Continental Drift and Plate Tectonics PowerPoint Teacher Guide

By Luke Talley

Thanks for your download! This PowerPoint covers continental drift and plate tectonics in a way that is different from most traditional PowerPoints. I don't typically use a lot of text in my PowerPoints so it can sometimes be difficult for other people to know how the presentation of the material is intended. That's why I have made this document, to guide you in how I use this PowerPoint in my class. This guide is just a suggestion, so obviously feel free to change things around to suit your own needs, but please do not redistribute this PowerPoint, either in its original form or in any revised form, without permission from me. You can contact me at lucas.talley@jordandistrict.org. I hope you enjoy the PowerPoint and that it is helpful in your classroom.

AUDIO WARNING: I use audio extensively in my PowerPoints, and most often it is copyright material that I have paid for and which I am not at liberty to resell. I will indicate in this guide anywhere that I used audio but where I am not able to include it. I highly recommend that you obtain the audio for yourself and that you integrate it as I have.

FONT WARNING: I use the font "AR Darling" extensively in the PowerPoint and in the note sheet. It is free to download. I encourage you to download the font so that you do not have to go through and change the majority of the text in the PowerPoint, but if you prefer you could always change the fonts to ones that better suit your needs.

In my own personal classroom I teach this material over 5 separate 50 minute class periods mixed with other assignments and activities. Most of the division points are built into the PowerPoint, but I also specify in the outline below where a new day of notes begins. So, without further ado…

DAY 1

Slide 1 – Like a good story or essay, I like to begin my PowerPoints with an attention getter. For this PowerPoint I have the theme song from 2001: A Space Odyssey playing as the words "Continental Drift" slowly rise up from behind the mountains. I realize it's a little cheesy, but it works. I typically say something like "Bam! You can't start notes much more exciting than that!" The first click will cause the title fade out and Alfred Wegener to wander on.

Audio: 2001: A Space Odyssey theme song (also known as "Sprach Zarathustra"), by Richard Strauss

Slide 2 – I talk about who Alfred Wegener is: arctic explorer / geologist / meteorologist / paleo-climatologist – take your pick. I explain that "Alfred Wegener was a man with a big, big idea which all began as he analyzed a map of the world. You see, he noticed something. Does anyone want to take a guess as to what Alfred Wegener noticed?" I explain that he noticed that the continents of Africa and South America look as if they may have once fit together. "The more he thought about this, and the more evidence that he collected, the more he became convinced that they did indeed use to be together and that they broke apart and drifted away from each other over time. We call the name of his idea 'continental drift'." (click)

Images: http://en.wikipedia.org/wiki/File:World-map-2004-cia-factbook-large-1.7m-whitespace-removed.jpg

Slide 3 – This page is fairly straightforward, we talk about the definition and I have them write it in their notes in the appropriate spot. Before clicking to the next slide I say something like "so if the continents have drifted away from each other over time, then there must have been a period in the past when they were all together, right? Alfred Wegener thought so too, and he came up with a name for it, he called this super continent, this continent made up of all of the world's land masses, Pangaea." (click)

Slide 4 – We talk about what Pangaea is and what the word means if you break it down ("Whole Earth"). We then write down the definition in our notes.

Slide 5 – "So in Alfred's mind it looked something like this. In fact, let's draw that in the first of the three circles on your notes under the heading of 'The Breakup of Pangaea'." I give them some time to draw it in their first circle. I tell them that they don't need to be perfectionists here, pretty much any blob of landmasses will do. I don't have them draw the second diagram, but we talk about how things are starting to break up and we now have Laurasia in the north and Gondwanaland in the south. They are such lovely words to say. I have them draw the third diagram in the second circle. I like to point out India and how it's just kind of sailing away on its own here. I don't have them draw the fourth diagram, but we talk about how things are starting to look pretty familiar, and then I have them draw the fifth diagram (present day) in the third circle.

Slide 6 – "This was a pretty bold claim that Alfred made here. Think about it. Continents are big, continents are heavy. Think about the Earth under your feet as you walk around outside or the mountains in the distance. Alfred Wegener was saying that they move, they drift, like their floating around. You need some pretty serious evidence if you expect anyone to believe something like that, but Alfred Wegener was no quitter, he went out and he found that evidence. Now, of course, the first evidence, the one that got the whole thing started, we've already mentioned, and that is the geometric fit of the continents – the fact that they appear to fit together." I start clicking through and showing the outlines of South America and Africa as they come together. In fact, I even have a sound clip from the song "Come Together" by the Beatles.

Audio: Come Together, the Beatles – I use the part where they sing "Come Together" for the first time and the short little bit that follows

Slide 7 – This slide brings up the text that I have the students write in their notes. Afterward I pause to make sure they are doing it right, I tell them that for each of these four evidences that we're going to talk about they need to have the title, a description, and an illustration.

Slide 8 – "Obviously Alfred had to go beyond this geometric evidence. It's cool to think about, but it could still just be a coincidence. So he started looking, and researching, and one of the first big evidences that he found had to do with fossils". I then click through this page, revealing the fossil distributions for Cynognathus, Glossopteris, and Mesosaurus. It is important to note that none of these were marine species. Even mesosaurus, which was obviously a swimmer, was a freshwater creature. This is pretty strong evidence of continental drift.

Images:

http://en.wikipedia.org/wiki/File:Cynognathus_BW.jpg
http://www.rbgsyd.nsw.gov.au/__data/assets/image/0015/53124/Glossopteristree.jpg
http://en.wikipedia.org/wiki/File:Mesosaurus_BW.jpg

Audio: Totally optional, but I like to play a sound clip from the "Jaws" theme song by John Williams when I make Mesosaurus appear. I like to freak out the students a little bit by choosing a local freshwater lake and telling them to imagine this thing swimming around underneath of you.

Slide 9 – Pretty straightforward, just have them write down the information in their notes and draw an illustration.

Slide 10 – "Alright, so fossil evidence is pretty good, but he didn't stop there, he also looked into the world's mountain ranges and the evidence that they provide. You geography pros, what mountain range is this over here in the eastern United States? (click to make them appear) That's right, Appalachians. Well, Alfred Wegener had a hunch that the Appalachians, and this mountain range here in Greenland, (click, click, click), and this mountain range here in Africa (click, click, click), and up here in Europe (click, click, click) used to all be part of the same mountain range, a mountain range that was ripped apart as the continents drifted apart. These aren't the only mountains, there are several more here along the border between Africa and the Americas that he noticed too. (Make sure you say "just kidding" after the smiley range that shows up in Asia). "

Slide 11 –" So the idea goes something like this (start the animation). Over time continents drift apart and oceans fill in the gaps (I breeze through the speech bubbles that appear from the mountains, if this is too cheesy for you style feel free to delete that part out, I won't be offended)." I talk about the image that appears and quickly reiterate the matching mountain ranges across continents.

Image: http://tasaclips.com/illustrations/Evidence_from_rock.jpg

Slide 12 – "Even more than this, the actual rock patterns within these mountains match up. That's pretty strong evidence, right? Right." (of course the two rock pattern images are just copied and pasted in this instance, one image being flipped to be the mirror image of the other). I then have them write down a description in their notes and give me an illustration.

Image: http://lh3.ggpht.com/-SjznVtPx86M/ResP1_h8C0I/AAAAAAAAAd8/qa5FCBJ3qFQ/s128/IMG_0191_2.JPG

Slide 13 – I tell them that if I were them I would do something like this as my illustration.

Slide 14 – "Now Alfred's specialty, really, was climate. His last major evidence was climate evidence." The penguin toboggans in, sees the palm tree, and right off the bat, I tell them, "now this is an extreme exaggeration. There are no tropical plants on Antarctica –but there is strong evidence, in the form of coal deposits, that tropical plants *used* to grow in Antarctica, long ago, when its position on the Earth was different and warmer." I know the whole penguin hopping in the hammock thing is pretty cheesy, feel free to axe it. Personally I just acknowledge, "that was pretty stupid, sorry." We write down in our notes what is says on the screen but I emphasize that the dot dot dot means that there is more to come on the next page.

Slides 15 and 16 – We write down the new text that appears on the screen and then we talk about what I mean as the penguin does his thing. I tell them how that during the time of Pangaea some of the places that we know of as warmer, like India and Australia, were located closer to the South Pole and were much colder. The animations pretty much take it from there, just supply some narration as you click along.

Slide 17 – I use this page to choose on random students and reviewing the major evidences while not allowing students to look at notes. Once we have all four I say something along the lines of "his evidence is pretty darn convincing right? Bam! Rejected. It turns out that despite all of his great evidence, Alfred Wegener was still rejected by the majority of his fellow scientists in his time."

Slide 18 – "Why? What was the problem? Well it turns out that despite all of his evidence, Wegener could not explain *HOW* it all happened. In other words, he had no mechanism. Sure, it looks like they are moving, but HOW? How could these massive chunks of Earth possibly float around the Earth? And Alfred couldn't explain that." I have them write down what they need to in the notes and I then tell the quick version of Alfred's unfortunate death and end my notes for the day.

DAY 2

Slide 19 – Another dramatic beginning, this time the words "The rise of plate tectonics" float up from behind the mountains while the 2001: A Space Odyssey theme song plays.

Audio: 2001: A Space Odyssey theme song (also known as "Sprach Zarathustra"), by Richard Strauss

Slide 20 – Pretty straightforward, I just read it out loud to the students. I am especially fond of my ninja. Anyways, before moving on to the next screen I ask them to remind me, if Alfred's evidence was so good then why was he rejected?

Slide 21 – "Before we go any further let's talk about the difference between a hypothesis and a theory, because what Alfred Wegener had, while a brilliant idea, was just a hypothesis." I then go over the page while having the information fly in and filling out the note sheets. Before going to the next page I say something like "So that's where we are, Alfred Wegener died without ever really being able to show how the continents could move, and in fact it wasn't until about 15 years after his death that things started moving forward. For you history pros in the room, what major worldwide event took place in the 1940's?"

Slide 22 – World War II. Gun sound effects courtesy of me. The students usually get a kick out of them. I talk about with this war, for the first time the enemy comes at us from under the water in submarines.

We need a new technology in order to detect them and to protect ourselves. Sonar. I make the diagram appear and then I explain what sonar is. Then I have the words appear and we write it down.

Image: http://s1.hubimg.com/u/5703084_f520.jpg

Slides 23 – 27 – The next few slides are pretty straightforward, the boat comes in, shoots some sound waves into the water, we follow those waves down, we show how they reveal a mid-ocean ridge which leads us to slide 28.

Slide 28 – Pretty straightforward. We introduce mid-ocean ridges and write down some basics in the notes. There is obviously a lot more to tell about mid-ocean ridges than the little bit said here, but I save that for later.

Slide 29 – Shows where the mid-ocean ridges are located. I just narrate as the lines appear, saying things about how this is the longest continuous mountain range on the planet, etc.

Slide 30 – Compare the cartoony version of the mid-ocean ridges to a satellite image of the planet where the mid-ocean ridges are prominent

Slide 31 – Harry Hess comes in on a boat, info about him pops up, we write that down in the notes. If you lean towards the side of music in your PowerPoints then this would be a chance to play "In the Navy" by the Village People.

Slides 32 – 36 – Show and explain the forming of new crust at a mid-ocean ridge and how it pushes the old crust out of the way. This series of slides ends by showing a research facility on the bottom of the ocean floor. The reason for the base is to have a reference in the next slide which shows seafloor spreading on a bigger scale.

Slide 37 – Pretty straightforward. Shows seafloor spreading and then a definition appears which we write in or notes.

Slide 38 – Just a bit of silliness, moving right along.

Slides 39 – 63 – This lengthy sequence shows how the age of the rocks changes as you move away from the ridge. The fact that the rocks get older the farther you get away from the ridge, and the fact that the ages match on both sides of the ridge, are evidences of seafloor spreading

Slides 64 – 80 – This sequence tells the story of how Earth's magnetic poles have not always been what they are today. There have been times in the past where the Earth's magnetic poles have been reversed. During these times a compass would point south instead of north. Tiny mineral particles inside of rising magma in the mid-ocean ridges magnetically align themselves to Earth's positive pole and then maintain their orientation as the magma cools, locking the minerals in their positions. As Earth's positive pole shifts between the north and the south poles there is no change in the orientation of the minerals in the already cooled rock, but the minerals in the newly formed magma is free to orient themselves in the direction of the pole. The fact that the magnetic striping is identical on both sides of the mid-ocean ridge is evidence of seafloor spreading – crust that formed around the same time and which has been moving away from the ridge at roughly the same rates. On slide 80 we copy down the words into our notes after having talked about the phenomenon. This can be a difficult concept for students to grasp, but the visuals and animations make it much easier.

Images:
http://cde.nwc.edu/SCI2108/course_documents/earth_moon/earth/tectonics/ocean_crust/ocean_crust_age_big.jpg

http://en.wikipedia.org/wiki/File:World_Distribution_of_Mid-Oceanic_Ridges.gif

Slide 81 – This goes in their notes on the bottom of the back of the front page where it says "Seafloor spreading diagram"

Slide 82 – This starts a little "quiz time" to review some of the concepts so far and to end day 2 of notes. I call on random students around the class. The first question is "What is the name of the supercontinent that existed millions of years ago?"

Slide 83 – What is the name of the idea that the world's landmasses are slowly drifting apart? What is the name of the man who came up with this idea?

Slide 84 – What four major evidences did Alfred Wegener have to support continental drift?

Slide 85 – Why was Alfred Wegener not accepted in his time?

Slide 86 – What is the name of the process shown in this series of diagrams? (I read the captions out loud)

Slide 87 – What is the mechanism of continental drift?

Slide 88 – Who came up with the mechanism of continental drift?

Slide 89 – Where does seafloor spreading take place?

Slide 90 – Seafloor spreading is what causes the continents to move. What evidence do we have that seafloor spreading is actually occurring?

DAY 3

Slide 91 – More 2001 Space Odyssey, as the caption for today's topic floats in. The next click of the button reveals that the number one driving force of plate movement is convection.

Slide 92 – Pretty straightforward, talk about convection and add it to the notes. I often have students comment that penguins cannot fly. I like to respond by saying something along the lines of "well then how do you explain that?" while pointing to the flying penguin on the PowerPoint.

Slide 93 – Have them fill in the part of their notes set aside for the diagram about convection

Slide 94 – Squeeze the words into the box about convection (not the convection diagram box). I like to use the example of a moving sidewalk at the airport. Convection moves the plates along just like the moving sidewalk rolls its passengers along.

Slide 95 – Before I show the next driving force of plate tectonics I ask them what they think it might be. Usually someone in class will throw gravity out as a possibility. The rest of the page is pretty straightforward – man falls out of sky, we reveal the word "gravity".

Slide 96 and 97 – Pretty straightforward, the dancing snowy peaks is just a little random bonus. Before moving on to page 98 I ask the students how is it possible that gravity, a force that pulls objects down, can move the plates sideways? That doesn't seem right? I then share two examples. The first is a demo that my college professor shared with the class, although in a very awkward way. He took off his belt and said "let me show you something." Of course our first thought was "what is going on here!?" Anyways, I do the same example with my class but I warn them first "I am going to take off my belt" I tell them, and then I take it off and lay it on a table. "Is gravity acting on my belt? Yes, so why isn't it moving? Right, because of the table. But if I hang a little of the belt off of the edge of the table… BAM! Gravity has something to hold on to and it pulls the rest of the belt with it. A force that pulls down causing an object to move sideways. The second example that I share is the good old table cloth trick. If I pull down on the edge of a table cloth then everything laying on top of that tablecloth moves sideways.

Slide 98 – "Gravity moves the plates the same way as the two examples that we mentioned. It pulls the plates down in areas called subduction zones." I then briefly talk about what a subduction zone is.

Slide 99 – Straightforward

Slide 100 – We write down the definition and discuss examples, like when a 2-liter of mountain dew is shaken up or taken to a higher altitude, or when alka-seltzer is put in a film canister with water creating a mini-rocket (something we had done earlier in the year). The shaking mountain that soon blasts off and flies away is a little cheesy, but usually goes over well. I usually say something like "Bam! You did not see that coming! It may have been kind of stupid, okay, but you did not see that coming."

Slide 101 – We talk about how pressure actually moves the plates and add it to our notes.

Slide 102 – Quick recap without their notes

Slide 103 – We draw a diagram, they are putting it in the appropriate box in their notes

Slide 104 – Nothing really to write down here, just a discussion about plates, how many there are, which one we live on, etc.

Images: http://upload.wikimedia.org/wikipedia/commons/d/d3/Plates_tect2_hr.svg

Slide 105 – We write down the definition of plate tectonics in our notes and I like to talk about how this is the new and improved version of continental drift. We're not ashamed to call this a theory, because not only does it have the evidence, it can explain how the continents are moving – seafloor spreading, and in an even more detailed explanation – through the three driving forces of convection, gravity, and pressure.

Slide 106 – I have the class name the traditional four layers of the Earth that they learned in previous years. I tell them that "there are two new layers that are based not on composition like the others, but based on the way that they act. Turns out that the tippy top part of the mantle acts more like the crust than the rest of the mantle. We call this the lithosphere. When we talk about the "plates" of plate tectonics, it's the lithosphere. It's not just the crust, it's also that top part of the mantle. " I have them write down "the plates" next to lithosphere in their notes and then label it on their diagram. "The asthenosphere is the location where all of the convection is happening that we've been talking about. It's the next part of the asthenosphere. The lithosphere, the "plates", floats around on top of the asthenosphere. *These are usually some pretty new terms for students so I really try to emphasize their meaning here.* I tell my students "be sure you remember this stuff. There is a question on your test that says something like 'use the words lithosphere, asthenosphere, and plates in the same sentence in a way that makes sense'." I then give them an example that would work, something like "The lithosphere, also known as the plates, floats around on top of the asthenosphere."

Slides 107 – 112 – I have found through experience that when teaching about lithosphere and asthenosphere that students often latch on to the misconception that the lithosphere and asthenosphere must be sandwiched between the crust and the mantle. These pages are just illustrations and animations that try to better convey what the lithosphere and asthenosphere are with slide 111 showing how convection in the asthenosphere moves the lithosphere, or the "plates". I have the repeat on slide 112 just to drill it into their heads again, choosing students who I know will struggle with the concepts to answer.

Slides 113 – 114 – "Speaking of plates and crust, there are really only two types of crust, and to really understand plate tectonics, we need to understand the difference between these two types of crust. There is ocean crust (click), and continental crust (click). And right off the bat you should notice some of the differences between the two, and no, I don't mean differences like 'one is in the ocean and the other is on land' or 'they are different colors', so what else do we notice?" Usually someone will say how the ocean crust is thinner or the continental crust is thicker, so I make that appear. If no one comments on the ocean crust subducting beneath the continental crust then I raise the question and ask why they think that is. Usually they arrive at the fact that the ocean crust must be more dense. The third set of facts is not at all obvious from the diagram so I just ask them, "if I was to determine how old these two types of crust are which of them would be younger? Why?" Talk about why – the constant creation of new rock on the ocean floor making ocean crust much younger on average than land crust.

Slide 115 – This slide is designed to clear up a misconception that students often have. We talk about land crust and ocean crust so students often get it into their heads that there are ocean plates and land plates when in reality plates can have both types of crust, and in fact nearly all plates do have both types of crust. The diagram of the Earth's plates clearly shows this.

DAY 4

Slide 116 – Another day, another dramatic entrance, cue the music. If you feel like it's getting old then feel free to axe it. The topic this time around? Plate boundaries.

Slide 117 – 119 – This is pretty straightforward stuff. I say something like "there are three types of plate boundaries. Plates can collide head on. They can move away from each other. Or they can scrape past each other." I have no idea why I have the exploding arrows, the crumbling words, or the mountain saying "woot". I suppose it was one of those moods.

Slide 120 – 121 – "Let's begin with the convergent boundary which will be expertly represented here, by two sumo wrestlers." My whole point with the sumo wrestler slides is to give a visual to the concept of convergent and to throw out some mnemonics to help them remember it. I tell them not to worry about the chart in their notes quite yet, that they don't need to write any of this down yet.

Slide 122 – Pretty straightforward, nothing for them to write here, I just go over what's on the page telling them that this is the reason why their chart has five rows even though there are only three types of boundaries.

Slide 123 – Time to start writing stuff down and filling out the chart. Straightforward enough.

Slide 124 – After having them write down the information I ask them to find an example where this is happening. I tell them "there is only one *really* good example and a couple of other just okay examples." And then I let them guess until somebody zeroes in on the India-Eurasian plate collision which gave rise to the Himalayas.

Slide 125 – 138 – These pages focus on what forms or happens at a continental vs. continental boundary. The slides act like pages a of cartoon flip book, each one bringing the two continental crusts together so that you can narrate at each stage what is happening. Of course, we don't really begin with a big empty pool of magma, but I usually don't even mention that and they usually don't ask. The emphasis for this type of plate boundaries is that you get mountains and Earthquakes. The two actual pictures of mountains are both of Mt. Everest. When the second picture shows up I like to throw something out like "this is the path that I took when I climbed to the top… this part was kind of hard, then this part wasn't too bad, then a hard part, and then I actually skipped for most of this part…" etc. Suffice it to say, sometimes I get a little too carried away during my notes… Anyways, it's pretty straightforward stuff, come up with a narration that works for you.

Images:

http://www.onepiecetravel.com/upimg/090516/1_002459.jpg

http://www.crackingdaysout.com/images/everest-route-north.jpg

Slide 139 – Making everything from the last cluster of slides official and getting it down on the notes and then introducing the next type of collision.

Slide 140 – Back to the map to find an example. There are a lot of examples scattered around the ring of fire but I specifically focus on the collision between the Nazca plate and the South American plate.

Slide 141 – 170 – Again you get a big cluster of slides that all focus on what forms at continental vs. ocean collisions. This time there are more things forming so there are more slides to go with it. The nonsense with the bear and the volcano was the product of a late night when I should have been in bed. I don't have anywhere in the notes where students actually write down what a trench is or what a subduction zone is, but I hold them accountable for knowing both things for the unit test so I make sure to emphasize it here.

Slides 171-172 – Just a couple of cool pictures of volcanoes. I don't spend much time on them.

Images: http://www.superedo.it/sfondi/sfondi/Citt%C3%A0%20e%20Metropoli/Hawaii/hawaii_7.jpg

http://studentglobeonline.com/blog/wp-content/uploads/2011/12/arenal-volcano.jpg

http://beachcomberpete.com/costa_rica/wp-content/uploads/2011/11/Mount-Arenal-Volcano-Costa-Rica.jpg

http://www.ebhavitha.com/star9/volcano-diagram-for-kids-worksheet-i14.jpg

http://i239.photobucket.com/albums/ff138/Mayosh_2007/Sweet%20May/volcano.jpg

Slide 173 – A diagram that's a little bit less cartoony and does a better job showing the big picture.

Image: http://i239.photobucket.com/albums/ff138/Mayosh_2007/Sweet%20May/volcano.jpg

Slide 174 – I use this page to quickly review what each of these structures is and then I pick on students to describe them in their own words.

Slide 175 – Making everything from the last cluster of slides official and getting it down on the notes and then introducing the next type of collision – ocean vs. ocean

Slide 176 - Back to the map to find an example. Again there are a lot of examples to choose from but I focus on the Phillipines – Pacific collision since it is the site of a good island arc example and the world's deepest trench.

Slides 177 – 196 – Another slide-by-slide flipbook-style analysis, this time covering what's happening at ocean vs. ocean boundaries. The emphasis is on island arcs and trenches.

Slides 197 – 200 – These are all pictures of different island arcs – two of Alaska and one of Japan. The last picture is of Mt. Fuji, the most popular volcano in the Japan island arc system.

Image:
http://eoimages.gsfc.nasa.gov/images/imagerecords/69000/69687/Alaska.A2004003.2210.250m.jpg

http://www.alaskannature.com/3Do_aleutians.jpg https://lh4.googleusercontent.com/-EQ0dpLzNB14/TXzt-3VsRsI/AAAAAAAAA-Q/UtHnv6pM3sg/s1600/Japan.jpg

http://4.bp.blogspot.com/_esI-JjdXJLw/TI3pL0LV-SI/AAAAAAAAAEM/JukKoSG9mz4/s1600/Mt+Fuji+and+house.jpg

Slide 201 – A satellite composite image clearly showing the Mariana trench with Challenger Deep, the deepest part of the world, being pointed out. This is where we put Megatron at the end of Transformers 1, but we soon learned that Decepticons were not to be underestimated and that not even Challenger Deep could hold them.

Image: http://www.mpi-bremen.de/Binaries/Binary14051/Fig_2_Mariana_Trench.jpg

Slide 202 – 203 – Wrapping up the "What forms at ocean vs. ocean boundaries" section by showing that you also get subduction zones and earthquakes.

Slide 204 – Making it official by adding it to the chart and introducing divergent. I usually end here for the day depending on how it has gone so far (but sometimes I muscle through to the finish.)

DAY 5

Slide 205 – 206 – Back to my sumo boys to demonstrate, in perhaps a rather cliché manner, that plates move away from each other at divergent boundaries.

Slide 207 – This is how I use to demonstrate plate boundaries before using sumos. As you can tell it was very dramatic. Maybe not so much, but it opens up the conversation for the plates acting like cars in a global demolition derby.

Slide 208 – Straightforward, just getting stuff down on the chart.

Slide 209 – Where do we find divergent boundaries? Almost without exception they are found in the oceans were ocean crust is moving away from ocean crust. Look familiar? That's because we've already talked about these, we just didn't use the name "divergent" – instead we said "mid-ocean ridge" because that's what you get there.

Slides 210 – 211 – Getting in to what it creates and then I show a flashback diagram from previous days' notes with seafloor spreading and mid-ocean ridges.

Slides 212-213 – I just wanted to give different, less cartoony perspective of what is happening at divergent boundaries. The second picture especially serves to show that it all more complicated in reality then we show in PowerPoints.

Image: http://2.bp.blogspot.com/-JPQLapsaC-g/UHJIoj7qljI/AAAAAAAAAH4/3ZhoFJEFkVA/s1600/Imagem19.jpg

http://1.bp.blogspot.com/_jHuooQTCYXc/S7nPCE9ZxsI/AAAAAAAAFmw/qFuYBEpr7HQ/s400/magma1.jpg

Slide 214 – I like to point out here that there a couple of rare places around the world where mid-ocean ridges run up through the land, like in Africa's great rift valley (which isn't shown well here) or in Iceland (which is what I focus on).

Slides 215 – 221 – These slides all contain images related to Iceland. Slide 215 shows images of the Silfra crack where people can actually go and swim down in the mid-ocean ridge. Slide 216 is an example of a natural hot spring, which are abundant thanks to the magma rising up from the mantle. Slide 217 shows volcanic activity in a land of ice, 218 just looks cool, don't know if it and 219 have anything to do with Iceland's geothermal activity, but Iceland has cool waterfall systems. 220 shows a cool valley that has formed at the ridge and a cheesy cartoon which might slightly exaggerate the length of time that it takes for the plates to drift apart. I take this time to teach them how fast the plates move (if it hasn't already come up). I tell the students that the plates move about as fast as your fingernails grow, and then to emphasize just how slow that is I pick a random student and I put my hand in front of their face and I ask how long it will take for my fingernails to reach their face. Slide 221, ladies and gentlemen, is the national flag of Iceland.

Images:

http://img.photobucket.com/albums/v311/ecox/IMG_4232.jpg

http://www.znanje.org/i/i27/07iv04/07iv0417/slike/7.jpg

https://lh3.ggpht.com/GWQXAB4QPv6-Pe1zvYKPg-SvOyihUbBcYUQdX3j_3QtXw88XlR2yuaB-_l_q34AlHyrTaw=s150

http://www.wyjazdydlafirm.pl/files/brilliant_gallery_temp/bg_cached_resized_78ae7035d526e4adef6218ce86468050.jpg

http://www.zingtravel.pl/Media/Default/Imprezy/15-91449_v3232323800x600.JPG

http://i297.photobucket.com/albums/mm204/j4jokes/funnyr1532.jpg

http://www.kentport.com/resimler/621_4125_1216923924_317.jpg

http://ic.pics.livejournal.com/naomi_anael/30595642/57592/57592_original.jpg

http://i.imgur.com/c9IZS.jpg

http://www.mapsofworld.com/images/world-countries-flags/iceland-flag.gif

Slide 222 – Before moving on to the final type of plate boundary I like to talk to the students about how it is possible to have earthquakes at a boundary where the plates are moving away from each other. I like to ask for two volunteers to come up to the front of the class and I give them a rubber band to hold between the two of them. I then instruct them to pull apart from each other while still holding tight to the rubber band. Now whether or not you actually let them snap the rubber band and inflict bodily harm on themselves is up to you, but it might be a good idea to stop them after you've made your point. Just like this rubber band there is tension in the rocks in the mid-ocean ridges at divergent boundaries. As these rocks pull apart, eventually they will snap and release their built up energy in the form of an earthquake. You will never have earthquakes anywhere near the magnitude of what you will find at convergent or transform boundaries, but you will have earthquakes all the same. Now, on to the final type of boundary – transform.

Slide 223 – I couldn't think of a good way to show this with sumo wrestlers, so I went back to the car example.

Slide 224 – Straightforward, just updating the chart

Slide 225 – Finding out where it is on the map. The best example is by far the San Andreas fault system in California

Slides 226 – 228 – These slides show the San Andreas Fault and the Earthquakes that happen along this plate boundary as the plates scrape past each other.

Slide 229 – We wrap up the chart and I can't help but comment on how beautiful the whole thing is ☺. Before moving on to the next slide I ask them what all types of plate boundaries have in common. The answer is obvious and they quickly reply "earthquakes". Which leads into the last little bit of the PowerPoint that we have left to cover.

Slide 230 – I begin this slide by saying "if I were to start plotting earthquakes in some of the places that they happen most often around the world, what would you expect to see? Obviously you would expect earthquakes in California (click), and there are always horrible earthquakes happening in Peru, and Chile (click, click, click). There was a terrible earthquake in Haiti not too long ago (click). There was the one off of the coast of Japan that triggered that disastrous tsunami (click), and then before that, one of the worst tsunamis of our time was triggered by an earthquake off of the coast of Malaysia and Indonesia. No obvious pattern yet, but when we start adding some of the world's volcanoes, like in Iceland (click) on the western coast of North and South America, over in the Philippines (click), and in Japan (click) and Italy (click). Over in Alaska (click), and of course, let's not forget, Hawaii (click). Let's keep on adding more and more data (be clicking continuously, building up to 4-5 dots per second), more earthquakes, more volcanoes. We see that they are happening all over the world, and as we add more and more volcanoes and earthquakes, we really need to start asking ourselves…" At this time I start watching for those points that signal the end of the dots. For example, I know that when the bottom-right most dot appears that the sequence is almost over so I start clicking a little more slowly so I don't overshoot. "These volcanoes, these earthquakes… are they random?" (time this so that the word "random" has appeared? Of course not, if I bring up an outline of the world's major plates (click) then we can see that this is not a random pattern at all. When Earth's plates move, earthquakes happen and volcanoes erupt…"

Slide 231 – 232 – "In fact, let's go ahead and add that to our notes." Click until the words appear and add them to the notes. "There are so many volcanoes and earthquakes that take place around the outside of the Pacific Ocean in particular that Geologists have lovingly given that part of the world it's own nickname…"

Slide 233 – If you're in my class, Johnny Cash's "Ring of Fire" begins playing as the boundaries and the rest of the volcanoes and earthquakes fade out other than those found along the edges of the Pacific (and Hawaii, since we will be talking about that in the next slide). "They call this part of the world the "Ring of Fire" and they know about it long before they knew what was causing so many volcanoes to sprout up. Now we know, plate tectonics, and the name has stuck. But something's kind of strange here…"

Slide 234 – "One of these things is not like the others. Notice that smack in the middle of the ring of fire we have an outlier. Hawaii. (click) A place that by all rights should be calm and relaxed, not at all volcanically active, but there it is. How? Why? Places like Hawaii, places that are volcanically active even though they are located far from the nearest plate boundary, are called "hotspots" (click).

S**lides 235 – 242 –** If finish up these slides by describing what a hotspot is, a giant plume of magma that bulges up through the crust as the plate above it moves overhead, while clicking through the different illustrations. Eventually it shows a rough idea of how the Hawaiian islands formed and ends with a definition of hot spot on slide 242 which we add to our notes.

Slide 243 – This slide marks the beginning of a review quiz which stretches to the end of the PowerPoint. I call on random students as I go through and have them answer the questions that they should be able to answer by now. This slide's question… "What are the three driving forces of plate tectonics?"

Slide 244 – How does convection move the plates?

Slide 245 – How does gravity move the plates?

Slide 246 – How does pressure move the plates?

Slide 247 – What is the lithosphere?

Slide 248 – What is the asthenosphere?

Slide 249 – Which type of crust is younger, thinner, and more dense? Oceanic or continental?

Slide 250 – Which of the following best represents the convection currents that you would see underneath a divergent boundary? (click to reveal answer, click again to bring all of the options back). Which one shows a convergent boundary? (click to reveal the answer)

Slide 251 – If this is a tectonic plate, and we know that it has these features – a trench on the western border, a mid-ocean ridge on the eastern border – then which direction would this plate be moving? What type of boundary would we find on the eastern border? On the western border?

Slide 252 – Label the points A-F on the diagram on the screen. (click one by one to reveal the answers).

Slide 253 – Where do most of the world's earthquakes and volcanoes occur?

Slide 254 – What do you call a place that is volcanically active even though it is not located near a plate boundary?

Slide 255 – Nothing too fancy here, just a deceased Alfred Wegener claiming that the PowerPoint has come to its conclusion as a penguin flies by in the distance ☺

And that's it! Hopefully this document helps you to figure out how to best use this resource in your own classroom, and hopefully both you and your students enjoyed using it. Obviously you are more than welcome to change things around to better suit your needs as necessary. If you liked this product then please be sure to leave feedback so that I can feel good about myself and please consider following me so that you can be updated when I develop new products. Thanks!