a difference in the level of caspase 11 protein when PARP-1 is knocked-down. How do they then determine if this difference is due to regulation of transcription or translation?

5. How did the authors determine that PARP-1 binds (directly or indirectly) to the promoter of caspase-11?

6. Is PARP-1 always involved in the induction of caspase-11? How do you know?

7. Why is tubulin shown in the figures of western blots (immunoblots)?

8. In all experiments, the authors used LPS (Lipopolysaccharide – a component of bacterial outer membranes). Why did they do this?

9. Let's say you joined this lab and were given the task of continuing the work presented in this paper. Describe a research question you would want to address to continue beyond this publication?

**How confident were you in doing the following tasks related to the assigned reading?**

| | 1<br>Very Uneasy | 2<br>Somewhat Uneasy | 3<br>Somewhat Confident | 4<br>Confident | 5<br>Very Confident |
|---|---|---|---|---|---|
| Understanding the abstract | 1 | 2 | 3 | 4 | 5 |
| Understanding the basis for the studies presented in the paper based on the introduction | 1 | 2 | 3 | 4 | 5 |
| Figuring out what experiments were done to generate the data in the figures | 1 | 2 | 3 | 4 | 5 |
| Interpreting the figures | 1 | 2 | 3 | 4 | 5 |
| Understanding the figure legends | 1 | 2 | 3 | 4 | 5 |
| Understanding the methods used in the paper | 1 | 2 | 3 | 4 | 5 |
| Finding a link between these studies and the "big picture" | 1 | 2 | 3 | 4 | 5 |
| Answering the questions about the reading | 1 | 2 | 3 | 4 | 5 |
| Overall reading the paper | 1 | 2 | 3 | 4 | 5 |

**Paper Reading Baseline Analysis Scoring Rubric**
**UNC PREP Critical Analysis Course Summer 2015**
**PARP-1 regulates the expression of caspase-11**
**Yoo et. al. BBRC 2011**

1. What is the main question/hypothesis being addressed in this paper?
    - Does PARP-1 regulate expression of caspase-11 (1pt)

2. What technique is being used to "knockdown" PARP-1?
    - RNAi (1pt) to reduce mRNA, and thus, protein levels of PARP-1 (1pt)

3. Describe the control used in the PARP-1 knockdown experiments? What is the importance of this control?
    - Vector pLKO.1 not containing PARP-1 shRNA were transfected into MEFs. (1pt)
    - Important to ensure "knockdown" phenotype was specific to the PARP-1 shRNAs (1pt)

4. The authors do a western blot (immunoblot) in Figure 1A to determine if there is a difference in the level of caspase 11 protein when PARP-1 is knocked-down. How do they then determine if this difference is due to regulation of transcription or translation?
    - Authors do RT-PCR (1pt) to measure mRNA levels of PARP-1 (1pt). A difference in Casp-11 mRNA levels would indicate transcriptional regulation whereas no difference would indicate translational regulation (1pt).

5. How did the authors determine that PARP-1 binds (directly or indirectly) to the promoter of caspase-11?
    - ChiP assay (1pt) on the promoter region of caspase-11 using PARP-1 antibody (1pt)

6. Is PARP-1 always involved in the induction of caspase-11? How do you know?
    - No (1pt), induction of caspase-11 by IFN-g is independent of PARP-1 (1pt).

7. Why is tubulin shown in the figures of western blots (immunoblots)?
    - To ensure that equal amounts of protein are loaded in each lane of the western blot (1pt)

8. In all experiments, the authors used LPS (Lipopolysaccharide – a component of bacterial outer membranes). Why did they do this?
    - LPS is a potent stimulator of the inflammatory pathway and caspase-11 expression (1pt)

9. Let's say you joined this lab and were given the task of continuing the work presented in this paper. Describe a research question you would want to address to continue beyond this publication? (1pt)

**PREP 2015 Methods and Techniques Assessment**

Please indicate the method/s that would be most appropriate to address the research question posed in the scenarios below. You will not necessarily use all of the options to complete this assessment. Some may require more than one step/method for completion.

| | | |
|---|---|---|
| Agarose Gel | Western Blot | Southern Blot |
| Sequencing | Microdialysis/voltammetry | RT-PCR |
| Immunoprecipitation | RNA-seq | RNAi |
| Microscopy | Transgenic Mouse | BLAST |
| ELISA | Fluorescence | *In Situ* Hybridization (FISH) |
| Flow Cytometry | HHPRED | ChIP-Seq |

1. You have been assigned to characterize the protein MAPK in the breast cancer cell line MCF-7. First, you want to be sure that the MAPK protein is expressed in these breast cancer cells. How would you do this?

2. You've just successfully PCR'd a gene from your own DNA that you believe is responsible for causing an extreme chocolate craving. You're convinced that it contains a mutation because most normal people don't crave chocolate quite as much as you do. What is the first thing you will do to check to be sure that you have successfully PCR'd your product?

3. Charcot-Marie-Tooth disease is a neurological disease caused by a duplication in a gene on chromosome 17. What method could be used to verify a duplication of a gene on chromosome 17 in a patient suspected of having this disease?

4. NUP98-DDX10 fusion causes a change in gene expression in cells based on microarray data. How could you confirm the changes in mRNA levels of specific genes that were identified by the microarray?

5. You have identified a previously uncharacterized gene associated with allergic asthma, *ZfpYFG*. You have developed an antibody that is highly specific to ZfpYFG and demonstrated that the protein is expressed in the airway epithelium. Interestingly, ZfpYFG has a zinc-finger domain, which means that it is able to bind DNA. You want to find out where ZfpYFG is bound in the genome, and what genetic motif ZfpYFG commonly binds. What assay can you use to determine both?

6. You think that ZfpYFG maybe a good target for therapeutic drugs in the treatment of allergic asthma. You know that you can predict drug targets based on active site topography. How can you go about predicting a preliminary structure for ZfpYFG?

7. You want to determine whether a vaccine induces a specific population of B-cells to become present in the blood stream of mice at one week post-injection. What type of procedure would you use to determine if the vaccine leads to an increase in the B-cell population compared to an unvaccinated control?

8. Dopamine is a neurotransmitter in the brain that is disregulated in many psychiatric disorders. You want to test whether a transgenic mouse model of schizophrenia has disregulated dopamine. How can you measure dopamine in the mouse brain in vivo?

9. You have hypothesized that the expression of HDAC-1 is required for Pax-2 expression in MDCK cells. How could you test the effect of the loss of HDAC-1 expression on Pax-2 expression in MDCK cells without a knockout mouse?