Supplemental Material

CBE—Life Sciences Education
Walck-Shannon et al.
Supplemental Item 1: Reflection exercise prompts.

**Post-exam survey: Exam 2**

The following questions are about your habits leading up to Exam 2. This will take 5-10 minutes to complete. The purpose is to help you reflect on your study and healthy habits.

Please answer honestly, your instructor will not see the responses given by individual students.

1. Please report the following by inputting numbers into the fields. Don’t include words like “hours” or “days.”
   - What is the number of class days that you missed between the start of the semester and Exam 2? There were a total of 15 class days.
   - About what percent of the time were you distracted during class? (0-100%)  
   - About what percent of the time were you distracted while studying? (0-100%)
   - In a typical **non-exam** week, how much time did you spend on this class (total number of hours per week)? Do NOT include in-class hours.

2. Please fill in the approximate number of hours you spent studying for Exam 2 on each of the following days. Use 15 minute increments (.25, .5, .75). Use a 0 if you did not study on a particular day. If you started studying earlier than Monday, March 18th, there will be another question about that next.

   [Have 7 days with blanks next to them that students fill in.]
   
   [Mon, 3/18: ______ hours
   ...
   ]

3. If you started studying for the exam before Monday, March 18th, please estimate the total number of hours that you spent studying **BEFORE** that day. Please leave blank if this does not apply to you.

4. Which of the following did you do to prepare for Exam 2? (check all that apply)
   - a. Re-watched lecture videos
   - b. Re-read lecture slides or class notes
   - c. Re-wrote your class notes word for word
   - d. Paraphrased or outlined class notes (includes creating a study guide or writing out answers to the provided study guides)
   - e. Re-read textbook
   - f. Answered the Problem Set questions
   - g. Answered the old Exam questions
   - h. Made my own diagrams or comparison tables from lecture notes
   - i. Quizzed myself using ungraded weekly quizzes, quizlets, flashcards
   - j. Attended the Review Session
   - k. Explained concepts to myself or others
   - l. Other
If you selected “Other” on the previous question, please explain: __________.

5. For the strategies that you selected on the previous question, fill in the percent of your total study time that you spent on each one. Altogether it should add up to 100%.

   a. Re-watched lecture videos
   b. Re-read lecture slides or class notes
   c. Re-wrote your class notes word for word
   d. Paraphrased or outlined class notes (includes creating a study guide or writing out answers to the provided study guides)
   e. Read textbook
   f. Answered Problem Set questions
   g. Worked on the old Exam questions
   h. Made my own diagrams or comparison tables from lecture notes
   i. Quizzed myself (using ungraded weekly quizzes, quizlets, flashcards) or had someone else quiz you
   j. Attended the Review Session
   k. Explaining concepts to yourself or others
   l. Other

6. Did you spend at least part of your time studying with other students? [yes/no]

7. Did you ask your instructor or one of the AIs for help (can include office hours, drop-in sessions, or study hall)? [yes/no]
Supplemental Table 1: Comparison of participants and non-participants. For continuous variables, the mean and standard deviation (in parentheses) are reported. Student’s T-tests were performed to obtain p-values. For categorical variables, percentages of total are shown. Chi-square tests were performed to obtain p-values. URM = under-represented minority (Black, Hispanic, Native American, Native Hawaiian, or Pacific Islander).

|                | Non-Participants | Participants | p     |
|----------------|------------------|--------------|-------|
| N              | 80               | 422          |       |
| ACT Math       | 32.65 (2.71)     | 32.93 (2.76) | 0.398 |
| Pre-Test %     | 44.06 (15.71)    | 45.32 (13.38)| 0.476 |
| Year           |                  |              | 0.136 |
| Freshman       | 75.00%           | 81.24%       |       |
| Sophomore      | 20.00%           | 14.96%       |       |
| Junior         | 2.50%            | 3.09%        |       |
| Senior or higher | 2.50%       | 0.71%        |       |
| Sex = F        | 48.75%           | 59.72%       | 0.069 |
| Race           |                  |              | 0.066 |
| Asian          | 35.90%           | 39.28%       |       |
| URM            | 33.33%           | 21.45%       |       |
| White          | 30.77%           | 39.28%       |       |
Supplemental Table 2: Means and standard deviations for all continuous variables. The total number of consenting students was 502. Note that the N below includes all data available for each variable. The tables in the text include multiple variables and may differ.

| Variable                                                      | N   | Mean   | Std. Dev. |
|---------------------------------------------------------------|-----|--------|-----------|
| ACT Math                                                      | 502 | 32.888 | 2.747     |
| Biology Pre-Test (%)                                          | 492 | 45.143 | 13.722    |
| Number of Classes Missed before Exam 1                        | 446 | 1.935  | 2.889     |
| Number of Classes Missed between Exams 1 and 2                | 485 | 2.835  | 3.391     |
| Total Exam 1 Study Hours                                       | 445 | 18.153 | 10.479    |
| Total Exam 2 Study Hours                                       | 487 | 20.725 | 11.303    |
| Proportion of Exam 1 Study Time Using Active Strategies        | 432 | 0.523  | 0.243     |
| Proportion of Exam 2 Study Time Using Active Strategies        | 473 | 0.546  | 0.244     |
| Number of Active Strategies Used for Exam 1 Studying           | 446 | 4.200  | 1.513     |
| Number of Active Strategies Used for Exam 2 Studying           | 487 | 4.187  | 1.523     |
| Days in Advance Exam 2 Studying Began                         | 460 | 5.820  | 4.342     |
| Number of Days Studied in the Week Before Exam 2               | 487 | 5.131  | 1.820     |
| Percent of Time Distracted While Studying for Exam 1           | 447 | 20.714 | 16.440    |
| Percent of Time Distracted While Studying for Exam 2           | 488 | 20.263 | 15.411    |
| Exam 1 (%)                                                     | 498 | 83.894 | 11.648    |
| Exam 2 (%)                                                     | 498 | 77.116 | 15.356    |
| Final Exam (%)                                                 | 501 | 72.659 | 13.294    |
| Biology Post-Test (%)                                          | 430 | 69.731 | 16.096    |
Supplemental Table 3: Pairwise correlation table for all included continuous variables. Correlations with p-values less than or equal to 0.05 are indicated in bold.

| ACT Math | Bio. Pre-Test (%) | Bio. Post-Test (%) | Exam 1 (%) | Exam 2 (%) | Final Exam (%) | Exam 1_Classes Missed | Exam 2_Classes Missed | Exam 1_Total Study Hrs. | Exam 2_Total Study Hrs. | Exam 1_Active Proportion | Exam 2_Active Proportion | Exam 1_Number Active Strat. | Exam 2_Number Active Strat. | Exam 1_Advance Study Days | Exam 2_Advance Study Days | Exam 1_Distracted Study (%) | Exam 2_Distracted Study (%) |
|----------|------------------|-------------------|-----------|-----------|---------------|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-----------------------------|-----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| ACT Math |                  |                   |           |           |               |                   |                     |                     |                     |                     |                    |                             |                             |                          |                          |                          |                          |
| Bio. Pre-Test (%) | 0.32 |                  |           |           |               |                   |                     |                     |                     |                     |                    |                             |                             |                          |                          |                          |                          |
| Bio. Post-Test (%) | 0.34 | 0.60             |           |           |               |                   |                     |                     |                     |                     |                    |                             |                             |                          |                          |                          |                          |
| Exam 1 (%) | 0.35 | 0.49 | 0.65 |               |           |               |                   |                     |                     |                     |                    |                    |                             |                             |                          |                          |                          |                          |
| Exam 2 (%) | 0.30 | 0.37 | 0.61 | 0.69        |           |               |                   |                     |                     |                     |                    |                    |                             |                             |                          |                          |                          |                          |
| Final Exam (%) | 0.33 | 0.42 | 0.63 | 0.74 | 0.78        |               |                   |                     |                     |                     |                    |                    |                             |                             |                          |                          |                          |                          |
| Exam 1_Classes Missed | -0.02 | -0.01 | -0.15 | -0.18 | -0.23 | -0.28 |               |                     |                     |                     |                    |                    |                             |                             |                          |                          |                          |                          |
| Exam 2_Classes Missed | -0.03 | 0.00 | -0.10 | -0.12 | -0.12 | -0.16 | 0.53         |                   |                     |                     |                    |                    |                             |                             |                          |                          |                          |                          |
| Exam 1_Total Study Hrs. | -0.11 | -0.11 | -0.07 | 0.08 | 0.13 | 0.08 | -0.10 | -0.11        |                   |                     |                    |                    |                             |                             |                          |                          |                          |                          |
| Exam 2_Total Study Hrs. | -0.14 | -0.13 | -0.09 | 0.04 | 0.08 | 0.05 | -0.04 | -0.07 | 0.66 |                   |                     |                    |                    |                             |                             |                          |                          |                          |                          |
| Exam 1_Active Proportion | -0.01 | 0.04 | 0.18 | 0.18 | 0.17 | 0.15 | -0.21 | -0.25 | 0.14 | 0.09 |               |                   |                     |                    |                             |                             |                          |                          |                          |
| Exam 2_Active Proportion | -0.02 | 0.06 | 0.14 | 0.17 | 0.19 | 0.20 | -0.24 | -0.28 | 0.09 | 0.06 | 0.59 |                   |                     |                    |                    |                             |                             |                          |                          |                          |
| Exam 1_Number Active Strat. | -0.07 | -0.02 | 0.13 | 0.26 | 0.19 | 0.21 | -0.28 | -0.20 | 0.36 | 0.20 | 0.52 | 0.37 |                   |                     |                    |                    |                             |                             |                          |                          |                          |
| Exam 2_Number Active Strat. | -0.06 | -0.04 | 0.10 | 0.17 | 0.29 | 0.22 | -0.27 | -0.25 | 0.24 | 0.28 | 0.39 | 0.53 | 0.55 |                   |                     |                    |                    |                             |                             |                          |                          |                          |
| Exam 1_Advance Study Days | -0.14 | -0.08 | 0.02 | 0.03 | 0.04 | -0.02 | -0.06 | -0.20 | 0.38 | 0.45 | 0.18 | 0.16 | 0.21 | 0.20 |                   |                     |                    |                    |                             |                             |                          |                          |                          |
| Exam 2_Advance Study Days | -0.18 | -0.17 | -0.17 | -0.11 | -0.04 | -0.07 | -0.12 | -0.19 | 0.36 | 0.47 | 0.06 | 0.03 | 0.22 | 0.23 | 0.55 |                   |                     |                    |                    |                             |                             |                          |                          |                          |
| Exam 1_Distracted Study (%) | -0.04 | 0.00 | -0.17 | -0.17 | -0.16 | -0.18 | 0.09 | 0.15 | -0.11 | -0.05 | -0.09 | -0.20 | -0.24 | -0.19 | -0.11 | -0.07 |                   |                     |                    |                    |                             |                             |                          |                          |                          |
| Exam 2_Distracted Study (%) | 0.01 | -0.04 | -0.11 | -0.10 | -0.16 | -0.15 | 0.03 | 0.06 | -0.14 | -0.15 | -0.15 | -0.19 | -0.24 | -0.19 | -0.09 | -0.04 | 0.43 |                   |                     |                    |                    |                             |                             |                          |                          |                          |
### Supplemental Table 4: Full output for the twelve, two-step hierarchical regression models per exam summarized in Table 3. The base model, which was used as step 1 of all models, is main text Table 2. In the second step, each study strategy was added to the model. Standardized β values, unstandardized b values, and standard errors (SE) are reported for each variable. Each model’s R² is also reported. Ranges of possible values for each variable are shown in brackets. The following symbols indicate significance, *p≤0.05, **p≤0.01, ***p≤0.001.

**Step 2, Read Notes**

| Term                                | Exam 1, n=424                  | Exam 2, n=471                  |
|-------------------------------------|--------------------------------|--------------------------------|
| Intercept                           | β_unstd. 37.14*** 5.618        | β_unstd. 18.55** 8.063         |
| Bio. Pre-Test % [0-100]             | 0.418*** 0.339*** 0.035        | 0.332*** 0.363*** 0.047        |
| ACT [0-36]                          | 0.239*** 0.96*** 0.172         | 0.222*** 1.243*** 0.243        |
| Total Exam 1 or 2 Study Hours [20]  | 0.127** 0.132** 0.042         | 0.156*** 0.207*** 0.055        |
| Number of Classes Missed before Exam 1 or 2 [0-15] or between Exams 1 and 2 [0-12] | -0.16** -0.63*** 0.158 | -0.1** -0.45** 0.183 |
| Read Notes                          | -0.03 -1.23 1.954              | -0.04 -2.63 2.705              |

**Step 2, Completed Problem Sets**

| Term                                | Exam 1, n=424                  | Exam 2, n=471                  |
|-------------------------------------|--------------------------------|--------------------------------|
| Intercept                           | β_unstd. 34.91*** 5.455        | β_unstd. 14.37 7.8             |
| Bio. Pre-Test % [0-100]             | 0.422*** 0.342*** 0.034        | 0.333*** 0.364*** 0.046        |
| ACT [0-36]                          | 0.24*** 0.963*** 0.17          | 0.228*** 1.273*** 0.238        |
| Total Exam 1 or 2 Study Hours [20]  | 0.112** 0.117** 0.042         | 0.129** 0.171** 0.054          |
| Number of Classes Missed before Exam 1 or 2 [0-15] or between Exams 1 and 2 [0-12] | -0.14** -0.53*** 0.159 | -0.09* -0.4* 0.18 |
| Completed Problem Sets              | 0.136*** 4.32*** 1.292         | 0.19*** 7.678*** 1.637         |

**Step 2, Completed Old Exams**

| Term                                | Exam 1, n=424                  | Exam 2, n=471                  |
|-------------------------------------|--------------------------------|--------------------------------|
| Intercept                           | β_unstd. 36.71*** 5.503        | β_unstd. 18.89* 7.816          |
| Bio. Pre-Test % [0-100]             | 0.415*** 0.336*** 0.035        | 0.325*** 0.354*** 0.047        |
| ACT [0-36]                          | 0.236*** 0.949*** 0.172        | 0.211*** 1.181*** 0.239        |
| Total Exam 1 or 2 Study Hours [20]  | 0.119** 0.124** 0.043         | 0.133*** 0.176*** 0.055        |
| Number of Classes Missed before Exam 1 or 2 [0-15] or between Exams 1 and 2 [0-12] | -0.15** -0.61*** 0.159 | -0.08* -0.37* 0.181 |
| Completed Old Exams                 | 0.05 1.444 1.177               | 0.174*** 5.847*** 1.373        |

**Step 2, Self-Quizzed**

| Term                                | Exam 1, n=424                  | Exam 2, n=471                  |
|-------------------------------------|--------------------------------|--------------------------------|
| Intercept                           | β_unstd. 35.14*** 5.405        | β_unstd. 14.27 7.851           |
| Bio. Pre-Test % [0-100]             | 0.412 0.334*** 0.034           | 0.342*** 0.373*** 0.047        |
| ACT [0-36]                          | 0.246 0.989*** 0.168           | 0.233*** 1.301*** 0.239        |
| Total Exam 1 or 2 Study Hours [20]  | 0.096 0.1* 0.042              | 0.138*** 0.182*** 0.055        |
| Number of Classes Missed before Exam 1 or 2 [0-15] or between Exams 1 and 2 [0-12] | -0.13 -0.53*** 0.157 | -0.08 -0.34 0.182 |
| Self-Quizzed                        | 0.17*** 4.377*** 1.042         | 0.168*** 5.395*** 1.317        |
### Step 2, Explained Concepts

| Term                      | Exam 1, n=424 | Exam 2, n=471 |
|---------------------------|---------------|---------------|
| Intercept                 |               | 0.258         |
| Bio. Pre-Test % [0-100]   | 0.413***      | 0.333***      |
| ACT [0-36]                | 0.239***      | 0.227**       |
| Total Exam 1 or 2 Study Hours [≥0] | 0.091* | 0.124         |
| Number of Classes Missed before Exam 1 [0-15] or between Exams 1 and 2 [0-12] | -0.11** | -0.07         |
| Explained concepts        | 0.24***       | 0.201         |

### Step 2, Synthesized Notes

| Term                      | Exam 1, n=424 | Exam 2, n=471 |
|---------------------------|---------------|---------------|
| Intercept                 | 0.381         |               |
| Bio. Pre-Test % [0-100]   | 0.421***      | 0.337***      |
| ACT [0-36]                | 0.247***      | 0.228**       |
| Total Exam 1 or 2 Study Hours [≥0] | 0.111** | 0.136***      |
| Number of Classes Missed before Exam 1 [0-15] or between Exams 1 and 2 [0-12] | -0.15** | -0.09*        |
| Read Notes                | 1.402         | 0.086*        |

### Step 2, Made Diagrams

| Term                      | Exam 1, n=424 | Exam 2, n=471 |
|---------------------------|---------------|---------------|
| Intercept                 | 0.334         |               |
| Bio. Pre-Test % [0-100]   | 0.416***      | 0.333***      |
| ACT [0-36]                | 0.247***      | 0.226**       |
| Total Exam 1 or 2 Study Hours [≥0] | 0.103** | 0.144***      |
| Number of Classes Missed before Exam 1 [0-15] or between Exams 1 and 2 [0-12] | -0.16** | -0.09*        |
| Made Diagrams             | 0.084*        | 0.066         |

### Step 2, Reviewed Online Outside Content

| Term                      | Exam 1, n=424 | Exam 2, n=471 |
|---------------------------|---------------|---------------|
| Intercept                 | 0.334         |               |
| Bio. Pre-Test % [0-100]   | 0.423***      | 0.328**       |
| ACT [0-36]                | 0.233***      | 0.218**       |
| Total Exam 1 or 2 Study Hours [≥0] | 0.138*** | 0.159**       |
| Number of Classes Missed before Exam 1 [0-15] or between Exams 1 and 2 [0-12] | -0.16** | -0.11**       |
| Reviewed Online Outside Content | -1.84* | -0.06         |

### Step 2, Watched Lecture

| Term                      | Exam 1, n=424 | Exam 2, n=471 |
|---------------------------|---------------|---------------|
| Intercept                 | 0.328         |               |
| Bio. Pre-Test % [0-100]   | 0.419***      | 0.327**       |
| ACT [0-36]                | 0.24***       | 0.222**       |
| Total Exam 1 or 2         | 0.125**       | 0.17**        |
| Term                                                                 | Exam 1, n=424 |                |                | Exam 2, n=471 |                |                |
|----------------------------------------------------------------------|---------------|----------------|----------------|---------------|----------------|----------------|
| Number of Classes Missed before Exam 1 [0-15] or between Exams 1 and 2 [0-12] | -0.16***      | -0.64***       | 0.167          | -0.08         | -0.34          | 0.19           |
| Watched Lecture                                                      | 0.009         | 0.194          | 0.968          | -0.09*        | -2.66*         | 1.305          |
| Study Hours [≥0]                                                     |               |                |                |               |                |                |
| Step 2, Read Textbook                                                |               |                |                |               |                |                |
| Intercept                                                            | --            | 36.13***       | 5.498          | --            | 16.56*         | 7.982          |
| Bio. Pre-Test % [0-100]                                              | 0.423***      | 0.342***       | 0.035          | 0.335***      | 0.365***       | 0.047          |
| ACT [0-36]                                                           | 0.24***       | 0.963***       | 0.171          | 0.224***      | 1.252***       | 0.243          |
| Total Exam 1 or 2 Study Hours [≥0]                                   | 0.129**       | 0.135**        | 0.042          | 0.156***      | 0.206***       | 0.055          |
| Number of Classes Missed before Exam 1 [0-15] or between Exams 1 and 2 [0-12] | -0.16***      | -0.64***       | 0.158          | -0.1*         | -0.45*         | 0.183          |
| Read Textbook                                                       | -0.06         | -1.35          | 0.911          | -0.04         | -1.43          | 1.525          |

| Term                                                                 | Exam 1, n=424 |                |                | Exam 2, n=471 |                |                |
|----------------------------------------------------------------------|---------------|----------------|----------------|---------------|----------------|----------------|
| Step 2, Attended Review Sessions                                    |               |                |                |               |                |                |
| Intercept                                                            | --            | 37.3***        | 5.384          | --            | 18.27*         | 7.936          |
| Bio. Pre-Test % [0-100]                                              | 0.412***      | 0.334***       | 0.034          | 0.327         | 0.357***       | 0.047          |
| ACT [0-36]                                                           | 0.247***      | 0.994***       | 0.168          | 0.228         | 1.275***       | 0.242          |
| Total Exam 1 or 2 Study Hours [≥0]                                   | 0.101**       | 0.106**        | 0.042          | 0.143         | 0.189***       | 0.055          |
| Number of Classes Missed before Exam 1 [0-15] or between Exams 1 and 2 [0-12] | -0.15***      | -0.58***       | 0.155          | -0.09         | -0.39*         | 0.185          |
| Attended Review Session/Help Sessions/Office Hours                   | 0.178***      | 4.6***         | 1.028          | 0.087         | 3.961*         | 1.897          |

| Term                                                                 | Exam 1, n=424 |                |                | Exam 2, n=471 |                |                |
|----------------------------------------------------------------------|---------------|----------------|----------------|---------------|----------------|----------------|
| Step 2, Rewrote Notes                                               |               |                |                |               |                |                |
| Intercept                                                            | --            | 36.14***       | 5.523          | --            | 18.92*         | 7.936          |
| Bio. Pre-Test % [0-100]                                              | 0.423***      | 0.34***        | 0.035          | 0.326         | 0.356***       | 0.047          |
| ACT [0-36]                                                           | 0.239***      | 0.96***        | 0.172          | 0.217         | 1.212***       | 0.242          |
| Total Exam 1 or 2 Study Hours [≥0]                                   | 0.133**       | 0.139**        | 0.044          | 0.171         | 0.226***       | 0.056          |
| Number of Classes Missed before Exam 1 [0-15] or between Exams 1 and 2 [0-12] | -0.16***      | -0.63***       | 0.158          | -0.1          | -0.46**        | 0.182          |
| Rewrote Notes                                                       | -0.03         | -0.85          | 1.232          | -0.1          | -4.18*         | 1.659          |
Supplemental Table 5: Full output for the two, two-step hierarchical regression models per exam summarized in Table 4 [pooled active strategies]. The base model, which was used as step 1 in both models, is reported in A. The second step, where the proportion of active study time (B) or the number of active strategies (C) variables were added is also given. Standardized $\beta$ values, unstandardized $b$ values, and standard errors (SE) are reported for each variable. Each model’s $R^2$ is also reported. Ranges of possible values for each variable are shown in brackets. The following symbols indicate significance, *$p<0.05$, **$p<0.01$, ***$p<0.001$.

### A) Step 1, Base Model

| Term                                      | Exam 1, n=422 |                | Exam 2, n=456 |                |
|-------------------------------------------|---------------|----------------|---------------|----------------|
| Intercept                                 | $-37.61^{***}$| $5.51$         | $-14.49$      | $7.85$         |
| ACT [0-36]                                | $0.224^{***}$ | $0.891^{***}$ | $0.170$       | $0.241^{***}$ | $1.323^{***}$ | $0.240$ |
| Bio. Pre-Test % [0-100]                   | $0.420^{***}$ | $0.345^{***}$ | $0.035$       | $0.343^{***}$ | $0.370^{***}$ | $0.047$ |
| Number of Classes Missed before Exam 1 [0-15] or between Exams 1 and 2 [0-12] | $-0.161^{***}$ | $-0.607^{***}$ | $0.153$     | $-0.100^{*}$ | $-0.428^{*}$ | $0.183$ |
| Total Exam 1 or 2 Study Hours [≥0]        | $0.157^{***}$ | $0.187^{***}$ | $0.049$       | $0.165^{***}$ | $0.214^{***}$ | $0.054$ |

### B) Step 2, Prop. Active

| Term                                      | Exam 1, n=422 |                | Exam 2, n=456 |                |
|-------------------------------------------|---------------|----------------|---------------|----------------|
| Intercept                                 | -- $34.79^{***}$ | $5.546$       | -- $8.004$   | $7.914$       |
| ACT [0-36]                                | $0.226^{***}$ | $0.901^{***}$ | $0.169$       | $0.248^{***}$ | $1.362^{***}$ | $0.237$ |
| Bio. Pre-Test % [0-100]                   | $0.413^{***}$ | $0.339^{***}$ | $0.035$       | $0.330^{***}$ | $0.356^{***}$ | $0.046$ |
| Number of Classes Missed before Exam 1 [0-15] or between Exams 1 and 2 [0-12] | $-0.140^{***}$ | $-0.520^{***}$ | $0.154$     | $-0.050$       | $-0.220$       | $0.187$ |
| Total Exam 1 or 2 Study Hours [≥0]        | $0.143^{***}$ | $0.171^{***}$ | $0.049$       | $0.157^{***}$ | $0.204^{***}$ | $0.054$ |
| Proportion of Exam Study Time Using Active Strategies [0-1] | $0.122^{**}$ | $5.499^{**}$ | $1.857$       | $0.163^{***}$ | $9.967^{***}$ | $2.587$ |

### C) Step 2, Number Active

| Term                                      | Exam 1, n=422 |                | Exam 2, n=456 |                |
|-------------------------------------------|---------------|----------------|---------------|----------------|
| Intercept                                 | -- $29.49^{***}$ | $5.49$       | -- $2.673$   | $7.72$       |
| ACT [0-36]                                | $0.241^{***}$ | $0.958^{***}$ | $0.164$       | $0.248^{***}$ | $1.362^{***}$ | $0.23$ |
| Bio. Pre-Test % [0-100]                   | $0.406^{***}$ | $0.333^{***}$ | $0.034$       | $0.342^{***}$ | $0.368^{***}$ | $0.045$ |
| Number of Classes Missed before Exam 1 [0-15] or between Exams 1 and 2 [0-12] | $-0.100^{*}$ | $-0.370^{*}$ | $0.153$     | $-0.030$       | $-0.14^{*}$       | $0.18$ |
| Total Exam 1 or 2 Study Hours [≥0]        | $0.069$       | $0.082$       | $0.050$       | $0.093^{*}$   | $0.121^{*}$       | $0.054$ |
| Number of Active Strategies Used for Exam Studying [0-6] | $0.253^{***}$ | $1.858^{***}$ | $0.320$       | $0.277^{***}$ | $2.759^{***}$ | $0.420$ |
Supplemental Table 6: Regression model incorporating all active strategies simultaneously for Exam 1 (n=424) or Exam 2 (n=471) when controlling for preparation, class absences, and total study hours (base model). This Table summarizes one two-step hierarchical model per assessment. The first step adjusted for the base model (see main text Table 2), and the second step included all active strategies simultaneously. Unstandardized \( b \) values, standard errors (SE), and the change in \( R^2 \) relative to the base model are reported. The following symbols indicate significance, *\( p \leq 0.05 \), **\( p \leq 0.01 \), ***\( p \leq 0.001 \). See Table 1 for wording of prompts.

| Step 2, Combined Active Strategies | Exam 1, n=424 |  | Exam 2, n=471 |  |
|-----------------------------------|---------------|---------------|---------------|---------------|
| Term                              | \( \beta_{unstd.} \) | \( b_{unstd.} \) | SE            | \( R^2 \) (\( \Delta R^2 A \)) | \( \beta_{unstd.} \) | \( b_{unstd.} \) | SE            | \( R^2 \) (\( \Delta R^2 A \)) |
| Intercept                         | --            | 34.02 ***     | 5.265         |                | --            | 14.83**       | 7.555         |
| ACT [0-36]                        | 0.247***      | 0.993***      | 0.164         | 0.222***       | 1.238***      | 0.230         |
| Bio. Pre-Test % [0-100]           | 0.413***      | 0.335***      | 0.033         | 0.333***       | 0.364***      | 0.045         |
| Number of Classes Missed before   |               |               | 0.156         |               | 0.041         | -0.181        | 0.179         |
| Exam 1 [0-15] or between Exams 1  | -0.085*       | -0.334*       | -0.156        | 0.083*         | -0.110*       | 0.054         |               |
| and 2 [0-12]                      |               |               |               |               |               |               |               |
| Total Exam 1 or 2 Study Hours [≥0]| 0.060         | 0.062         | 0.043         | 0.083*         | 0.110*        | 0.054         |               |
| Completing Old Exams              | -0.017        | -0.502        | 1.147         | 0.125**        | 4.183**       | 1.356         |
| Completing Problem Sets           | 0.085*        | 2.713*        | 1.286         | 0.128**        | 5.136**       | 1.647         |
| Explain concepts                  | 0.210***      | 4.857***      | 0.940         | 0.156**        | 4.943***      | 1.303         |
| Make Diagrams                     | 0.010         | 0.213         | 0.937         | -0.012         | -0.368        | 1.395         |
| Synthesize Notes                  | 0.016         | 0.364         | 0.945         | 0.038          | 1.224         | 1.427         |
| Self-quizzing                     | 0.126**       | 3.229**       | 1.040         | 0.086*         | 2.736*        | 1.325         |

\( ^{\wedge} \) Relative to a base model with \( R^2 = 0.327 \) that included ACT score, Bio. Pre-Test %, Number of Classes Missed Before Exam 1, and Total Exam 1 Study Hours. See Table 2 for base model details.

\( ^{\&} \) Relative to a base model with \( R^2 = 0.219 \) that included ACT score, Bio. Pre-Test %, Number of Classes Missed Between Exams 1 and 2, and Total Exam 2 Study Hours. See Table 2 for base model details.
Supplemental Table 7: Full output for the two, two-step hierarchical regression models per assessment summarized in Table 5 [study timing]. The base model, which was used as step 1 in both models, is reported in A. The second step, where the days in advance studying began (B) or the number of days studied in the week before exam 2 (C) variables were added is also given. Standardized β values, unstandardized b values, and standard errors (SE) are reported for each variable. Each model’s R² is also reported. Ranges of possible values for each variable are shown in brackets. The following symbols indicate significance, *p<0.05, **p<0.01, ***p<0.001.

| A) Step 1, Base Model | Exam 2, n=447 | Post-Test, n=392 | Final Exam, n=450 |
|-----------------------|--------------|-----------------|-------------------|
| Term                  | βstd | unstd | SE  | βstd | unstd | SE  | βstd | unstd | SE  | R²  |
| Intercept             | --   | 15.49 | 8.224 | --   | 9.029 | 8.124 | --   | 9.029 | 8.124 | 0.231 | 0.396 |
| ACT [0-36]            | 0.226*** | 1.28*** | 0.252 | 0.176*** | 1.038*** | 0.251 | 0.222*** | 1.087*** | 0.212 | 0.308*** |
| Bio. Pre-Test % [0-100] | 0.34*** | 0.376*** | 0.049 | 0.539*** | 0.617*** | 0.049 | 0.378*** | 0.361*** | 0.041 | 0.353*** |
| Number of Classes Missed between Exams 1 and 2 [0-12] | -0.1* | -0.45* | 0.189 | -0.07 | -0.36 | 0.197 | -0.15*** | -0.59*** | 0.158 | 0.343*** |
| Total Exam 2 Study Hours [≥0] | 0.155*** | 0.209*** | 0.057 | 0.005 | 0.007 | 0.056 | 0.124** | 0.144** | 0.048 | 0.273 |

B) Step 2, Days in Advance Studying Began

| B) Step 2, Days in Advance Studying | Exam 2, n=447 | Post-Test, n=392 | Final Exam, n=450 |
|-----------------------|--------------|-----------------|-------------------|
| Term                  | βstd | unstd | SE  | βstd | unstd | SE  | βstd | unstd | SE  | R²  |
| Intercept             | --   | 15.41 | 8.329 | --   | 6.54 | 8.266 | --   | 21.15** | 6.975 | 0.275 |
| ACT [0-36]            | 0.227*** | 1.281*** | 0.254 | 0.186*** | 1.095*** | 0.253 | 0.217*** | 1.063*** | 0.212 | 0.356*** |
| Bio. Pre-Test % [0-100] | 0.34*** | 0.376*** | 0.049 | 0.535*** | 0.612*** | 0.049 | 0.378*** | 0.363*** | 0.041 | 0.356*** |
| Number of Classes Missed between Exams 1 and 2 [0-12] | -0.1* | -0.45* | 0.194 | -0.06 | -0.3 | 0.201 | -0.16*** | -0.63*** | 0.161 | 0.356*** |
| Total Exam 2 Study Hours [≥0] | 0.154*** | 0.207*** | 0.064 | -0.02 | -0.03 | 0.062 | 0.149** | 0.174** | 0.053 | 0.356*** |
| Days in Advance Exam 2 Studying Began [≥0] | 0.003 | 0.011 | 0.168 | 0.071 | 0.252 | 0.162 | -0.06 | -0.18 | 0.14 | 0.356*** |

C) Step 2, Number of Days

| C) Step 2, Number of Days | Exam 2, n=447 | Post-Test, n=392 | Final Exam, n=450 |
|---------------------------|--------------|-----------------|-------------------|
| Term                      | βstd | unstd | SE  | βstd | unstd | SE  | βstd | unstd | SE  | R²  |
| Intercept                 | --   | 18.55* | 8.672 | --   | 13.5 | 8.697 | --   | 23.74** | 7.252 | 0.278 |
| ACT [0-36]                | 0.221*** | 1.247*** | 0.254 | 0.167*** | 0.98*** | 0.254 | 0.214*** | 1.047*** | 0.213 | 0.372*** |
| Bio. Pre-Test % [0-100]   | 0.336*** | 0.372*** | 0.049 | 0.535*** | 0.612*** | 0.049 | 0.372*** | 0.354*** | 0.041 | 0.372*** |
|                                    | coef1 | coef2 | coef3 | coef4 | coef5 | coef6 | coef7 | coef8 | coef9 | coef10 |
|------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-------|
| Number of Classes Missed between  | -0.11 | -0.49 | 0.193 | -0.08 | -0.42 | 0.2   | -0.17 | -0.64 | 0.16  |        |       |
| Exams 1 and 2 [0-12]              |       |       |       |       |       |       |       |       |       |        |       |
| Total Exam 2 Study Hours [≥0]      | 0.18  | 0.24  | 0.064 | 0.034 | 0.047 | 0.063 | 0.16  | 0.18  | 0.05  |        |       |
| Number of Days Studied in Week     | -0.05 | -0.46 | 0.41  | -0.07 | -0.59 | 0.41  | -0.08 | -0.61 | 0.34  |        |       |
| Before Exam 2 [0-8]                |       |       |       |       |       |       |       |       |       |        |       |
Supplemental Table 8: Full output for the two-step hierarchical regression models summarized in Table 6 [distraction]. The base model, which was used as step 1 in the model is reported in A. The second step, where the percent of time students reported being distracted when studying was added is also given. Standardized β values, unstandardized b values, and standard errors (SE) are reported for each variable. Each model's $R^2$ is also reported. Ranges of possible values for each variable are shown in brackets. The following symbols indicate significance, *$p$≤0.05, **$p$≤0.01, ***$p$≤0.001.

### A) Step 1, Base Model

| Term                                  | Exam 1, n=435 |           |          |          | Exam 2, n=473 |           |          |          |
|---------------------------------------|---------------|-----------|----------|----------|---------------|-----------|----------|----------|
|                                       | $\beta_{std.}$ | $b_{unstd.}$ | SE       | $R^2$    | $\beta_{std.}$ | $b_{unstd.}$ | SE       | $R^2$    |
| Intercept                             | --            | 36.98***  | 5.406    |          | --            | 17.69*    | 7.898    |
| ACT [0-36]                            | 0.234***      | 0.932***  | 0.168    |          | 0.222***      | 1.236***  | 0.242    |
| Bio. Pre-Test % [0-100]                | 0.420***      | 0.344***  | 0.034    | 0.328    | 0.333***      | 0.364***  | 0.047    |
| Number of Classes Missed before Exam 1 [0-15] or between Exams 1 and 2 [0-12] | -0.158*** | -0.608*** | 0.153    |          | -0.100*       | -0.445*   | 0.183    |
| Total Exam 1 or 2 Study Hours [≥0]     | 0.134***      | 0.141***  | 0.042    |          | 0.152***      | 0.202***  | 0.055    |

### B) Step 2, Distraction

| Term                                  | Exam 1, n=435 |           |          |          | Exam 2, n=473 |           |          |          |
|---------------------------------------|---------------|-----------|----------|----------|---------------|-----------|----------|----------|
|                                       | $\beta_{std.}$ | $b_{unstd.}$ | SE       | $R^2$    | $\beta_{std.}$ | $b_{unstd.}$ | SE       | $R^2$    |
| Intercept                             | --            | 39.75***  | 5.394    |          | --            | 21.00**   | 7.910    |
| ACT [0-36]                            | 0.229***      | 0.913***  | 0.166    |          | 0.222***      | 1.236***  | 0.240    |
| Bio. Pre-Test % [0-100]                | 0.420***      | 0.344***  | 0.034    | 0.347    | 0.325***      | 0.354***  | 0.047    |
| Number of Classes Missed before Exam 1 [0-15] or between Exams 1 and 2 [0-12] | -0.146*** | -0.564*** | 0.152    |          | -0.094*       | -0.418*   | 0.181    |
| Total Exam 1 or 2 Study Hours [≥0]     | 0.118**       | 0.125**   | 0.042    |          | 0.132**       | 0.174**   | 0.055    |
| Percent of Time Distracted While Studying [0-100] | -0.139*** | -0.093*** | 0.027    |          | -0.123**      | -0.119**  | 0.040    |