Who’s That Speci-Mon? Using Pokémon™ to Understand Biological Terminology Using Greek and Latin Roots

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Abstract

We set out to create a fun and engaging activity using recognizable fictional characters, so students get a chance to practice using Greek and Latin roots to create binomial names. Students in biology courses are faced with a plethora of scientific jargon that are often composed of Greek and Latin roots that hint at their definitions. Students often struggle to understand and apply these terms due to a lack of familiarity with these roots. With this scaffolded activity we attempt to alleviate these concerns by first having students define biological terms by looking up the roots that the word is composed of. We then provide examples of real species and their binomial names with Greek and Latin roots to give examples of how species characteristics are used to create their scientific names. Lastly the students work in groups to group Pokémon™ into genera and give each Pokémon™ a binomial name. Students were engaged in the activity and reported that it helped improve their understanding of Greek and Latin roots for future projects and exams. This activity can enrich introductory and advanced biology courses of any size.

Learning Goals

Students will:

◊ have a basic understanding of how morphology is used to name species.
◊ begin to develop a working knowledge of Greek and Latin roots.
◊ practice problem solving and collaboration with peers to develop communication skills.
◊ contribute to their peers’ understanding of Greek and Latin roots.

Learning Objectives

Students will be able to:

◊ define key morphological features that are used to name and describe species.
◊ imitate scientific naming procedures and support their naming scheme.
◊ apply Greek and Latin roots to interpret words they do not know.

INTRODUCTION

College students in the biological sciences quickly become aware that their courses require them to learn a multitude of new scientific terms. Even in high school classrooms, science textbooks may expect students to comprehend over 2000 new terms in a school year (1), and it seems that more and more college students are entering university without having a strong grasp of Greek and Latin roots (2). A lack of understanding of the linguistics behind scientific jargon can turn a challenging task into an insurmountable one. College biology classes often ask students to read and understand a variety of new terminology; however, lessons devoted to helping the students comprehend these new terms are less common. Often, new terms are provided, either in literature or during lecture, and students are expected to memorize or otherwise commit another definition to memory. Since biology classes often build upon previously taught material, if new words are introduced but not comprehended, then understanding material in subsequent courses will become more challenging. Thus, it is important for students to be able to not only understand the terminology required for their classes but also build the skills necessary to apply that understanding to new words they encounter both within the classroom and outside of it.

Many students will try to memorize a newly presented definition rather than deconstruct why the new word is defined that way. Unfortunately, these memorization techniques are unlikely to promote learning because memorization does not require comprehension (3). Thus, memorization may be seen as “shallow learning,” or learning that is done with the main goal of doing well on an exam. A deeper form of learning strives for comprehensive understanding of the information which allows students to more easily apply their knowledge to novel situations (4). The application of knowledge to new problems is a main goal of university learning; we want our students to be able to use their education to succeed in their future workplaces and within their communities. Thus, it is important to help...
students move beyond just using memorization techniques as these techniques don’t encourage the level of understanding with which we want students to exit our classrooms.

In this lesson, we use a simple and fun activity that gets students to engage with Greek and Latin roots by devising binomial names for a group of Pokémon™. We begin the lesson with an activity that asks students to identify Greek and Latin roots that comprise a set of biological terms that are important in our classes. From this, we discuss how these roots are used in the naming of species. Subsequently, students work in small groups to create genus and species names for a handful of Pokémon™ “species.” This activity serves as a basis for building an understanding of biological terminology and naming schemes. In this article we describe the activity, which fosters student collaboration and imagination while helping students understand how morphology and Greek and Latin roots have come together to give so many species their binomial names.

To our knowledge, this is the first published lesson that meets these learning goals and is intended for a college-level course. Previous work published in CourseSource has addressed the challenge of teaching science vocabulary when the scientific definition of a term is different from the commonly understood meaning (5). However, there is a lesson plan intended for younger students titled Learn Dinosaur Names with Greek and Latin Words. This lesson describes how 1st through 3rd grade students can use Greek and Latin roots to identify the meaning of dinosaur names. The students use flashcards and a list of Greek and Latin roots to determine how the names of the dinosaurs are derived from their behavior or morphology (6). Another set of activities aims to teach Greek and Latin roots to grade school students through the use of regular exposure to new root-terms (7). In this way, our article contributes new materials to help teach Greek and Latin roots to more advanced students.

**Intended Audience**

The lesson has been taught to advanced undergraduate biology students taking an anatomy course at a research university. We implemented this lesson during the discussion section of the course (~20 students per section). This lesson is also applicable to a wider demographic of students, including non-biology majors and high school students as the concepts are straightforward and include references that are easily understood at these educational levels. While we implemented this lesson in small discussion sections, we anticipate it could be easily adapted for larger classes. If teaching a particularly large class, a discussion board via your Learning Management System could be used to promote whole-class discussion. This lesson can be implemented in all types of synchronous classrooms (online, hybrid, and in-person) and could be modified to be done as an asynchronous or homework assignment (see Supporting File S1).

**Required Learning Time**

This lesson was originally taught in a 50-minute discussion course. This required time may be altered depending on the quantity and difficulty of the terms provided. In addition, the instructor’s explanation of the activity may need to be expanded depending on the experience level of the students in the course.

**Prerequisite Student Knowledge**

Students need a basic understanding of the species used within your activity. Depending on the course, this could be common knowledge expected of the general population (such as reptiles, birds, fish, amphibians, and mammals in a vertebrate anatomy course) or it could be more specialized for an advanced class. Students also need to be able to group the species based on their morphological features or additional knowledge of Pokémon™. However, prior knowledge of Pokémon™ isn’t required.

**Prerequisite Teacher Knowledge**

Instructors need to have a basic understanding of Latin and Greek roots to help the students name their genera and species. Instructors should know which roots comprise the biological terms that students will be asked to identify. Instructors should also know the definitions of any terms the students will be asked to define. Many Greek and Latin roots are provided in Supporting File S2. An example set of words, alongside their definitions, are available in Supporting File S3. Instructors also need to be able to identify key morphological features that can be used to divide the Pokémon™ into groups. Prior knowledge of Pokémon™ isn’t required.

**SCIENTIFIC TEACHING THEMES**

**Active Learning**

This lesson requires students to complete two activities in small groups: a root-words activity and a scientific naming activity. These activities engage students with Greek and Latin roots, scientific naming conventions, and the observation of morphological features. Group work also fosters cooperation (8). By actively engaging in the activity, students are more likely to remember scientific naming conventions and the meanings of any roots they used. This allows students to achieve all of the learning objectives stated for this lesson.

**Assessment**

The goal of this activity was to get students engaged with Greek and Latin Roots; thus, students were assessed only for participation. After completing the root-words activity, students were shown the roots and definitions for each word they were asked to define. Students were able to use this key to self-evaluate their work and ask questions about any concerns or misconceptions. After completing the scientific naming activity, students were asked to share some of the names they had devised with the class. The teacher can then offer feedback to the student and the class by verifying the terms that the student came up with when creating the new name of their Pokémon™. Students were not formally assessed on Greek and Latin roots on any exams but were expected to be able to use this knowledge to learn new terms that would be assessed on exams. However, we did not assess if exam scores improved after this lesson was implemented.

**Inclusive Teaching**

This lesson is inclusive because it allows all students to participate regardless of their level of background knowledge. There are a multitude of Greek and Latin roots that can be used to name each of the Pokémon™ species and students are encouraged to be creative and have fun. Fun lessons are more likely to increase student motivation and concentration while also helping to build a classroom community (9). Additionally,
by removing the barrier of having a ‘right’ or ‘wrong’ answer, students can feel comfortable completing this activity without the fear of being incorrect. This could further increase student participation and engagement especially when it comes to sharing the names they have created. By using Pokémon™, a beloved world-wide franchise, we connect science terminology and linguistics with characters most, if not all, students will have seen outside the classroom. After completing the lesson, students will be reminded of this activity when they see Pokémon™ characters depicted in their communities.

LESSON PLAN

Summary
There are two major components to this lesson—(a) a root-words activity where students determine the Greek and Latin roots (available in Supporting File S2) that make up a series of biological terms and (b) a scientific naming activity where students use Greek and Latin roots to come up with binomial names for Pokémon™ (see Table 1). The lesson can be completed in one 50-minute session. This time frame allows students to have sufficient time to discuss the words and names with each other.

Preparation
Before class, prepare the slides and ensure students can access the links they need for the Greek and Latin roots. Put relevant scientific terms you want students to analyze on a slide (example is shown in Supporting File S3, but any words that have Greek and Latin roots used in your class will work). Make sure the Greek and Latin roots you want students to use are available in the materials you provide them (Supporting File S2). If a necessary root is missing, be sure to add it to the materials. Test out the slides and make sure they are working as you intend on your computer. Create a key to the root-words activity and place it on a subsequent slide (example is shown in Supporting File S3).

Find pictures of 6–8 Pokémon™ (such as at this website). Make sure to choose Pokémon™ that you can group into similar genera (for example: Pidgey and Spearow which are both small birds). When we taught this lesson, we used: Pidgey, Spearow, Rattata, Tirtouga, Pikachu, Squirtle, and Minccino. This allows students to easily group into approximately three groups: Birds (Pidgey, Spearow), Turtles (Tirtouga, Squirtle) and Mammals (Pikachu, Rattata, Minccino). You can choose any Pokémon™ species that work best for your class. Place each picture on a slide with the instructions for the activity (Supporting File S3).

We do not recommend posting slides ahead of time if they include answer keys (for the root-words activity). Versions of slides without keys can be posted ahead of time so students can have them open on their computers; however, this activity can also be completed seamlessly without posting the slides until after the activity is completed.

In-Class Activity
This activity has been taught as an introductory lesson in a class that focuses on the evolution and function of vertebrate anatomy. Students participated using only their background knowledge and the materials provided by the instructors. We did not lecture on Greek and Latin roots before doing this lesson. For this reason, our assessment was based on participation and completion. If your students are already familiar with the Greek and Latin roots you expect them to use in the first activity, you could assess them for accuracy instead. This alteration would require you to collect each student’s response.

Root-Words Activity
This is a small-group activity. Project the prompt and instructions on the board (Supporting File S3). Also, direct students to any materials you want them to use to help them identify Greek or Latin roots. We suggest using the Online Etymology Dictionary or the provided list of Greek and Latin roots (Supporting File S2); however, you may choose to use other resources with which you are more familiar. We have provided the biological terms we used in the supporting materials (Supporting File S3), but we encourage instructors to change these to terms that will be used within your course to make this activity more beneficial to your students. Instruct students to form small groups (2–3 students) and ask them to identify at least two Greek or Latin roots that make up each of the terms you’ve provided and infer a definition for the word. For example, homodont is composed of the Greek roots “homo” (which means “same”) and “odont” (which means “tooth”). An animal with homodont dentition has teeth that are morphologically similar.

Give students some time to start this activity on their own. Be available to answer questions they may have. After five minutes or so, check in on your groups. Ask students what word they are working on, and what words they have already finished. Have them tell you the roots they used for a word. This helps students stay on task and also lets you know if they are progressing as planned. Ask them if any of the words are proving particularly tricky so you can direct them to the appropriate resources. For example, if students are struggling with a specific word or a specific root, ask them if they can think of another word that uses the same root such as the root “odont,” which is in homodont and orthodontist. This can help them figure out what a likely meaning of the root might be. The role of the teacher in this part of the activity is to facilitate discussions that lead students to the answers. If students are confused, do not just provide the answer. We want students to apply their own prior knowledge and utilize available resources to solve the problem on their own. If the class is small, you will be able to check in on each group individually. If your class is larger, you may need to check in on just a sample of the student groups. In this case, we recommend bringing any common questions or confusions up to the entire class.

When students have completed the activity, have groups share what roots they learned and what their inferred definition for the term was. You can call on groups at random or ask for volunteers. Don’t worry if a group doesn’t quite have the roots or definition correct. You will provide them with the key, and they will be able to correct their notes. Once the class has gone through each word, project the answer key up on the board (Supporting File S3) and go through any roots or words with which students struggled. Give students a chance to ask questions at this time.
Scientific Naming Activity

Walk students through some binomial names of real species. The examples we used are available in Supporting File S3. For example, we showed *Megachasma pelagios* (the megamouth shark) which has roots that mean “big mouth of the ocean.” You can use our examples or supply species that you will discuss in your class. The purpose of doing this is to showcase how scientists use these roots to give names to real species. The students will be imitating this process using Pokémon™ species.

Project the Scientific Naming Activity slide (Supporting File S3) that includes the pictures of the Pokémon™ you chose during preparation. Walk students through the instructions. Let them know they will be sharing the names they came up with and the roots they used, and recommend that the students write down this information. First, students need to group the Pokémon™ into multiple genera and name each genus. After determining how many genera are present, students need to assign a species name to each Pokémon™. This, in addition to the genus name, makes up the binomial name of the Pokémon™ species. Once you have finished giving the directions, have students get back into their groups from the first part of the lesson and start the activity.

The goal of this part of the activity is to get students to learn and apply new Greek and Latin roots. After a few minutes have elapsed, go around to the groups and ask them what names they have come up with. If students are struggling, you can provide some direction by asking them about the features of the Pokémon™ (Is it very large?, What color is it?, Does it have fur?). Remind students that there are no right or wrong answers for this activity. As you bring the activity to an end, allow students to share their favorite name and talk you through the roots they used and what each root means. By doing this, students begin to teach each other new Greek and Latin roots. If time allows, you can share the etymology of a Pokémon from the Scientific Naming Activity or any of the hundreds available online at this website (see slide 5 in Supporting File S3 for an example).

TEACHING DISCUSSION

As opposed to traditional lecture teaching techniques, this active learning approach helps students remember relevant Greek and Latin roots that will help them define terminology throughout the course. Based on observations made during teaching this lesson, students were excited about the content of the activity and were fully engaged and actively participating. Students utilized what they learned in this lesson to help define difficult vocabulary presented in the course and on the exams. Several students reported that this activity helped them determine definitions for terminology they could not initially recall. While no exam questions specifically assess Greek and Latin roots, students were expected to memorize a large number of vocabulary words that were then incorporated into exam questions. We did not assess if this lesson improved exam scores.

Potential Responses

Students were more likely to use certain characteristics when giving their Pokémon™ generic and species names. For genera, students looked for which characteristics the Pokémon™ had in common. For example, bird Pokémon™ all had feathers and the students might have searched and found the Greek root “pterón.” Turtle Pokémon™ all had shells and students might have used the Latin root “tegmen.” For the species names, students identified what was unique to the specific Pokémon™. For example, Pikachu is yellow and is often described as “mouse-like.” The Greek root xanthos means yellow and the Latin root mus means mouse. A potential species name for Pikachu might then be “xanthosmus,” which means yellow mouse.

It is important to remember that there are no right or wrong answers as long as the name makes sense for the Pokémon™ being represented. Some groups may try to include roots that refer to color while other groups may focus on other characteristics that they find important (such as the presence or absence of horns or claws). Thus, many genus and species names are possible for each Pokémon™. This open-endedness allows students to come up with unique and fun names, which aids with engagement. We acknowledge that the potential for many acceptable answers can be overwhelming to an instructor. Thus, we encourage any instructor to have students explain their names when they share them with the class, so that it is easy to verify if the roots used are appropriate.

Potential Variations

This lesson could be taught in different formats (online, hybrid, in-person) or class sizes. For a larger class setting, the lesson could be done using a ‘Think-Pair-Share’ technique: letting students come up with names, then discussing with their surrounding classmates and ultimately sharing with the rest of the class. This lesson could also be completed as a homework assignment if teachers want to verify the correctness of the terms the students are using.

If you are teaching online, be sure to familiarize yourself with the software you are using. In Zoom, the breakout room function can be used during the activities to facilitate group discussion. If you use this function, be prepared to put your discussion prompts in the chat so students can refer to them while in the breakout rooms.

Future lessons could expand on what students previously learned. For example, more Pokémon™ with more complex features or less obvious groupings could be used to elicit specific names. These new lessons could help build on related material by letting the students learn even more root words, which could help them understand future terminology in your course and in future courses.

SUPPORTING MATERIALS

- S1. Name that Species – Take-Home Version
- S2. Name that Species – Greek and Latin Roots Spreadsheet
- S3. Name that Species – Lecture Slides

ACKNOWLEDGMENTS

We thank Michael Fugate for providing the curated list of Greek and Latin roots.
REFERENCES


### Table 1. Greek and Latin roots lesson timeline.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
<th>Estimated Time</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preparation for Class</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials Preparation</td>
<td>1. Determine which biological terms you will use.</td>
<td>10+ minutes</td>
<td>Post any resources the students will need to access (such as the Online Etymology Dictionary) to your LMS. Outlines of slides that you can edit are in Supporting File S3.</td>
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<tr>
<td></td>
<td>2. Find pictures of 6–8 Pokémon that can be grouped.</td>
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<td></td>
<td>3. Curate your slides with your terms and Pokémon pictures.</td>
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<td></td>
<td>4. Post materials you want students to have ahead of time.</td>
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<tr>
<td><strong>In Class</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Root-Words Activity</td>
<td>1. Go through the instructions.</td>
<td>10 minutes</td>
<td>List of root words is available in Supporting File S2. Instructions and our example are available in Supporting File S3.</td>
</tr>
<tr>
<td></td>
<td>2. Have students start the activity.</td>
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<tr>
<td></td>
<td>3. After 5 minutes or so, check in on the groups.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Root-Words Follow-up</td>
<td>1. Have groups share the roots and definition for the assigned terms.</td>
<td>~5 minutes</td>
<td>Example key is available in Supporting File S3. If there were many common mistakes, you may need to spend more time on this portion of the lesson.</td>
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<tr>
<td></td>
<td>2. Show the key to students and go through common mistakes.</td>
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<td></td>
</tr>
<tr>
<td>Scientific Naming Overview</td>
<td>1. Show students the example of real species names and the Greek or Latin roots that make up the names.</td>
<td>2 minutes</td>
<td>Our example is available in Supporting File S3.</td>
</tr>
<tr>
<td>Scientific Naming Activity</td>
<td>1. Walk students through the instructions for the activity.</td>
<td>10 minutes</td>
<td>Instructions are available in Supporting File S3.</td>
</tr>
<tr>
<td></td>
<td>2. Have students begin the activity.</td>
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<tr>
<td></td>
<td>3. Go around and have students share their progress.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientific Naming Follow-up</td>
<td>1. Have students share the names they have created and explain which roots they chose and why.</td>
<td>5–10 minutes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. If time allows, share the etymology of a Pokémon you chose or ones of interest, available online <a href="#">here</a>.</td>
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</tr>
</tbody>
</table>