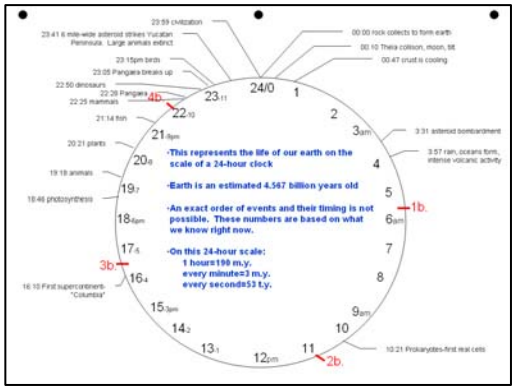
Teacher Notes- "Earth Clock-A Timeline, Past To Present"

Would you believe that teaching earth history can be fun for your students? This lesson reaches back to the beginning of earth, some 4.567 billion years ago, and presents its entire life, up to now, on the scale of a 24-hour clock. The activity initially looks difficult because of the math, but the process is simple and repetitive. Every kind of student can do this, even those who struggle with math.



This activity is broad in perspective, so it can easily adapt to cover several kinds of chapters, like plate tectonics, volcanoes, and adaptations. We even left you some room in the activity for you to add in your own things.

Materials per student:

1-bowl, or round object that can be traced around, to make the face of the clock; 5½ "- 6 ½ " around (a small group of students can share one bowl)
1-blank sheet of copy paper, punched with holes along the side
1-Student Handout (see p. 8)
1-calculator

Additional Teacher Materials:

PowerPoint (see p. 8)

Beforehand:

- Print extra copies of slide 1 for students who can't read small print on overhead.

- About a week before you plan on doing this, start gearing your mind up for this activity. This is not a lesson you want to do "cold". Look through your current chapter and find connections. Another good reading is http://wikipediaondvd.com/nav/art/a/e/5.html . You'll notice that on this activity we intentionally steered away from the most controversial topics because we didn't want to lose the main point of the lesson- a very general overview of our earth's history.

- If you'd like to add more events to the list, you can write those in the 2 spare boxes at the bottom of the Student Handout. You could also write them on your chalkboard.

- You'll want to do the math yourself two days before this activity so you know exactly what your students will be doing and feeling. If you get a little

confused at some point, that tells you to be that much more clear and deliberate when explaining that part to your students.

ANSWERS-Earth Clock

Billions of years	Event	Time (Divide yrs ÷ .190)	Convert minutes	Hr : Min
.05	"Theia" collision, debris forms moon, earth tilts 23 ½ °	.03 ÷ .190 = 00 16	.16 x 60 = 9.6 =10	00 : 10
.15	Crust is cooling	.15 ÷ .190 = 0 79	.15 x 60 = 47	00:47
.667	Asteroid bombardment	.667 ÷ .190 = 3 . 51	.51 x 60 = 31	03:31
.75	Rain, oceans, intense volcanic activity	.75 ÷ .190 = 3.95	.95 x 60 = 57	03:57
1.967	Prokaryotes-first real cells	1.967 ÷ .190 = 10.35	.10.35 x 60 = 21	10:21
3.07	First supercontinent-"Columbia"	3.07 ÷ .190 = 16.16	.16 x 60 = 10	16:10
3.567	Photosynthesis	3.567 ÷ .190 = 18.77	.77 x 60 = 46	18:46
3.667	First animals	3.667 ÷ .190 = 19.30	.30 x 60 = 18	19:18
3.867	Plants	3.867 ÷ .190 = 20.35	.35 x 60 = 21	20:21

- This activity as-is takes about 55-60 minutes to do. That includes having students draw and number the clock face, calculating the times of the events, and putting them on the clock. If you have 45 minute classes then you have 2 options. You could take 10-15 minutes at the end of a class period for students to set up their clock face, and then do the rest the next day. Or, you could do what you can in one class period, and send the remaining calculations and work home with students to finish. That's a little more risky, depending on how mathematically able your students are, but it takes less class time.

- Copy the Student Handout (list of events) for students, and punch holes along the top. There are 2 reasons for these holes- referring to them on the PowerPoint makes it easy to orient the paper during the activity ("See the holes at the top kids? Turn your papers that way."). And if your students keep a science folder, the paper can go immediately in there.

Procedure:

1. Check that students have materials: blank sheet with holes, Student Handout listing events and times, calculator, and pencil.

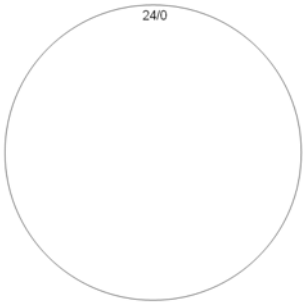
2. Give a brief introduction:

   "True or false- the earth is old? (true!)
   We all know that's true, but the word "old" is a relative term. Most of you think that anything older than you is "old". Well, maybe.

   In today's activity we're going to look at some of the biggest events in the history of the earth. Like you, it had a beginning, a period when it was undergoing tremendous change, and a present/now. This is information that we all seem to know, yet today, because we're assembling it on a continuous scale, it will make more sense than ever before. Sort of like to know you is to look at every event in your life and not just one."

3. Begin the PowerPoint. It will lead you and your students through the activity. Slide 1 shows a large circle.

4. Have students first trace a circle around the bowl that's between 5 ½ and 6 ½ inches in diameter. Any larger and we won't be able to fit our labels on the outside. Any smaller and the inner statements won't fit either.

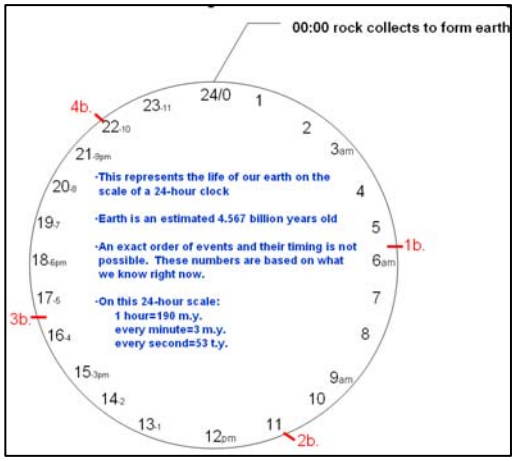


5. Advance the PowerPoint to show the "24/0" at the top of the circle and have students put this on theirs.

> "Now, we're used to clocks with hands that go around two times in one day, but this clock is different. This zero represents where the earth first formed. Between it and the 24, notice we've just gone around the circle once, is all 24 hours. It might be confusing at first, but this wouldn't work any other way. Using this clock we get to keep one long continuous scale, while applying it to the unit you're most familiar with- time."

6. Now have students put the 6, 12, and 18 on. Don't use rulers or compasses to be exact; that's not necessary. Next to 18 (and anything on the left side of the clock for that matter) we'll be putting a small "12 hour real time" that we're more familiar with. So, next to 18 will be a "6", as in 6 o'clock pm, and so forth.

7. Keep advancing the PowerPoint, adding hours 3, 9, 15, and 21 in between the other numbers, and then finally all the remaining individual numbers. The hours were put on this way because it's easier to keep things halfway in the right place when thinking in terms of halves and fourths.



8. Read aloud the 4 blue statements in the middle and have students copy them.*[1] They are meant to focus everyone, get us all on the same page, and set a serious tone for this activity. The 3rd one (exact time/order) is most important. No, we don't know anything for sure. But there was a time when early earth was just forming. In between then and now, things have changed. The events on your sheet and their times is our best guess right now.

9. Mark the billion year increments at every 5 ½ hrs (shown in red on the PowerPoint).*[2]

10. Advance the slide and have students copy the very first event (*00:00 rock collects to form earth*) as shown.

11. With the clock set up, now turn your attention to the worksheet. Explain the 5 columns.

Earth Clock

Billons of years	Event	Time (Divide yrs ÷ .190)	Convert minutes	Hr : Min
.03	"Theia" collision, debris forms moon, earth tilts 23 ½ °	.03 ÷ .190 = 00 . 16 (Hours / Hundredths of an hour)	.16 x 60 = 9.6 =10	00 : 10

Column 1- Billions of Years This tells the age at which the event happened, in billions of years. .03 billion years is the same as 30 million years, and .75 billion = 750 million.

Column 2- Event A brief description of what happened

Column 3- Time Here students will divide the time from column 1 by .190. That converts billions of years to hours.

Column 4- Convert Minutes In this column students will multiply the hundredths of hours (the decimal only from the previous answer) by 60 to convert to real minutes.

Column 5- Hr : Min Where students put their final time they computed.

12. It's finally time to do some math! Have everyone grab a calculator. No calculator, no help later.

> "Students, if you give me your complete attention for the next 5 minutes, I'll give you all the help you need later. If you get stuck, I'll stay with you and help you until you understand. If you don't, and I'll be watching to see who stays with me, then I won't be able to help you. I say that because if you don't pay attention, it WILL confuse you when you try and do it without any instructions, and there are other people who were paying attention who need help, so they are the ones I will help."

13. Look at/do 1st event together ("Theia"). Go slow! Think of the next 5-10 minutes as an investment that will pay off later when students are working well on their own. Take extra time now to be clear, to watch for and help students struggling. One student that struggles is usually an indicator of others. Explain the calculations as a sequence of simple steps, which is really is anyway. The worksheet will lead them through with examples and arrows.

This lesson was designed to get students to think "this is no big deal" before they are left to work on their own. They're gradually led through the first 3 events. The steps are simple, and they keep repeating.

14. Talk students through the first example, which is already filled in for them. In the "Time" column is .03 ÷ .190. Even though the answer is printed, make each student do the division on their own calculator. (*You want to build their confidence starting right now with easy work*)

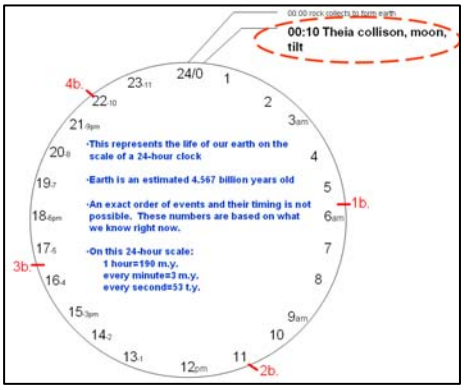
15. Look at the answer on the handout and let it confirm what your calculator says (.157, which we'll round to 0.16).

16. Pause and analyze that answer. What we just did was convert time from billions of years to hours. In the number 0.16 the zero means it occurred at zero hours. Follow the arrow and notice it's already printed in the "Hr" column.

17. The answer was zero hours and sixteen hundredths of an hour. That sixteen hundredths does NOT! NOT!! NOT!!! mean 16 minutes. It means 16 hundredths of an hour. What in the world in 16 hundredths of an hour? Let's follow the arrow and find out in the next column.

18. Multiplying .16 by 60 tells us how many minutes we have (9.6, which rounds to 10). That's already at the end under "Min".

19. Advance the PowerPoint to show the Theia label on the clock face and have students copy this onto theirs. The time, in hours : minutes format, goes first, then the word description of the event.



20. For the second example (*crust is cooling*) talk slow to give students who are catching on time to work ahead of you (which you want). Everyone else needs to go slow anyway. Go extra slow when explaining what 0.79 means- zero hours and 79 hundredths of an hour (which they're about to find out is 47 minutes).

21. Put the label for *crust cooling* on the clock at 00:47.

22. Before doing the 3rd one together, announce you're giving everyone a 30 second head-start to work ahead of you. If they get an answer, they'll see if they're right when you catch up with them. If they get stuck, you'll be explaining things soon.

23. After the third example, let them work on their own. Be available, but not too helpful. Don't get tied to a few students who were not listening or are not willing to try on their own.

24. If some students want, they can choose to do the "Time" column for all the events first by dividing all those times by .190, then do all the next column at once too.

That might cut down on mistakes as they're not having to "change gears" and do different steps.

Accessories: Other sub-topics you can add for more length and depth.

- *[1] **Point 2**-"And just how do we know that earth is 4.567 billion years old? Well, we don't know for sure. No one was there, so we have to go by evidence. You all have trash cans in your homes. Say the trash can is full. That means the trash on the bottom is oldest, and was there first. Then garbage was put on top over time. So the newest garbage is on top. That's also how it is with the ground below your feet. The further down we dig, the further back in time we're going. And as we go further back, we find periods when there are certain things going on.

  Point 3- Some of you are no doubt wondering why in the world we're using class time to talk about something that happened in the past and doesn't directly affect your life. It's kind of like that door over there. Behind it is something amazing. Something you've never seen before. Would you like to see it? (open and there's nothing there). You see, human curiosity is driving all this. It's what makes us explore space and the beginnings of our planet, like we're doing today. Something inside our minds makes us naturally curious about these kinds of things, and that makes it worth all the effort and resources.

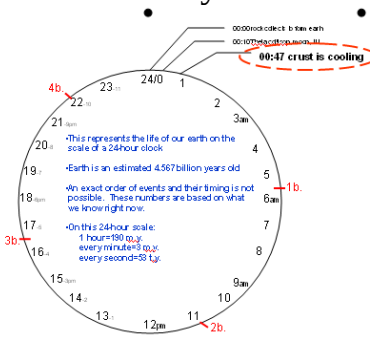
  Point. 4- "That means… hmm (multiply number of minutes they've been in your class) you've been in this room now about 33 millions years. (*prepare for wise cracks!*).

  And you're lifetime on this scale is 2 milliseconds (2 thousandths of a second!). Think of it- divide one second into one thousand equal parts, and two of those is how long your life is!"

- *[2] It's actually closer to 5 hours and 26 minutes per billion years on this clock, but 5 ½ is close enough. That and the rounding (which we need to do to the lesson simple and manageable) produce a quirk that one observant student may notice during the lesson. The "Columbia" super continent event is said to have occurred when the earth was 3.07 billion years old, yet on the clock it will appear before the 3 billion years mark.

Come back and visit InteractiveScienceTeacher.com to upgrade this lesson with:

PowerPoint- lead your students through the lesson click-by-click



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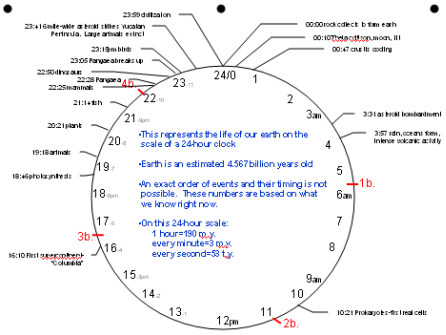
.15	Crust is cooling	.15 ÷ .190 = 0.79	.79 x 60 =47.4	00:47
.667	Asteroid bombardment	.667 ÷ .190= 3.51	.51 x 60 =30.6	03:31



Student Handout

Earth Clock

Billons of years	Event	Time (Divide yrs ÷ .190)	Convert minutes	Hr : Min
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.667	Asteroid bombardment	___ ÷ .190 = ___.___	___ x 60 =	:
.75	Rain, oceans, intense volcanic activity			:
1.957	Prokaryotes-first real cells			:
3.07	First supercontinents-"Columbia"			:
3.567	Photosynthesis			:
3.667	First animals			:
3.867	Plants			:
4.037	Fish			:
4.257	Mammals			:
4.267	Pangaea			:
4.337	Dinosaurs			:
4.387	Pangaea breaks up			:
4.417	Birds			:
4.502	6 mile-wide asteroid strikes Yucatan Peninsula. Large animals extinct			:

*Quick*Notes

Teacher *Quick* Notes- "Earth Clock"

Materials per student:

1-bowl, or round object that can be traced around, to make the face of the clock; 5½ "- 6 ½ " around (a small group of students can share one bowl)
1-blank sheet of copy paper, punched with holes along the side
1-Student Handout-Earth Clock (in the *Resources* folder)
1-calculator

Procedure:

1. Check that students have a blank sheet with holes, Student Handout listing events and times, calculator, and pencil.
2. Have students trace a circle around the bowl.
3. Add times to the circle, as shown on the PowerPoint.
4. Copy the 4 blue statements in the middle.
5. Mark the billion year increments at every 5 ¼ hrs.
6. Copy the very first event label *(00:00 rock collects to form earth)*