**POE Instructor Guide**

**What is a POE?**

POE stands for Predict-Observe-Explain

POE activities are used to help students gain a better conceptual understanding of the material they learn in lecture. These activities are meant to expand upon students’ prior knowledge and the information they learn in lecture through investigation of a scenario. POE activities are generally used in a laboratory setting, but they can also be applied in a lecture-based classroom. The main difference is that instead of students conducting an experiment to collect data and make observations, they will use the data provided to make these observations. All course POE activities follow a similar format, but the scenario and driving questions will be different each time. Ultimately the POE activities will provide an engaging and interactive way for students to go beyond memorizing facts and content and truly understand important course concepts.

**How does a POE work?**

Students will begin by reading the scenario of interest, and as they read, they should highlight important parts that will help them in understanding this scenario. Students will then read the driving question(s) in order to prepare for the first step in the POE process. After students have read the scenario and driving question(s) they will generate hypotheses and predictions in response to the scenario and accompanying driving question(s). At this point in the activity students will rely mainly on their prior knowledge, material from lecture, and the information provided in the scenario to generate their best scientific hypotheses and predictions. Students do not need to know the answer to the driving question(s) at this point in the activity, rather this prediction phase should give them an opportunity to show what they currently know and understand about the scenario.

The next step in the POE process is investigation and observation of the relevant data. The instructor will provide students with relevant data and analysis questions to aid students in understanding the scenario. Students should spend time looking through all of the data, marking important pieces of information, and completing analysis questions to help expand their knowledge about the scenario. The data and analysis questions will be presented in a variety of forms including tables, charts, graphics, images, descriptions, etc. This will allow students to work with numerous forms of scientific data, and become familiar with the relevant and important aspects for understanding the scenario.

After students have had a chance to investigate the data and answer the analysis questions, they will begin the observation phase of the POE activity. The observation phase is where students will either include written information, visual represents, or use a combination of the two to express what they observed when investigating the data. Student observations should include data and information that is relevant to understanding the scenario and answering the driving question(s). Students should include at least 10 observations that will assist them in their final explanation of the scenario.

Once students have recorded their observations it will be time for them to gather all of the information they gained from prior classes, lecture material, and the data and analysis question section into a cohesive explanation of the scenario. The final step of the POE activity is for students to be able to write a comprehensive and complete explanation of the scenario by answering the driving question(s). Students should write an explanation that thoroughly answers the driving question(s), includes relevant data and evidence, shows that they have a conceptual understanding of the material, and goes beyond listing scientific facts and pieces of information. For this specific set of POE activities, students will also need to include the concept of homeostasis in all of their explanations as it will relate to every scenario they encounter.

**This Instructional Guide**

This guide will focus on general POE activity design and implementation, but the examples will be centered around college level introductory anatomy and physiology content and concepts. This guide can be used to design and implement POEs in essentially any course, but the example POE activities, answer guides, and rubrics are related to college-level introductory anatomy and physiology lecture. The units for this introductory anatomy and physiology course are listed below. Following the unit descriptions, this guide will take you through the POE design process, POE implementation process, and end with some general teaching notes. All five of the POE unit activities can be found at this supplemental materials link:

**BIO 201 Introductory Anatomy and Physiology Units**

Unit 1: Overview of A&P and the Cell (Homeostasis Overview, Body Systems, & Levels of Organization)

Unit 2: Histology, Integumentary, Bone (Bones, Blood Calcium, Calcium and Muscle/Nerve Function)

Unit 3: Nervous Tissue (Neurotransmitter Dysfunction, Membrane Potentials, Synapses, Action Potentials)

Unit 4: Nervous System and Connections

Unit 5: Muscular System

The purpose of these anatomy and physiology-based POE activities is to promote conceptual learning. Normally anatomy courses rely heavily on memorization of facts and content, especially for assessments, but with the POE activities the goal is to go beyond rote memorization. Instead, students should be able to use the facts and content they learn and apply them to real world scenarios or phenomena. Through the use of POE activities students can investigate anatomy and physiology phenomena, and generate conceptual explanations that connect the material they learn in lecture with the material presented in the activities. On top of improving conceptual understanding of the material another goal of these POE activities is to incorporate the overarching concept of homeostasis. Each scenario is designed to relate to homeostasis, and allow students to continually be aware of this concept. By including this continual link of homeostasis, students can begin to better understand how the body is one large system with multiple interconnected parts that are working together to maintain balance within the body.

**Designing POE Activities**

Step 1: Creating a POE Template

In order to create POE activities for your students, you will need to develop a template that will properly guide and support your students’ learning. POE templates should follow a similar format from unit to unit or topic to topic, with changes being made to the content in each POE. The general components in a POE activity will include a scenario, driving questions, predictions/hypotheses, data and analysis questions, observations, and explanations. Each of these sections serves a different purpose within the POE, and each component will be described in depth below. A generic blank POE template is included in appendix A of this guide.

Step 2: Developing a Scientific Scenario

Whether you are incorporating one or several POE activities into your course, you should take the time to create engaging and thought-provoking phenomena. Every POE activity will be centered around a scientific scenario, and this can either be one that you create from a variety of science resources, or you can search for an interesting scenario in research studies, textbooks, or online. If you are creating your own scenario, make sure it is scientific and cannot be answered easily. POE phenomena should require students to use what they have learned in class, their own knowledge, and supplemental data and material within the POEs to assist in their explanations of the scenario. Example phenomena can be found in the POE template supplemental link.

Step 3: Creating Driving Questions

Driving questions direct students’ focus onto the important aspects of the POE scenario, and ask students to explain the why and how behind the scenario. Similar to creating a thought-provoking scenario, it is also important to develop driving questions that cannot be answered easily. The driving questions should require students to use the material from class, analyze data, answer analysis questions, and make observations in order to fully understand and explain the scenario. Example phenomena can be found in the POE template supplemental link.

Step 4: Student Predictions/Hypotheses

This is the first part of the POE activity that requires students to express their thoughts and ideas about the scientific scenario. This section of the POE will ask students to provide their initial thoughts, ideas, predictions, and hypotheses about the scenario and driving questions. Students do not have to know the correct answers or explanations at this point in the activity. This allows students to voice their initial ideas, and allows instructors to get a baseline understanding of their students’ current level of knowledge about the POE concepts.

Step 5: Providing Students with Data & Analysis Questions

Typically POE activities have been implemented in laboratory settings, but for the purposes of this guide we will focus on POE activities in a lecture-based class. In this case rather than students conducting experiments and collecting their own data for the scenario, they will be provided various forms of data to assist in their understanding of the scenario. The data section is important, because this is where students will use the knowledge they acquired in lecture in combination with the new data in the POE to make observations and analyze the evidence. The data in POEs should be in a variety of forms including graphs, tables, charts, graphics, etc. This will expose students to a number of different data formats, and allow them to analyze and interact with all forms of data.

To accompany the data, analysis questions are a great way to scaffold students throughout the POE. Analysis questions will not only keep students on track, but they will direct students to focus on the important aspects of the data. Analysis questions should also be presented in a variety of forms, to allow students to express their knowledge and learning in different formats. Analysis questions can be fill in the blank, chart completions, graphic creation, interaction with tables and graphs, etc. By presenting the data and analysis questions in different forms, this will keep students engaged and focused on the POE material. Example data and analysis questions can be found in the POE template supplemental link.

Step 6: Student Observations

After completing the data and analysis questions section, students will begin recording observations they made while they were analyzing all of the data related to the scenario. The observation section is an area that students can begin to organize their thoughts and ideas to prepare for their final explanations of the scenario/driving questions. Observations will usually be written, but students can also include visual representations of the information if that assists in their conceptual understanding. Appendix A provides a template showing the format for the observation section.

Step 7: Student Explanations

The final part of the POE activity requires students to generate and evidence-based explanation that answers the driving questions and explains the scenario. This section will require students to use what they have learned in lecture in combination with the information provided in the POE to support the claims they make in their explanations. The final explanations should include data from the POE and discuss the concept of homeostasis. Appendix A provides a template showing the format for the explanation section.

**Implementing POE Activities**

Once you have created POE activities for your class or if you decide to use the ones included in this instructional guide it is now time to implement these into your classroom. Implementation of POEs will vary depending on class size, class time, class format, and grade level. But a general overview of POE implementation in a college level introductory anatomy and physiology course will be outline below. It also important to take note that this course was conducted virtually via Zoom, due to the pandemic, but it could easily be translated to an in-person format with some modifications. This course was also only 50 minutes in duration, so longer classes will allow for more time, or you can consider having students complete portions of the POE outside of class. A combination of in-class and out of class work was conducted by the students participating in these POE activities.

**General Outline for POE Implementation**

Outside of class: (Approximately 30 minutes)

A couple of days before the POE class period, students should be given the POE activity, where they will only work on the first page of the activity which will include reading and annotating the scenario introduction, reading the driving question(s), and generating initial hypotheses and predictions.

Allowing students to conduct this portion of the POE at home before coming to class will get them thinking about the activity, and afford them more time in-class to ask questions, work with peers, and complete other portions of the POE activity.

In-Class: (50 Minutes)

Whole class introduction: (Approximately 10-15 minutes)

Brief explanation of what POEs are and how they will be implemented only before the first unit POE

Introduce the unit topic and scenario of interest making sure all students read the introduction and driving question(s).

Present a few PowerPoint slides (example in appendix B) to outline the class structure for students

Spend some time answering any student questions

Depending on class size could incorporate a quick class activity where students share their initial ideas about the POE scenario, and make their thoughts visible to other students

Breakout Groups: (20-25 minutes)

This will be the longest portion of the POE activity.

Students will be broken into groups, and begin investigating and observing the data.

During this time, they will work through the data and analysis questions section in order to learn more about the scenario

Once students have completed their data investigation and answered the analysis questions, they will write down relevant and important observations for understanding the scenario.

Each group should write down some key data observations to share with the whole class.

Since students are working in groups they can come together and help each other with the questions and observations, but their answers should be individualized.

Including interactive online poll questions during this time can also keep students on track and help the instructor determine concepts that need to be discussed in the closing whole class discussion

The instructor and teaching assistants will spend this time bouncing from group to group to answer questions, probe students’ ideas, and ensure everyone is on the right track with the activity.

Whole Class Discussion & Explanations: (~15 minutes)

After the breakout group session, the whole class will come together, and have a brief open conversation about the scenario and possible explanations for the driving question(s).

During this time the instructor will address confusions based on the poll results, and student questions

This final classroom discussion is important to get students on the right track for their final explanations

Outside of class: (Approximately 15-20 minutes)

In order to keep the information fresh in students’ heads it is important to have them work on and complete their final explanations the same day the POE was conducted in class.

By giving students until the end of the day to construct their final explanations this allows them to have enough time, but also ensures they will not forget about the POE material in order to generate thoughtful explanations

Students should spend around 15-20 minutes generating an evidence-based explanation that answers the driving questions and explains the scenario of interest

They should include relevant data and observations from the POE template that they constructed during class

Instructors can choose to have students submit their entire POE packet for grading, or you can have them submit the final explanations only

Assessing POE Activities

The POE activities that were implemented in the introductory anatomy and physiology courses, only required students to submit their final explanations. Students were expected to complete their entire POE packets, but for grading purposes only the final explanations were assessed. Since this was our first attempt at implementing POE activities into a large college lecture course, the explanations were graded for completion, but the explanations were assessed more in-depth by the creator of the activities. If you plan on grading the entire POE activity packets or using a rubric to assess the POE activities answer guides and a generic rubric are provided for the five anatomy and physiology POE unit activities. These answer guides and rubric are also included in the supplemental link.

**Teacher’s Notes**

After implementing the five POE unit activities into introductory anatomy and physiology college courses, there are a few instructor notes that might be helpful for future instructors planning to use these activities.

Helpful Tips:

* Leave enough time in class to discuss as a large group the major concepts from the POE activity
* Have students complete a larger portion of the POE activity at home before class, to leave more time in-class for students to fully grasp the material
* Include more interactive polls or questions that students can quickly reply to during breakout sessions (This provides information about how well students are understanding concepts)
* Could spread the POE activity over two class periods to allow students to have more time interacting with the activities
* Have students submit entire POE packets to assess how well they analyze and interact with the data in order to create observations and generate explanations for the phenomena
* Include a survey for students to fill out asking for their thoughts and opinions about the activities
* A survey will allow you to assess how helpful the POEs were, and ways they can be changed or modified for future units or courses
* If you plan on grading for correctness, use a rubric and provide that information to students so they understand how they are being assessed

**Appendix A**

**Blank POE Template**

**POE (#): Title**

**Topic**

Unit Topic

[Disclaimer for Students]

The case study/scenario below has been simplified for the purposes of this introductory anatomy and physiology course. As you progress in your academic and professional careers you may learn more extensive details related to this scenario.

**Introduction to the Scenario**

*As you read through the scenario below underline specific facts and information you find important to the situation*

[Include the scenario description here]

**Driving Question(s)**

[Questions related to the scenario included here]

**Initial Hypotheses/Predictions**

*In the box below, please provide your initial ideas about a possible answer to the driving question above.*

**Relevant Data & Analysis Questions**

***ALL analysis questions are italicized in the pages below***

[Include data, graphics, tables and charts in this section]

*If incorporating analysis questions make sure they relate to the data and are italicized*

**Observations**

*After examining the data and answering the analysis questions above, describe interesting observations and patterns you believe are relevant to explaining the scenario. You can include both textual and visual observations in order to help organize the data from above. (Include at least 10 important pieces of data and evidence that will aid in your final explanation of the scenario below)*

**Explanation**

*Based on the data and analysis questions above, please provide an answer to the driving question(s) in the box below. Remember to include data from above as evidence, important ideas from previous units, and the concept of homeostasis in your response.*

**Driving Question(s)**

*[Restate the driving question(s) from the first page of the POE again he*