What are learning assistants?
Learning Assistants (LAs) at Central Washington University are talented undergraduates who enhance student learning in introductory physics courses by making them more collaborative, student-centered, and interactive. In the process, LAs are given an early teaching experience. Throughout the quarter, LAs engage in a variety of tasks including helping students solve problems, assisting with conceptual understanding, and facilitating lab activities. LAs effectively engage students in the class material through careful listening, diagnosing student needs, and leading students to a better understanding via strategic questioning strategies.

Being an LA is a great way to review your introductory physics content and to practice explaining physics concepts to others. If you are interested in a career in teaching, you should definitely be an LA. But even if you are not interested in a teaching career, you will use the questioning, interpersonal, and explanatory skills in whatever job you have.

Diagrammatic Summary of the LA Experience (from http://www.learningassistantalliance.org/)

What are the specific LA tasks?

- **LA Seminar (PHYS 292/392):** First quarter LAs must enroll in PHYS 292, a 2-credit inquiry-based course that provides preparation for facilitating physics learning in an interactive college classroom. Subsequent quarters, students may enroll in PHYS 392. This 2-credit course incorporates the same seminar but requires LAs to delve deeper into teaching tasks. Upon completion of PHYS 292, students can be LAs without enrolling in PHYS 392. But they must still attend the seminar and participate in discussions as mentors to the new LAs.

- **Facilitating learning in an introductory physics course:** LAs work approximately four hours a week in an introductory physics class. Most of this time is spent walking around the classroom while students work on independent and small group learning projects. LAs certainly answer student questions. But more importantly, they listen in on group conversations and watch groups working in order to proactively ask questions and effectively probe student learning.

- **Advance preparation:** LAs are expected to meet with their instructor once a week to discuss the upcoming week’s lessons. This is also a good opportunity for the LA to give feedback to the instructors about issues they have noticed about class learning, in general, or the problems specific students are having.

Instructor course planning outline

**Previous school year**

- Assign PHYS 292/392 to a faculty member. Ideally, the same person should teach the seminar and administer the LA program all three quarters. Even though this is a 2-credit course, assign 1 WLU/quarter for the instructor of record because the seminar is small and there is typically only one hour of instructor planned curriculum per week.
Two quarters in advance
- Make sure both PHYS 292/392 are on the course schedule. Request a room in Lind Hall.
- Pick a time that does not conflict with upper level physics department courses. Early evening works best.
- The second hour of seminar should overlap with an evening section of a first year physics course. That way, the first hour of seminar can consist of discussing pedagogical issues in theory and the second hour can consist of a practicum in which all seminar students work with the physics class. This allows the seminar instructor to observe the LAs in action and discuss pedagogical events that actually occurred that night.

One quarter in advance
- Select the seminar readings. See the sample syllabus for ideas.
- Discuss the whole class, seminar-following practicum with the evening physics course instructor. Stress that this night is a great opportunity to do conceptually, computationally, or logistically difficult tasks because of all the expert support that will be in the classroom.
- Recruit LAs from the current pool of LAs, prior quarter LAs, and upper level students.
- Recruit faculty members to host LAs in their classes. This should be done via email and in person at a department meeting. See the sample faculty recruitment email.
- Work with the department secretary and HR to make sure the LA job is posted online for the students to apply for. The earlier the students apply, the more likely it is they will be able to start work immediately.

Early in the current quarter
- Make sure all LAs have applied (if new) or that their LA position has been extended (if returning).

LA requirements
- Successful completion of PHYS 181-183 or equivalent. Typically, “successful” means grades of “B” or higher. Students with a slightly lower physics GPA may be effective LAs depending on background or circumstances.
- Strong desire to learn teaching and learning facilitation skills. Ask students about their career interests and what they would like to get out of being an LA.

Recruiting LAs
- Ask PHYS 183 instructors which students have the ability and interest to be successful LAs.
- Promote the LA program at an SPS meeting.
- Discuss the LA program in the main sophomore-level courses such as optics (PHYS 363) and Modern Physics I (PHYS 317).

Tips for LAs (advice from veteran LAs)
- Be prepared. Don’t go into class thinking “I got an “A” in this class last year so I don’t have to prep”.
- Listen well before speaking. Listening to students will give an LA a starting point for how to help.
- Don’t answer questions right away. Ask questions in return. Give students or groups of students every opportunity to determine an answer on their own.
• **Relate concepts to previous concepts or the real world.** Students have difficulty determining how new knowledge relates to old, especially if that "old" knowledge is something that is nearly new to them.

**The next few pages consists of course syllabi and assignments.**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 292 Syllabus</td>
<td>Brief overview of course outcomes, assignments, and calendar.</td>
<td>4</td>
</tr>
<tr>
<td>Sample case study</td>
<td>LAs in PHYS 292 write a case study based on one of their interactions with a group of students.</td>
<td>6</td>
</tr>
<tr>
<td>Case study rubric</td>
<td>Overview of how the case study assignment is evaluated.</td>
<td>8</td>
</tr>
<tr>
<td>Tip sheet description and rubric</td>
<td>Each LA in PHYS 292 develops a short set of tips to share with new LAs.</td>
<td>9</td>
</tr>
<tr>
<td>Sample tip sheet</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Self-evaluation essay</td>
<td>Students write this as an overall evaluation of the course, themselves, their classmates, the physics course instructor, and the seminar instructor.</td>
<td>11</td>
</tr>
<tr>
<td>LA feedback form</td>
<td>The LA and the physics course instructor fill this out about the LA.</td>
<td>12</td>
</tr>
<tr>
<td>Weekly teaching reflection</td>
<td>Each week, LAs describe an interaction they had with a student or group of students. They typically base their case study off of one of these.</td>
<td>13</td>
</tr>
<tr>
<td>Sample weekly teaching reflection</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>PHYS 392 Syllabus</td>
<td>Brief overview of course outcomes, assignments, and calendar. Note how the assignments differ somewhat from 292.</td>
<td>16</td>
</tr>
<tr>
<td>Action research project description</td>
<td>Describes what goes into the main PHYS 392 assignment, the action research project.</td>
<td>18</td>
</tr>
<tr>
<td>Lesson plan description</td>
<td>Describes what goes into the lesson plan assignment. Typically, LAs do the lesson plan as part of their action research project.</td>
<td>19</td>
</tr>
</tbody>
</table>
PHYS 292: Exploring Physics Teaching I (2 credits)

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Bruce Palmquist</th>
<th>Email</th>
<th><a href="mailto:palmquis@cwu.edu">palmquis@cwu.edu</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Office Location</td>
<td>SCI 107C Lind 117</td>
<td>Office Hours</td>
<td>MTh 3-4 (Lind 117) Other times by appointment</td>
</tr>
<tr>
<td>Phone</td>
<td>509-963-3142</td>
<td>Meeting time</td>
<td>M 6:30-8:20 pm Plus one hour to meet and plan with the instructor of the class you are an LA for.</td>
</tr>
<tr>
<td>Classroom</td>
<td>Lind 204</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Course Description: Inquiry-based learning course that provides preparation for teaching physics using pedagogies that have been guided by physics education research.

- Upon successful completion of this course, you will have met the criteria to be a Certified Academic Tutor, certified nationally through the College Reading and Learning Association (CRLA).
- Upon successful completion of this course and the first section of your mathematics teaching portfolio, physics-math teaching dual degree students will have fulfilled the requirements of MATH 299E.

Prerequisites: PHYS 113 or 183

Corequisite: Working at least three hours a week as an LA. You will get paid for this.

Course introduction: This is an inquiry-based learning course that provides preparation for facilitating physics learning in an interactive environment such as a college classroom. In the course, we will reflect on and integrate content knowledge, practical skills, and the pedagogy of science teaching. Throughout the quarter, we will discuss issues such as participating in dialogue with students, active listening, communication skills, and formative assessment. This course will involve a great deal of discussion so we all need to be both active participants and respectful listeners.

Course outcomes and assessments:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Assessment</th>
<th>Specific assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop skills listening and responding to physics conceptions in a classroom.</td>
<td>Write a case-study highlighting one's own use of active listening to address a physics learning issue.</td>
<td>Written case study and presentation</td>
</tr>
<tr>
<td>Use effective strategies for explaining physics skills and concepts</td>
<td>Develop a tip sheet for helping students teach a physics concept or skill.</td>
<td>Tip sheet and presentation</td>
</tr>
<tr>
<td>Effectively self-assess and reflect on teaching practice</td>
<td>Keep a reflective notebook based on the process standards of quantitative literacy that highlight all teaching experiences.</td>
<td>Physics skill &amp; quantitative literacy teaching reflections</td>
</tr>
<tr>
<td>Develop pedagogical content knowledge in physics.</td>
<td>Read articles and analyze a series of video case studies addressing teaching and learning issues in a physics class.</td>
<td>Article reflections</td>
</tr>
</tbody>
</table>

Final Grades for the course will be calculated as follows:

A 92 - 100%  A- 90 - 91%  B+ 88 - 89%  B 82 - 87%  B- 80 - 81%  C+ 78 - 79%  C 72 - 77%  C- 70 - 71%  D+ 68 - 69%  D 62 - 67%  D- 60 - 61%  F <60%

Grading Specifics (PHYS 292) Relative Weight

Peer, self, and instructor evaluation .................................................................20%
Written case study .......................................................................................20%
Tip sheet ......................................................................................................20%
Article reflections .....................................................................................20%
Teaching reflections ...................................................................................20%
Total ........................................................................................................ 100%

Brief summary of course assignments

Peer/self/instructor evaluation: Because this course relies so heavily on building a community of practitioner-scholars, an evaluation of your contributions to this community makes up a significant portion of the course grade. At the end of the quarter, each student will fill out a survey to evaluate the contributions of their classmates. You will evaluate your own contributions on the same survey. Finally, the instructor you work with will as a learning assistant will evaluate your contributions to helping student learn physics in his/her course on a separate rubric.
**Article reflections:** Each week, you will be assigned a physics education-related paper to read, and you will be asked to answer a series of discussion questions and respond to the answer of two of your classmates. We will use these discussion questions/reflections as the starting point for discussion in class. Your initial answers are due on Thursday night and your responses to two classmates are due on Sunday night, the day before class. See Canvas for assignment guidance and a rubric.

**Physics skill & quantitative literacy teaching reflections:** Over the quarter, you will have many different experiences in helping students learn physics and develop quantitative reasoning skills. You will describe and reflect on at an average of one of these each week using the provided template. Each description and reflection will be based on either the quantitative literacy process skills from National Council of Teachers of Mathematics (NCTM) or the goals of introductory physics from American Association of Physics Teachers (AAPT).

**Case Study:** You will write a brief case study based on an interaction you had with students during a class while you were an LA or during a tutoring session while you were helping students learn physics or apply math to physics. Your case will set up the situation, describe the background, provide actual dialogue, and pose the issue that you have to deal with as an LA. You will include discussion questions asking the reader to propose how they would have addressed the situation you encountered. Then you will describe what you did/said and summarize how the situation got resolved. You will present your case study in class.

**Tip Sheet:** You will design a handout to share some of the teaching strategies you learned or developed with future LAs. Think of the following questions: What helps you get through to the students in class? What skills do the students need to develop? How do you help them develop those skills? Consider the work you do to help the students in class. Ponder your strategies. What works? Doesn’t work? How can you adapt strategies so your students can be more successful? Keep track of what you do because your more successful strategies will become your tip sheet. You will present your tip sheet in class.

<table>
<thead>
<tr>
<th>Tentative schedule PHYS 292</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Week</strong></td>
<td><strong>Topics/activities</strong></td>
<td><strong>Reading due</strong></td>
</tr>
<tr>
<td>1</td>
<td>Intro to the course and being an LA LA responsibilities (LA video) Quantitative literacy - physics standards Teaching specific physics concepts, FCI</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Tutoring cycle, characteristics of effective tutors (INSPIRE model), Study skills Teaching specific physics concepts, 1-D kinematics</td>
<td>Wood and Tanner (2012)</td>
</tr>
<tr>
<td>3</td>
<td>Discourse (LA video) Active listening (Communication video) Teaching specific physics concepts, 1-D kinematics</td>
<td>Knuth and Peressini (2001)</td>
</tr>
<tr>
<td>4</td>
<td>Types of questions (LA video) Teaching specific physics concepts, 2-D kinematics</td>
<td>Lord and Baviskar (2007)</td>
</tr>
<tr>
<td>5</td>
<td>Mental Models (LA video) Independent and active learning Teaching specific physics concepts, Newton’s Laws</td>
<td>Redish (1994)</td>
</tr>
<tr>
<td>6</td>
<td>Formative assessment (LA video) Teaching specific physics concepts, Forces</td>
<td>Moss and Brookhart (2009)</td>
</tr>
<tr>
<td>7</td>
<td>Cooperative learning (LA video) Teaching specific physics concepts, Forces</td>
<td>Johnson, et. al. (1998)</td>
</tr>
<tr>
<td>8</td>
<td>Argumentation and Metacognition (LA video) Teaching specific physics concepts, 2-D forces</td>
<td>Schoenfeld (1987)</td>
</tr>
<tr>
<td>10</td>
<td>Presentations</td>
<td></td>
</tr>
</tbody>
</table>

Last updated Spring 2015
A Case Study from PHYS 183: Can we believe the data?

Student A: “Coulomb’s Law says $1/r^2$. Our hypothesis says $1/r^2$. So the data must be wrong.”
Student B: “Data is data. It can’t be wrong.”

Background
This is a brief but most telling exchange of students in PHYS 183 (General Physics III). This course covers static electricity, electric fields, electric potential, circuits, magnetism, and electromagnetic induction. The LA was helping a group of four students who were working on a computer simulation called Charges and Fields from the website http://phet.colorado.edu/en/simulation/charges-and-fields. The students set up a charge distribution, mapped the field, graphed electric field strength (E) and distance from the charge distribution (r), and determined the relationship between E and r. So, even though this was a computer simulation, the instructor was asking them to make and test a hypothesis, just like a real experiment.

Situation and dialogue
The LA stood back and listened to the group for about a minute. They had just set up a line of positive charges and measured the electric field at six locations. They had entered the data but were arguing about the best fit. The LA walked up and the following brief conversation ensued.
LA: “So what’s the issue here?”
Student A: “We did a best fit trend line which showed a power of -1 (meaning $E \propto 1/r$). But, Coulomb’s Law says $1/r^2$. Our hypothesis says $1/r^2$. So the data must be wrong.”
Student B: “Data is data. It can’t be wrong.”
LA: “Is the data really wrong? How can you check this?”
Student B: “Check it again.” (They checked a couple points and these matched the earlier data.)
Student C: “So why doesn’t this match Coulomb’s Law because we are definitely not getting $1/r^2$.”
Student C: “Coulomb’s Law applies to point charges.”
LA: “Is this a point charge?”
Student B & C: “No.”
LA: “So what does this tell you about analyzing data?”
Student C: “The trend line just tells us about the data, it does not tell us about the physical situation.”
Student A: “But what about our hypothesis? We said E field would be proportional to $1/r^2$ because of Coulomb’s law. Even though this isn’t a point charge, it is a set of point charges.”
Student C: “Maybe a set of point charges can cancel each other out or something so the relationship looks like something different from a point charge.”
Student A: “That doesn’t make sense. How can one charge make another disappear… or magically change the relationship from $1/r^2$ to $1/r$?
Student B: “It doesn’t matter what can and can’t happen. What DID happen is that our data fits $1/r$ and that’s that.”

Questions
1. What is the main issue here? How can the LA make sure that everyone in the group knows the issue?
2. Should the LA let students A and B continue this discussion any longer? If so, how can the LA make it productive? If not, how should the LA end the discussion?

3. Notice that the Background section says there are four students in the group but only three speak. What can the LA do to better include the 4th student?

LA classmate ideas to discuss

Solutions (Don’t share this until readers express their own ideas above.)

1. There are two main issues. The first issue is that the students don’t seem know that Coulomb’s law is limited to point charges. While it is a reasonable starting point for hypothesizing relationships with other charge distributions, students should not assume that a Coulomb’s law relationship will be the final answer. The second issue is that students think something is wrong when their data does not fit the model they have in mind. They need to learn to trust their data and look for theoretical support for their best fit.

2. The LA should not let the students continue this direction of the discussion because it is no longer productive. The LA should redirect the discussion in another direction.

3. When the LA leads the discussion in another direction, she can ask the non-participating student the redirecting question.

How the case actually ended (Don’t share this until readers express their own ideas above.)

Student B: “It doesn’t matter what can and can’t happen. What DID happen is that our data fits $1/r$ and that’s that.”

LA: “[Student D], what do you think about the whole Coulomb’s law-point charge issue?”

Student D: “The book says it applies to point charges. And, I mean, how can you measure $r$ to a line of charges unless you measure it to each point?”

Student B: “So this is probably some combination of charges that makes the E field look like $1/r$.”

Student C: “It must be because our $R^2$ is 0.9481.”

LA: “[To student D] So is your data wrong?”

Student D: “No, but our hypothesis was.”

LA: “That’s okay. Look in the book for something to support what you found in the analysis.”
PHYS 292 Case Study Rubric (20 points)

_____ Background
Sets up the case well, includes all relevant information such as course, general assignment, and what the students are doing (2 points)
Sets up the case poorly to fairly well, includes some relevant information (1)

_____ Situation and dialogue
Relevant and interesting situation, at least 10 lines of dialogue, detailed enough for the reader to feel as if they are really listening in (4-5)
Somewhat relevant situation, not enough dialog or details for the reader to feel a part of the case (2-3)

_____ Discussion questions for written case
Questions require critical thinking to answer, highly related to the case (2)
Questions require some critical thinking to answer, somewhat related to the case (1)

_____ Solutions
Solutions logical, complete, and follow best practices as discussed in the class, get at main point of the case, include concluding dialogue (3)
Solutions somewhat logical and complete, get at main point of the case, include some concluding dialogue (1-2)

_____ Class presentation
Case presented in a logical and interesting way, easy to follow, presents an interesting and relevant classroom situation, effective use of presentation aids such as visuals, role playing, etc.; presentation flows naturally; facilitates class participation (7 points)
Case presented in a logical and interesting way, easy to follow, presents an interesting and relevant classroom situation; presentation flows naturally; facilitates class participation (5-6 points)
Case presented in a sequence, somewhat easy to follow, fairly interesting and relevant case, few/no presentation aids (3-4)

_____ One of the above done exceptionally well. (1)
Tip Sheet General Requirements:
1. One page
2. Include graphics, pictures, word art, etc.
3. Readable font (size can vary depending on stylistic concerns)
4. Present it to the class.

Specific Requirements:
1. As you’ve worked as an LA, you have probably developed strategies for helping your students succeed. The purpose of this assignment is design a handout so that you can share these strategies with the other LAs. Consider the following questions: What really helps you get through to your students? Do you do anything that you’re pretty sure no one else does? What class were you an LA for? What skills do your students need to develop? How do you help them develop these skills?
2. Throughout the quarter, consider the work you do with your students. Ponder your strategies. Try new things. What worked? What didn’t? How could you adapt strategies so that they will be more successful? Keep track of your experiments, these will become your Tip Sheet.
3. Design a one-page sheet highlighting your tips for other LAs. You will include three or four tips.
4. Be creative and have fun! Make your Tip Sheet eye-catching.
5. Describe your tips, the environment in which the tips were developed and answer your classmate’s questions when you present your tip sheet.

PHYS 292 Tip Sheet Rubric (20 points)

_____ Quality and general applicability of the tips
   Tip Sheet contains 3-4 tips that strongly support being a successful LA, tips are applicable to all 100-level physics courses, sheet describes situations when the tips best used, at least two tips include a supporting reference properly cited (class articles are fine) (7-8 points)
   Tip Sheet contains 3-4 tips that somewhat support being a successful LA, tips are applicable to most 100-level physics courses, situations for optimal use only weakly described, at least one tip includes a supporting reference properly cited (class articles are fine) (5-6.5)
   Tip Sheet contains about 2 tips that weakly support being an LA, tips are applicable to specific courses, situations for optimal use not described (3-4.5)

_____ Organization
   Tip Sheet has a logical organization (numbered list, bullet points, etc.); graphs, pictures and word art strongly help convey the tips (3-4)
   Tip Sheet has a somewhat logical organization but may be a bit confusing; graphs, pictures and word art somewhat lacking or distract from the message (2-2.5)

_____ Mechanics
   Tip Sheet is free from all proofreading and mechanical errors such as spelling, punctuation, and word choice errors (2)
   Tip Sheet is partially to mostly free from proofreading and mechanical errors such as spelling, punctuation, and word choice errors (1)

_____ Class presentation
   Speaker is poised, fully explains tips and the environment in which the tips were developed, speaker adequately answers questions, presentation is from 2-3 minutes (excluding questions) (4-5 points)
   Speaker is somewhat poised, mostly explains tips & environment in which they were developed, speaker answers questions, presentation is up to 1 min too long/short (2.5-3.5 points)
   One of the above done exceptionally well. (1)

Last updated Spring 2015
TIPS FOR TEACHING PHYSICS AND ASTRONOMY (SAMPLE TIP SHEET)

Tip 1: Have the student prove themselves Wrong
Students will have their preconceived notions of how the world works. These notions are the result of just experiencing the world.

To help the student adapt more accurate notions you must clearly have the student realize where their notions can’t accurately describe what should be happening. Simply using their words to talk to them or even creating pitfall traps for their specific incorrect notions can do this.

Tip 2: Relate what is being taught to something the student has experienced before
It is easier to learn something if you have a previous experience to relate it to.

Once the student builds the bridge between new and old they can better understand and integrate the new into their knowledge pool. The best way to do this is to apply it to a real world situation.

Tip 3: Listen to the student and speak only when they have reached their limit
It is perfectly acceptable to say very little in an interaction with a student or group of students and an effective LA should really only speak if the student has reached the end of their rope.

Students tend to learn better if they can create their own understanding. The LA is there to make sure that the struggling student is going in the right direction in terms of creating her or his own understanding of the topic.

Work Cited
PHYS 292 Self evaluation and Peer evaluation essay

Please respond to the following questions (3-5 sentences each):

1. What does the word “community” mean to you?
2. To what extent (and how) has the Fall 2013 LA Program functioned as a thriving community? To what extent has it not?
3. What unique contributions have each of the following ‘actors’ made to the development of community in the LA Program?
   a. Yourself
   b. Your peer LAs (LA names here). Here, write one or two sentences about each of your classmates.
   c. Seminar instructor
   d. The instructors in the courses in which you LA
4. In addition to this essay, you will fill out a Faculty Feedback Form on yourself.
Name of learning assistant: _  
Professor’s name: 

Please rate these statements using the five point scale. You may circle or highlight two to represent a half score.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Neutral</th>
<th>Strongly Disagree</th>
<th>Not App.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The learning assistant (LA) understood the course content well.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2. The LA asked effective and appropriate questions to the students.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3. The LA effectively listened to student questions and group interactions.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4. The LA gave individuals and groups ample time to talk and did not dominate group interactions.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5. The LA modeled appropriate physics and general quantitative thinking skills.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>6. The LA was patient, enthusiastic, and respectful to students.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>7. The LA was punctual and showed up well prepared for all assigned meetings and classes.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>8. The LA followed instructor directions and addressed the goals the instructor had for the class.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>9. The LA clearly exhibited concern about whether or not the students learned.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Provide more details on two or three of the above characteristics that the learning assistant did well.

List two or three things related to knowledge or skills that the learning assistant can improve upon. If possible, give specific suggestions for improvement.

Last updated Spring 2015
**Teaching Reflection Template:** Circle the standards you practiced during the interaction described below. See Blackboard for a richer description of the standards. Over the quarter, you need to address at least four NCTM and three physics standards.

<table>
<thead>
<tr>
<th>NCTM</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Problem solve</td>
<td>1. Designing experiments</td>
</tr>
<tr>
<td>2. Reason and prove</td>
<td>2. Experimental and analytical skills</td>
</tr>
<tr>
<td>3. Communicate</td>
<td>3. Conceptual learning</td>
</tr>
<tr>
<td>4. Make connections and theory</td>
<td>4. Differentiate between observation, inference, and theory</td>
</tr>
<tr>
<td>5. Use multiple representations</td>
<td>5. Collaborative learning skills</td>
</tr>
<tr>
<td>6. Use technology</td>
<td></td>
</tr>
</tbody>
</table>

Briefly describe the focus of the interaction. Include the class, number of students, what they were working on:

Precisely and accurately describe what you did as an LA and how you helped the students meet the circled standard(s). Use the NCTM and physics standards handouts found on Blackboard to guide your description. (Use the back of the sheet if needed.)

Reflection: How could the interaction have gone better?

Last updated Spring 2015
Teaching Reflection Sample: Circle the standards you practiced during the interaction described below. See Blackboard for a richer description of the standards. Over the quarter, you need to address at least four NCTM and three physics standards.

<table>
<thead>
<tr>
<th>NCTM</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Problem solve</td>
<td>1. Designing experiments</td>
</tr>
<tr>
<td>2. Reason and prove</td>
<td>2. <strong>Experimental and analytical skills</strong></td>
</tr>
<tr>
<td>3. Communicate</td>
<td>3. Conceptual learning</td>
</tr>
<tr>
<td>4. Make connections and theory</td>
<td>4. Differentiate between observation, inference,</td>
</tr>
<tr>
<td>5. <strong>Use multiple representations</strong></td>
<td>5. Collaborative learning skills</td>
</tr>
<tr>
<td>6. Use technology</td>
<td></td>
</tr>
</tbody>
</table>

Briefly describe the focus of the interaction. Include the class, number of students, what they were working on:
I helped a group of four students in PHYS 183. They were working on a computer simulation called Charges and Fields from the website [http://phet.colorado.edu/en/simulation/charges-and-fields](http://phet.colorado.edu/en/simulation/charges-and-fields). The students were supposed to set up a charge distribution, map the field, graph electric field strength (E) and distance from the charge distribution (r) and determine the relationship between E and r.

Precisely and accurately describe what you did as an LA and how you helped the students meet the circled standard(s). Use the NCTM and physics standards handouts found on Blackboard to guide your description.
I stood back and listened to the group for about a minute. They had just set up a line of positive charges and measured the electric field at six locations. They had entered the data but were arguing about the best fit. I walked up and asked “so what’s the issue here?” (even though I thought I knew the issue). Student A said they did a best fit trend line which showed a power of -1 (meaning E $\propto \frac{1}{r}$) but Coulomb’s law says E $\propto \frac{1}{r^2}$ meaning their data is wrong. I asked, “Is the data really wrong? How can you check this?”. Student B said “check it again” so they checked a couple points and these matched the earlier data. Student C asked “so why doesn’t this match Coulomb’s Law because we are definitely not getting $1/r^2$.” I said, “look in your book, what does Coulomb’s Law apply to?”. They didn’t have a book handy so I said I’d come back in a couple minutes. When I can back, they said Coulomb’s Law applies to point charges. I asked if this is a point charge and they said no. I asked, “so what does this tell you about analyzing data?”. Student A: “The trend line just tells us about the data, it does not tell us about the physical situation.”
Student B: “But what about our hypothesis? We said E field would be proportional to $1/r^2$ because of Coulomb’s law.”
Student A: “Our hypothesis is separate from our data. It can be whatever we want but our data is our data.”
Student C: “So that means the real relationship here is $1/r$.”
Me: “That’s what it seems.”

**I addressed NCTM standard 5: multiple representations** because I helped students relate the data to their graph and to the physical situation which was the arrangement of charges. Students are supposed to use representations to organize, record and communicate ideas. They were trying to use their data to communicate an idea that was not correct: that the line of charge had a $1/r^2$
relationship when the data showed something else. I guided them to check their data and review the limit of their assumption that it must be $1/r^2$.

**I addressed physics standard 2: experimental and analytical skills** because I helped the students separate their trend line from their hypothesis. Students need to judge their data based on what the data says and not what they think it should say. I asked them to think about the purpose of data analysis.

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**Reflection: How could the interaction have gone better?**

I should have followed up on the statement “[Our hypothesis] can be whatever we want”. This might encourage students to not think about an effective hypothesis. I could have brought up a silly hypothesis and asked if their hypothesis could have been that. Also, student D never said anything. I could have asked student D to look in her book and had her report back to me what I revisited the group.
PHYS 392: Exploring Physics Teaching II (2 credits)

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Bruce Palmquist</th>
<th>Email</th>
<th><a href="mailto:palmquis@cwu.edu">palmquis@cwu.edu</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Office Location</td>
<td>SCI 107C</td>
<td>Office Hours</td>
<td>TuTh 3-4 (SCI 107C), W 1-3 (Lind 117)</td>
</tr>
<tr>
<td></td>
<td>Lind 117</td>
<td></td>
<td>Other times by appointment</td>
</tr>
<tr>
<td>Phone</td>
<td>509-963-3142</td>
<td>Meeting time</td>
<td>W 5:00-6:50 pm</td>
</tr>
<tr>
<td>Classroom</td>
<td>Lind 204</td>
<td></td>
<td>Plus time each week to meet with the instructor of the class you are an LA for.</td>
</tr>
</tbody>
</table>

Course Description: Inquiry-based learning course that enhances preparation for teaching physics using best-practice pedagogies, lesson planning, and action research.

Prerequisites: PHYS 292

Corequisite: Working at least three hours a week as an LA. You will get paid for this.

Course introduction: This is an inquiry-based learning course that provides continued preparation for facilitating physics learning in an interactive environment such as a college classroom. In the course, we will reflect on and integrate content knowledge, practical skills, and the pedagogy of science teaching. Throughout the quarter, we will discuss issues such as participating in dialogue with students, active listening, communication skills, and formative assessment. You will take a more active role in class leadership and in teaching initiative than you did in PHYS 292.

Course outcomes and assessments for PHYS 392:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Assessment</th>
<th>Specific assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan a basic physics lesson about a specific skill or concept</td>
<td>Write a physics lesson plan including outcomes, activities, and assessment.</td>
<td>Physics lesson plan</td>
</tr>
<tr>
<td>Demonstrate research-based teaching practices</td>
<td>Complete a small action research project that involves diagnosing a physics learning issue, developing a scheme to remediate and evaluating the effects of the intervention.</td>
<td>Action research project and presentation</td>
</tr>
<tr>
<td>Effectively self-assess and reflect on teaching practice</td>
<td>Action research project reflection</td>
<td>Action research project and presentation</td>
</tr>
<tr>
<td>Develop pedagogical content knowledge in physics.</td>
<td>Select and read articles addressing teaching and learning issues in a physics class. Share main ideas with the class.</td>
<td>Article reflections</td>
</tr>
</tbody>
</table>

Final Grades for the course will be calculated as follows:

- A 92 - 100%
- A- 90 - 91%
- B+ 88 - 89%
- B 82 - 87%
- B- 80 - 81%
- C+ 78 - 79%
- C 72 - 77%
- C- 70 - 71%
- D+ 68 - 69%
- D 62 - 67%
- D- 60 - 61%
- F <60%

Textbook: None

Grading Specifics (PHYS 392)

<table>
<thead>
<tr>
<th>Relative Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peer, self, and instructor evaluation .........................................................20%</td>
</tr>
<tr>
<td>Action research project.............................................................................40%</td>
</tr>
<tr>
<td>Physics lesson plan...................................................................................20%</td>
</tr>
<tr>
<td>Article reflections.....................................................................................20%</td>
</tr>
<tr>
<td>Total...................................................................................................................100%</td>
</tr>
</tbody>
</table>

Brief summary of course assignments

Peer/self/instructor evaluation: Because this course relies so heavily on building a community of practitioner-scholars, an evaluation of your contributions to this community makes up a significant portion of the course grade. At the end of the quarter, each student will fill out a survey to evaluate the contributions of their classmates. You will evaluate your own contributions on the same survey. Finally, the instructor you work with will as a learning assistant will evaluate your contributions to helping student learn physics in his/her course on a separate rubric.

Article reflections: Most weeks, the PHYS 292 students will be assigned a physics education-related paper to read, and will be asked to think carefully about a series of discussion questions and/or to write a reflection/summary. As a 392 student, you have...
read and reflected on most of these articles. So you will search the CWU library data bases and find an article that covers the same topic but says something different about it. You will write and answer three discussion questions related to the article. During class, you will lead a discussion of the article you selected. You may work on this with another 392 student meaning you may use the same article and discussion questions and you may lead the class discussion together. Your written reflections must be done individually. See Canvas for assignment guidance and a rubric.

**Physics Lesson Plan:** You have observed many physics lessons in your time as an LA. This quarter, you will write and teach a physics lesson. Your plan should include specific outcomes, activities, and a means to assess the activities. See Canvas for assignment guidance and a rubric.

**Action Research Project:** You will complete a small action research project that involves diagnosing a physics learning issue, developing a scheme to remediate and evaluating the effects of the intervention. Your scheme to remediate can be the lesson that you use for your lesson plan assignment. At the end of the quarter, you will present this research project to the class. See Canvas for assignment guidance and a rubric.

### Tentative schedule for PHYS 392

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics/activities</th>
<th>Reading due</th>
<th>Homework due</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Intro to the course and being an LA LA responsibilities (LA video) Quantitative literacy - physics standards Teaching specific physics concepts, EaMCS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Tutoring cycle, characteristics of effective tutors (INSPIRE model), Study skills Teaching specific physics concepts, impulse/momentum</td>
<td>Article similar to Wood and Tanner (2012)</td>
<td>Article reflection</td>
</tr>
<tr>
<td>3</td>
<td>Discourse (LA video) Active listening (Communication video) Teaching specific physics concepts, work</td>
<td>Article similar to Knuth and Peressini (2001)</td>
<td>Article reflection</td>
</tr>
<tr>
<td>4</td>
<td>Types of questions (LA video) Teaching specific physics concepts, energy</td>
<td>Article similar to Lord and Baviskar (2007)</td>
<td>Article reflection</td>
</tr>
<tr>
<td>5</td>
<td>Mental Models (LA video) Independent and active learning Teaching specific physics concepts, energy</td>
<td>Article similar to Redish (1994)</td>
<td>Article reflection</td>
</tr>
<tr>
<td>6</td>
<td>Formative assessment (LA video) Teaching specific physics concepts, torque</td>
<td>Article similar to Moss and Brookhart (2009)</td>
<td>Article reflection</td>
</tr>
<tr>
<td>7</td>
<td>Cooperative learning (LA video) Teaching specific physics concepts, waves</td>
<td>Article similar to Johnson, et. al. (1998)</td>
<td>Article reflection</td>
</tr>
<tr>
<td>8</td>
<td>Argumentation and Metacognition (LA video) Teaching specific physics concepts, waves</td>
<td>Article similar to Schoenfeld (1987)</td>
<td>Article reflection</td>
</tr>
<tr>
<td>9</td>
<td>Nature of Science (LA video) Discuss evaluations</td>
<td>Article similar to Lederman (1998)</td>
<td>Article reflection Lesson plan and action research drafts Peer and self evaluations</td>
</tr>
<tr>
<td>10</td>
<td>Presentations</td>
<td></td>
<td>Lesson plan and action research</td>
</tr>
</tbody>
</table>

Last updated Spring 2015
PHYS 392 Action Research Project

**Introduction**: This is a brief summary of what you are teaching, why you are teaching it, and a justification of the methods you are using. Support your concept and/or teaching strategies with at least two references from, or similar to those from, PHYS 292/392. Describe what led you to choose this physics concept and these teaching methods. Possible reasons include observations of past student performance, subject of a past PHYS 292 case study, or literature review showing past student difficulties with this subject. (5 points)

**Pre-assessment and results**: You will develop a “pretest” to measure student performance on our concept before you teach them. This present need not be extensive. It could be a short multiple choice assessment, a section from a standardized test such as the FCI, a short problem to solve, or a brief essay about a topic. Don’t make it too long because you have to read each one, summarize, and analyze the results. Describe how the results of the pretest informed your remediation. (8 points)

**Remediation Scheme**: This is what you’ll do to help students better understand the concept. For the sake of time management, the instructor suggests you use the lesson plan assignment to address this. (7 points)

**Post-assessment and results**: You will have an assessment build into the lesson such as a worksheet or lab report template. In addition, you will re-administer your pre-assessment as part of the lesson. Compile the student responses and summarize the relevant ones on a data table. Compare the post-assessment results with the pre-assessment results. If your lesson includes a worksheet, you don’t have to include everything on your worksheet in the analysis, just the aspects that are most directly related to the lesson objectives and that best show whether or not student understanding increased. (8 points)

**Discussion**: This is the section in which you will make sense of the data. Describe whether or not student understanding of the key concept(s) increased because of your intervention. Why do you think student understanding increased or didn’t increase? What did you try to control in this lesson? What things were out of your control? If you could re-teach this lesson, what would you do differently? What advice would you give someone else who would teach this lesson? (7 points)

**Conclusion**: Briefly summarize what you did and how student understanding changed because of this. (5 points)
Lesson Plan Template for PHYS 392

Lesson Overview: A one paragraph summary of the main concept you are teaching, what you will be doing to help students learn the concept, what the students will be doing, and how you’ll be evaluating the students. (2 points)

Standards: Chose two NCTM or Physics standards (from the PHYS 292 Teaching Reflection template) that you will address in the lesson. (2 points)

Learning objectives: List two specific things the students will know or be able to do by the end of the lesson. Start each sentence: “Students will ...” There are numerous examples on the test objective sheets on Canvas. (2 points)

Material needed: This is what you will need to teach your lesson. Include any lab equipment, worksheets, and external resources (such as a computer simulation) (2 points)

Lesson Events: This is the main body of what you will do when you teach the lesson. Include detailed teaching notes, PowerPoint slides, and any other written material you use to teach the lesson. Annotated PowerPoint slides (or similar) would be an acceptable summary of your lesson events. This section should be detailed enough for you to give to another Learning Assistant to use with no other notes. (6 points)

Assessment: Include a complete and correct version of the product that you will collect from the students to evaluate. Describe how this product addresses each standard and learning objective. (4 points)

Resources: Include a copy of all worksheets, ones that you create and ones that you copy from another source. Provide a complete bibliographic reference, including url if appropriate, for each resource. (2 points)