

Important 4-H Dates

December

December 1st - Catch-a-Calf Application Deadline

December 25th - Extension Offices Closed

January

January 1st - Extension Offices Closed

January 2nd - Youth Fest and LDC District VI Scholarship Deadline

January 3rd - LDC Registration Deadline

January 11th-26th - National Western Stock Show

January 17th - 4-H Day at the Stock Show

January 25th-27th - Leadership Development Conference

February

February 1st - Cheyenne County Enrollment Deadline

February 14th - CWF Application Deadline

February 14th-16th- Youth Fest

March

March 1st - All Other SEA Counties Enrollment Deadline

Catch-a-Calf Contest

Applications are currently being accepted for the 2020 National Western Stock Show Catch-a-Calf Program. The program is open to any 4-H member that is 12 and older by December 31st, 2019. Youth that sign up for the program will compete at a 2020 NWSS rodeo performance to catch a calf. Those that are successful will receive a calf in May 2020. They are responsible for all care and must purchase their own feed and equipment. The deadline to apply is December 1st, 2019. More information and an application can be found online at <https://nationalwestern.com/catch-a-calf-program/>.

Southeast Area Office

27901 CR 21
Rocky Ford, CO 81067
719-254-7608

Baca County
700 Colorado Street
Springfield, CO 81073
719-523-6971
coopext_baca@mail.colostate.edu

Cheyenne County
Box 395
Cheyenne Wells, CO 80810
719-767-5716
coopext_cheyenne@mail.colostate.edu

Kiowa County
Box 97
Eads, CO 81036
719-438-5321
coopext_kiowa@mail.colostate.edu

Prowers County
1001 South Main
Lamar, CO 81052
719-336-7734
coopext_prowers@mail.colostate.edu

Bent County
1499 Ambassador Thompson
Las Animas, CO 81054
719-456-0764
coopext_bent@mail.colostate.edu

Crowley County
613 Main Street
Courthouse Annex
Ordway, CO 81063
719-267-5243
coopext_crowley@mail.colostate.edu

Otero County
Box 190
Rocky Ford, CO 81067
719-254-7608
coopext_otero@mail.colostate.edu

WHAT LEADERSHIP DEVELOPMENT CONFERENCE

WHO SENIOR 4-H MEMBERS, AGES 14-18

WHERE RENAISSANCE HOTEL
3801 QUEBEC ST, DENVER, CO 80207

WHEN REGISTRATION DEADLINE:
JANUARY 3
CONFERENCE DATES:
JANUARY 25-27

Leadership Development Conference

Sign up now for LDC and 4-H Day at the Capitol, January 25th-27th. Join senior 4-H members from across Colorado at this outstanding leadership event, then see our state government at work. The conference includes community service, workshops, awards banquet, and a dance. A morning at the state capitol and visits with legislators wraps up the event. Remember some counties offer financial assistance for attendees. Participants will also need additional money for some meals. You must be 14 by December 31st, 2019 to attend. The Southeast Area registration deadline is January 3rd, and is done through 4HOnline. Contact your local Extension office for more information.

Youth Fest

Youth Fest is a camp for youth ages 9-13 and is held each year at the Ponderosa Retreat and Conference Center in Larkspur. This year's camp will be held February 14th-16th. The camp is filled with activities, workshops, dances and great food. This year's camp dates are soon to be determined and is limited to the first 195 campers. Registration is through 4HOnline. Camp fills up fast, so the sooner you register, the better. Information will be available soon from your local extension office.

Meat Quality Assurance

All 4-H members in breeding and market beef, sheep, swine, goats, poultry, rabbits, dairy animal and horse projects must complete Meat Quality Assurance training their first year in 4-H, and again when they change age divisions. You may attend any MQA in the area; be sure to sign in and complete the quiz so your county will know you attended. This is a come and learn-by-doing training that will take approximately an hour to complete. Parents and leaders are strongly encouraged to attend. Times and locations will be announced in a future newsletter. Plan to attend one of these sessions:

- March 12th - Cheyenne County
- March 13th - Kiowa County
- March 16th - Baca County
- March 17th - Prowers County
- March 18th - Bent County
- March 19th - Crowley & Otero Counties

District VI Scholarship Deadlines

Scholarships will be available from the District VI 4-H Senate again this year. Two scholarships are given each for LDC, Youth Fest, District Retreat, and State Conference. One scholarship per county is given for Dare to Be You. Scholarships cover 2/3 of the cost of the event and can be received once per calendar year. Contact your Extension Office for applications. Deadlines are below:

- Youth Fest/LDC—January 2nd
- District Retreat—February 1st
- State Conference—May 1st
- Dare to Be You—October 1st

BENT COUNTY NEWSLETTER

4-H ENROLLMENT

Enrollment for the upcoming 4-H year began October 20, 2019. You are welcome to begin your enrollment through 4HOnline any time. Please keep in mind that enrollment is a 3-step process. Your family must sign the Bent County 4-H Member Agreement, enroll in 4HOnline through your family account, and pay your \$20.00 membership (per member) fee at the Extension Office. If you need any help, please don't hesitate to contact the Extension Office at 719-456-0764.

OPPORTUNITIES AND DEADLINES

December 1st - Catch-a-Calf Application Due
December 23-27 - Extension Offices Closed

January 3rd - LDC Registration Deadline
January 2nd - Youth Fest & LDC District VI
Scholarship Deadline
January 11th-26th - National Western
Stockshow
January 17th - 4-H Day at National Western
Stockshow
January 25th-27th - LDC



MANUALS FOR 2019

There are a few manual changes for projects this year. The new publications order form is available through Colorado 4H. The Extension Office will be placing orders monthly, so feel free to contact us to put in an order. Please be aware manuals must be paid for in advance to place an order.

LEADERSHIP DEVELOPMENT CONFERENCE



Leadership Development Conference (LDC) gives 4-H members the opportunity to learn about leadership, citizenship, and civic engagement. LDC will take place January 25-27, 2020 with 4-H Day at the Capital. Registration will open in 4HOnline in December. The deadline for registration is January 3, 2020. LDC is open to youth 4-H ages 14-18.



COLORADO 4-H SCHOLARSHIP

The Colorado 4-H Foundation is pleased to announce that applications are being received for the 2020-2021 academic year. Graduating high school seniors and current college students are invited to apply at this link, also accessible through the 4-H Foundation webpage:
<https://co4hfoundation.extension.colostate.edu/benefits/colorado-4-h-foundation-scholarships/>.

Applicants will set up a secure account using the instructions on the web page. During the application process students are instructed that they need two letters of reference to complete their scholarship application. They will receive instructions explaining how to provide secure information to their references. Applications will be received now through April 30, 2020, and will be reviewed by the Scholarship Committee in May 2020. Recipients will be announced on or before June 1, 2020 and there will be a scholarship breakfast for recipients and donors during the week of State Conference at CSU.

Happy Holidays



Santa's Workshop

\$15
DEC. 20TH
COMMUNITY BUILDING, EADS
REGISTER BY DEC. 13TH.

LINEUP

- CHRISTMAS GNOMES
- SAND ART COOKIE MIX
- WINTER SPA
- NAIL ART
- GRINCH KABOBS
- CHRISTMAS ORNAMENTS

11:00 am - 2:00 pm
REGISTER AT
[FORMS.GLE/ZAJEVOEEJPUSJVQEA](https://forms.gle/ZAJEVOEEJPUSJVQEA)

OPEN TO YOUTH
AGES 5-18.

SANTA'S WORKSHOP COMING TO THE SOUTHEAST AREA

Be one of Santa's Elves at Santa's Workshop on December 20th at the Community Building in Eads. The event will be held from 11:00 am-2:00 pm and participants will have the opportunity to make six different projects: Christmas Gnomes, Grinch Kabobs, Sand Art Cookie Mix, Winter Spa items, Christmas Ornaments and Rustic Nail Art. Youth ages 5-18 are welcome and the cost to attend is \$15. Please bring payment to the Bent County Extension Office, or can pay the day of the workshop. Make checks payable to District VI Senate.

Register by December 13th by going to forms.gle/Tpf1EJsifopAz8Jf9.



COLORADO STATE UNIVERSITY
EXTENSION

DISTRICT VI 4-H SENATE 4-H Camp Scholarship Application

District VI 4-H will allocate funds to provide an opportunity for youth to participate in 4-H camps offered by Colorado 4-H. Submit the 4-H Camp Scholarship Application to your County Extension Office on or postmarked by the date advertised. ***Late or incomplete applications will not be considered.***

HOW TO APPLY

The following guidelines have been established for applying for a scholarship to attend camps offered by Southeast Area 4-H only.

1. Any youth who are enrolled members in a Southeast Area 4-H program (Baca, Bent, Cheyenne, Crowley, Kiowa, Otero, and Prowers Counties) are eligible.
2. Participants will be required to include a deposit for the registration amount for the camp. That deposit will be held by the member's county Extension Office and will only be deposited in the case that the member does not attend the event.
3. The District VI 4-H Senate has a limited amount of funding available for camp scholarships. For Dare to Be You one scholarship will be offered for each of the seven counties. For Leadership Development Conference, Youth Fest, South Central District Retreat, and State 4-H Conference, two scholarships will be offered for the whole district. *Scholarships cover 2/3 of the cost of the camp.*
4. Members may receive one scholarship during the calendar year.
5. The District VI 4-H Camp Scholarship Application is due by the date advertised. Applications that are incomplete or received after the deadline will NOT be considered.
6. All applications must be signed by the member, a parent, and the county Extension Agent. No funding will be provided without all signatures.
7. IMPORTANT: This application form is for camp scholarships only. Receiving a scholarship does not register youth for a camp. Instructions for registering for each individual camp must be followed.
8. Selection for Dare to Be You scholarships will be done at the county level at the discretion of the Extension Agent. Selection for scholarships for other camps will be done through a selection committee comprised of Extension Agents and volunteers outside of the Southeast Area.
9. Award announcements will be made in advance of the registration deadline for each individual camp.



**COLORADO STATE UNIVERSITY
EXTENSION**

DISTRICT VI 4-H SENATE

4-H Camp Scholarship Application

Name _____ Age _____

Home Address _____

City _____ State _____ Zip _____

Which 4-H camp do you want to attend? _____

Why would you like to go to this camp? _____

Why should you be selected for this scholarship? _____

Please list any 4-H, community, and school activities you are involved in. _____

SUBMIT APPLICATION TO YOUR EXTENSION OFFICE

I agree the information provided is true and accurate.

Member Signature

Date _____

Parent Signature

Date _____

Extension Agent Signature

Date _____

Welcome to the Bent County 4-H Program!

We're excited that you've decided to join 4-H and *Make the Best Better!*

All 4-H Members Must:

- **Participate in at least half of your club meetings.** You will not be allowed to show at the fair if you do not meet this requirement. Club attendance records will be submitted to the Extension Office to verify participation.
- **All members must meet 4-H enrollment and Fair Entry deadlines as set out in the 4-H Newsletter.**
- **Complete and exhibit a project with a completed record book.** We prefer the exhibit to be at the county fair, but if this not possible, make arrangements in advance with the Extension Agent to show your finished project at another event/time.
- **Show others how to do something** you have learned in your project. This is called a demonstration.
- **Do a community service project.** Most clubs do a community service activity together.
- **Work in the concession stand as scheduled** during the Bent County Fair. This is the only fundraiser for the county 4-H program, and helps pay for activities open to all members.
- **Participate in one county, district or state activity** as designated in the 4-H newsletter.
- **Meet any other requirements set by your club.**
- **Please remember 4-H Enrollment & Fair Entry are two different things.** All 4-H Enrollment will go through **4HOnline** and the deadline is March 1st. However, all general projects, livestock, etc. that you'll be exhibiting at the Bent County Fair also need to be entered into **Fair Entry** before the deadline or you **WON'T** be able to show!
- **Read the Fair Book!** It has important rules & regulations that everybody needs to know & follow. You will be required to provide a signature to your club leader stating you've received the book. It'll be available in February, and will be distributed at tagging for those attending & then club meetings afterwards for those that weren't present.

All 4-H Members, Leaders, and Volunteers are accountable for adhering to posted deadlines for 4-H and Fair Activities on 4-HOnline and Fair Entry. If you are unable to complete entries for any reason, please make an appointment at the Extension Office for assistance before the deadline! A computer with access to these entries will be made available for you!

Please Be Sure To:

- **Read the monthly newsletter.** It's our main form of communication for 4-H. The Newsletter will tell you about upcoming events, educational opportunities, deadlines, and important information. **All Newsletters will be sent out electronically, so makes sure you have the correct email on 4HOnline.** There will also be copies available at the Bent County Extension Office, and on the Bent County 4-H website.
- **Ask a lot of questions!** Ask your leader or call the Extension Office, (719) 456-0764. You can also refer to our website: <http://bent.colostate.edu> or <http://colorado4H.org>.
- **Ask for help when needed!** If you can't find the help you need from a leader or the office, we may also refer you to a project leader. All you've got to do is ask!

Important Dates:

- February 29, 2020 – 10:00-11:00 AM Beef Tagging
- March 1, 2020 – 4-H Enrollment Deadline
- May 1, 2020 – Dog Identification Forms Due on 4-H Online
- May 1, 2020 – Horse Identification Forms Due on 4-H Online
- May 9, 2020 – 4:00-6:00 PM Small Animal Weigh In
- May 11, 2020 – 2:00 PM Hog Nominations Deadline
- June 18, 2020 – Fair Entry Deadline (Bent County Fair Exhibits)
- July 2, 2020 – Fair Entry Written Corrections Deadline
- July 17-24, 2020 – Bent County Fair

***There will be no exceptions made for missed deadline dates.**



DON'T FORGET TO CHECK YOUR NEWSLETTERS FOR OTHER IMPORTANT DATES!

PLEASE KEEP THIS FORM FOR YOUR RECORDS!

Enrollment Guide

1. 4HOnline website access is at: <https://co.4honline.com>
2. **New Members:** Create family profile by selecting the “I need to setup a profile” button.
Returning Members: Use your e-mail and password to access your established profile. If you have forgotten your e-mail and/or password contact your county Extension Office for assistance. **DO NOT CREATE A NEW PROFILE!!!!**
3. **New Members:** Add a youth and/or adult profile under your family profile. As you enter information please verify for accuracy.
Returning Members: Click on the “Edit” button (right side) on inactive member’s profile listing. Review and update all information associated with this profile. **DO NOT JUST CLICK AND MOVE ON - CHECK IT ALL!!!!** Incorrect information will affect ability to register for events, proper enrollment fees, communication, etc.
4. Once all profile information has been verified, and is current under the Personal Information, Additional Information, Health Form, and Participation (Club/Projects), etc., click “Submit Enrollment”.
5. The county Extension Office will review all information.

Write down your login information below and save it for your records:

Email:

Password:

Role:

Enrollment Facts:

- You are not a member/volunteer of Colorado 4-H until you have an ACTIVE status listed on your 4HOnline profile.
- 4-H members must be ACTIVE to register for an event/contest in 4HOnline.
- Please fill out as much of your Health Record in 4HOnline as possible. It must be completed to attend out-of-county 4-H events.

For any questions, please contact the Bent County Extension Office!

Hours: Monday-Thursday 8AM-2PM

1499 Ambassador Thompson Blvd.

Las Animas, CO 81054

(719) 456-0764

Coopext_bent@mail.colostate.edu

Bent County 4-H

Membership Requirements Agreement

All Bent County 4-H Members must:

- **Participate in at least half of your club meetings.** You will not be allowed to show at the fair if you do not meet this requirement. Club attendance records will be submitted to the Extension Office to verify participation.
- **All members must meet 4-H enrollment and Fair Entry deadlines as set out in the 4-H Newsletter.**
- **Complete and exhibit a project with a completed record book.** We prefer the exhibit to be at the county fair, but if this not possible, make arrangements in advance with the Extension Agent to show your finished project at another event/time.
- **Show others how to do something** you have learned in your project. This is called a demonstration.
- **Do a community service project.** Most clubs do a community service activity together.
- **Work in the concession stand as scheduled** during the Bent County Fair. This is the only fundraiser for the county 4-H program, and helps pay for activities open to all members.
- **Participate in one county, district or state activity** as designated in the 4-H newsletter.
- **Meet any other requirements set by your club.**

Having read the above information, I agree to these conditions of membership in the Bent County 4-H Program. I understand that it is my responsibility to ensure that all requirements are met.

Youth Signature: _____ Date: _____

Parent/Guardian Signature: _____ Date: _____

If your family will need help/support with enrollment or Fair Entry from the Extension Office, you will need you will need to contact the office no less than 72 hours (3 days) before the deadline of the event you are needing help for.

4-H Enrollment is a three-step process: 1. **Enroll through 4HOnline** in your family account, 2. **Return this agreement** with your 3. **Membership fees** to the Bent County Extension Office by the enrollment deadline of March 1, 2020.

Family e-mail for newsletter:

Email 1 (Parent e-mail address) _____

Email 2 (Member e-mail address) _____

Bent County 4-H Enrollment Fee \$20.00

Fees Paid	
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Payment is due at time of enrollment. Make checks payable to Bent County 4-H Council.

ST[EMpower]

PALEONTOLOGY 4: CHANGE

VOLUME 9, ISSUE 4, DECEMBER 2019



THIS MONTH

- Revisit Cladograms pg. 2
- Climate Change pg. 6
- Mass Extinction pg. 8
- Comparing Climate and Extinction Events pg. 11
- Complete Precambrian Timeline pg. 12

POWER WORDS

- **cosmos**: the universe seen as a well-ordered whole
- **Eon**: any of the four major divisions of this history of the Earth
- **fundamental**: forming a necessary base or core; of central importance
- **MYA**: million years ago
- **Precambrian**: a general term that includes the three Eons before multicellular life appeared in the fossil record—Hadean, Archean, and Proterozoic

CAREER CONNECTION

- You have taken a survey of your interests. This month, take a basic personality test. This will provide you with some information about how you perceive the world and make decisions. Pg. 14

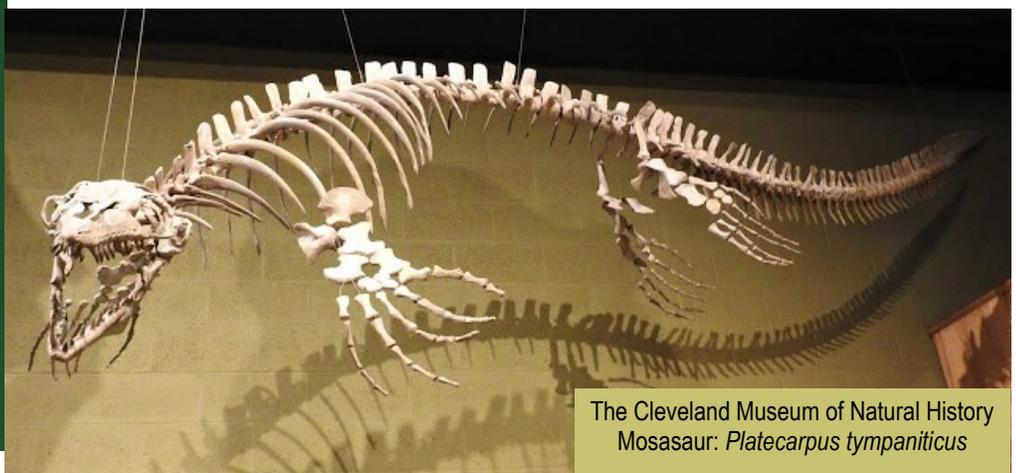
CHANGE THROUGH TIME

Change is the **fundamental** order of the **cosmos**. This ancient idea was first proposed 2,600 years ago by the Greek philosopher Heraclitus of Ephesus. This holds true for paleontology. Earth's record shows massive swings in climate from hot-house swamps of the Carboniferous 300 **MYA** to a snowball Earth 650 **MYA** in the **Precambrian Eons**.

The fossil record reflects these changes. Fossils that lived in oceans are found all over

Colorado, nowhere near oceans, 6,800 feet above sea level. For example, you can find mosasaur teeth in Archuleta County! Mosasaurs lived during Mesozoic (time of dinosaurs). They are aquatic reptiles (now called diapsids).

Major changes recorded in the fossil record are mass extinctions. Are they all related to climate? Are there other factors related to mass extinction? Let's figure this out! (Hooray for science!)



The Cleveland Museum of Natural History
Mosasaur: *Platecarpus tympaniticus*



SCIENCE, TECHNOLOGY,
ENGINEERING, AND MATH
COLORADO STATE UNIVERSITY
EXTENSION

COLORADO STATE UNIVERSITY EXTENSION
4-H PROGRAMS ARE AVAILABLE TO ALL WITHOUT DISCRIMINATION

Last month's ST[EMpower] newsletter included a whirlwind tour of cladograms. Before the activities on climate through Earth's history, I would like to revisit cladograms one more time.

In this activity, you will build a cladogram of your family. While cladograms generally depict how different organisms are related to each other, this might be a way to better explain how they work.

Cladograms are samples of related organisms. This is not a complete family tree. Instead, we are only looking at a snippet of your family. Just your mother, your mother's mother, one of your mother's siblings, and one of your cousins.

Directions:

- Complete the data table of a sampling of your mother's history, and then a sampling of your father's family history. You will not collect a complete family history, only a small sample of it.
- Sample of your mother's history
 - You and your siblings
 - Your mother
 - Your mother's mother
 - Your mother's sibling (either a brother or sister a **maternal** aunt or uncle)
 - Your mother's brother or sister's child (your **maternal** cousin)
- Sample of your father's history
 - You and your siblings
 - Your father
 - Your father's father
 - Your father's sibling (either a brother or

sister—a **paternal** aunt or uncle)

- Your father's brother or sister's child (your **paternal** cousin)
- If one of your parents is a single child, you will not have any information about an aunt/uncle and cousin. That is okay.
- Once you have completed the data table, fill in the blanks on your cladogram.

Results:

- A **cladogram** is a branching diagram of species. The **nodes** represent a shared common ancestor. For example, the orange circles on the page 3 example represents my shared common ancestor with my brothers (our mother), and my cousin, uncle and mother (our **maternal** grandmother). I am related to my cousin, and our common ancestor is our **maternal** grandmother.
- Look at your cladogram. If you were to add your **maternal** grandmother's mother (your mother's mother's mother), where would you add her?
- In the future, if you or your siblings have children, where would you add them?
- What can you say about this

POWER WORDS

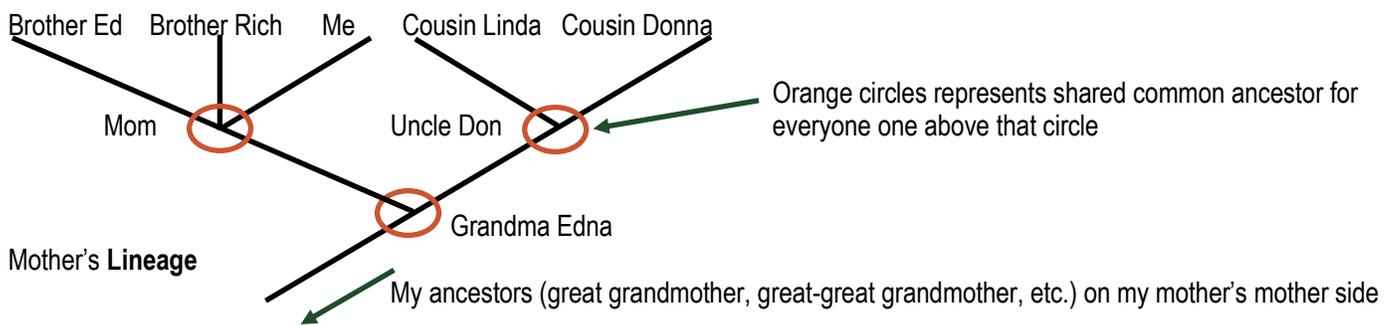
- **cladogram**: branching showing the relationship among selected species
- **lineage**: lineal (in a line) descent from an ancestor
- **maternal**: related through the mother's side of the family
- **node**: a point at which lines or pathways intersect or branch; a central or connecting point
- **paternal**: related through the father's side of the family

- cladogram on dinosaurs? (Each node represents the shared common ancestor of every organism above that line.)
- Crocodiles are the first group listed on the cladogram. The node (circled in blue) shares a common ancestor with dinosaurs.

MATERIALS

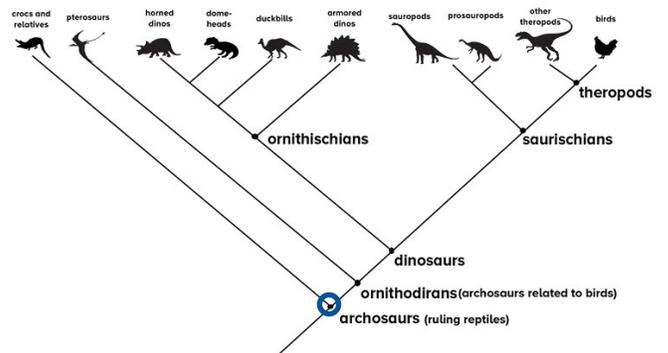
- computer with printer
- pencil or pen
- print page 3
- parents for information

You and your siblings	Your Mother/Father	Grandparents	Aunts and/or Uncles	Cousins
<i>Example Mother's lineage:</i> Barb (me), my brothers Ed and Rich	Dorothy (my mother)	Edna (my <i>maternal</i> grandmother)	Donald (my <i>maternal</i> uncle)	Linda and Donna (my <i>maternal</i> cousins, Uncle Don's daughters)
Mother Lineage				
Father Lineage				



Complete your **lineage** cladogram (keep it simple—you don't need to list everyone):

Your Mother's Lineage



Your Father's Lineage

Can you read this cladogram of dinosaur lineage?

What happens when you don't include every relative, but skip a **generation** or more? How does that change the cladogram? Would the basic information be different? This starts to look more like the information scientists use in their cladograms to evaluate how animals (or other **organisms**) are related.

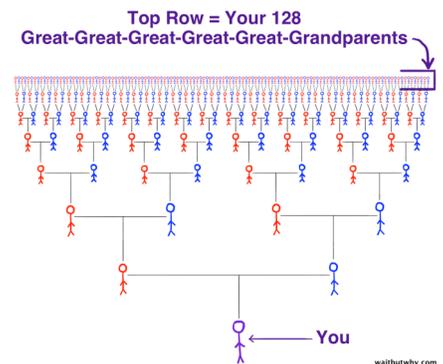
This time, you are going to not include your grandmother on your mother's side, or your aunt or uncle on your father's side. As the example, I used my mother's lineage without my mother listed. Examine your two cladograms, and compare it to the example. Then you will have a final challenge!

Directions:

- Start with your slanted line from lower left to upper right. Lower left represents back in time. Upper right will be the most recent ancestor.
 - Think of each node as a hinge that can swivel. If you compare the two examples (on page 3 and on page 5), note that "me" is switched on the left to the right. It was swiveled at the node. The information remains the same. What is your first node (your oldest shared common ancestor)?
 - Each node continues to represent the common ancestor with everyone one above the line directly related to your share common ancestor at the node.
 - How many nodes are there between you and your cousin?
 - Repeat for your father's line, but this time, you do not
- include your uncle or aunt.
 - Finally, make a cladogram of your family with ancestors you never met, and probably don't know even their names. You will follow the lineage on your mother's side of your family with:
 - you
 - your great-great-great-great grandfather
 - his great-great-great-great grandmother
 - her great-great-great-great grandmother
 - her great-great-great-great grandfather
 - Figure out how many generations between you (listed on the upper right) and your great-great-great-great-great-great-great-great-great-great-great-great-great-great-great-great grandfather
 - When you have all your cladograms, examine each of them. What information is lost, and what information is retained? Your last cladogram is most similar to what scientists use when looking at organism relationships, like dinosaurs or ground sloths!
 - If each of your ancestors lived an average of 90 years, what century did your great (x 16) grandfather live? (Answer on the last page.)

POWER WORDS

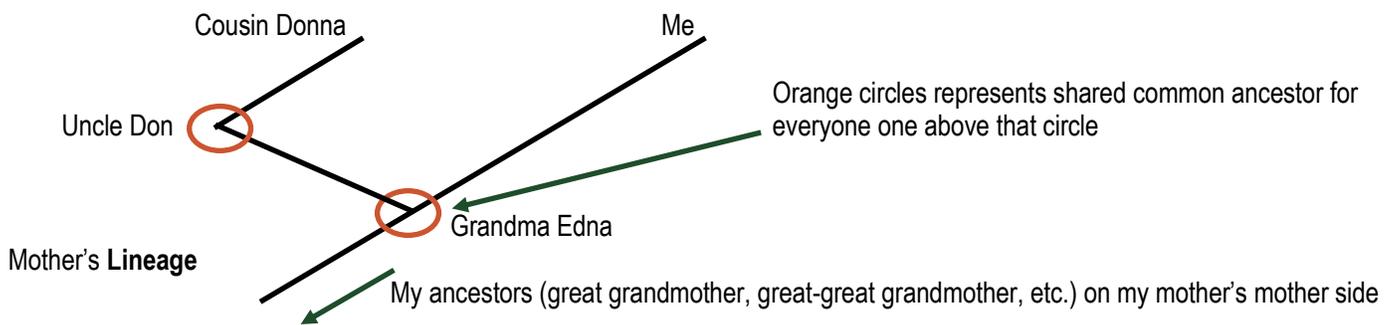
- **generation**: all of the people born and living at about the same time
- **organism**: an individual animal, plant, or single-celled life form



MATERIALS

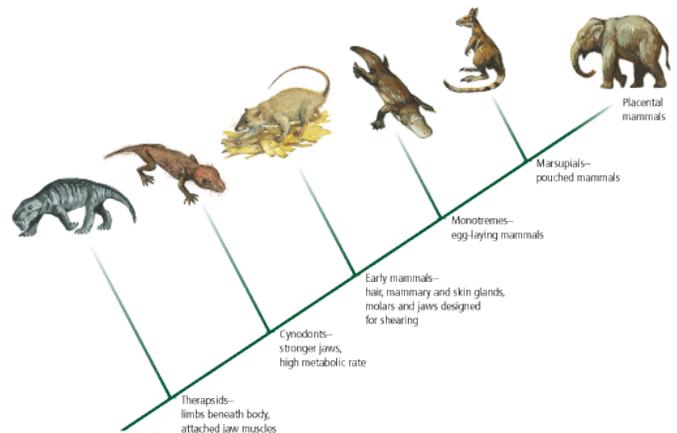
- computer with printer and calculator
- pencil or pen
- print page 5
- parents for information

You and your siblings	Your Mother/Father	Grandparents	Aunts and/or Uncles	Cousins
<i>Example Mother's lineage:</i> <i>Barb (me)</i>		<i>Edna (my maternal grandmother)</i>	<i>Donald (my maternal uncle)</i>	<i>Donna (my maternal cousin, Uncle Don's daughter)</i>
Mother Lineage				
Father Lineage				



Complete your **lineage** cladogram (keep it simple—you don't need to list everyone):

Your Mother's **Lineage**



Your Father's **Lineage**

Can you read this cladogram of mammal lineage?

Scientists are not concerned that climate is changing, but the rapid rate of change. Human activities (**e.g.** cars using gasoline, coal power plants) are releasing carbon trapped in trees, coal, and gasoline. Carbon traps solar energy in our atmosphere. From data we glean from the Earth's history, this is the most rapid change we have seen. **

Our Earth has been much warmer in the past. In fact, the Earth during the past 2.5 million years of Ice Ages is much colder than it has been for about 650 million years! When changes are slow, organisms have time to adapt to cooling or warming world. Too fast, organisms will go extinct.

Directions:



- Open the Smithsonian website (green box below), and explore how our planet looked like during different times in the past. For example, 650 MYA, the Earth was almost entirely encased in snow and ice, called “Snowball Earth.”
- Open Word (or similar program). On the menu bar, click “Layout.” Set page:
 - orientation to “landscape”
 - custom margins to 0.15”

- top and bottom
- custom margins to 0.25” left and right
- Open the Scotese website. This is the same website you explored in the two prior issues. Dr. Scotese also has climate information, and the link will take you directly to the climate pages. You will copy and paste selected maps (listed below) on your timeline. You need to match the Period of the map to the your timeline’s period (example, Devonian map will be pasted to the Devonian timeline).
- Be sure that your maps are pasted next to the left margin labels as possible. Each month will add more information to your timeline, so you want to make sure to leave room to the right.
- On the Scotese website’s left menu bar, note that there are links to different Periods from Early Cambrian to Miocene.
- You do not need all 26 maps, only a sampling to follow how climate changes through time. On the website, or press control key and place cursor over each map, click on the following 14 maps:
 - [Miocene Climate](#)
 - [Oligocene Climate](#)
 - [Late Eocene Climate](#)
 - [Paleocene Climate](#)

POWER WORDS

- **e.g.:** exempli gratia, Latin means “for example”
- **quadrant:** any of the four quarters into which something is divided by two real or imaginary lines that intersect each other at right angles

** If interested in activities related to weather, climate, and climate change, see the ST[EMpower] issues 46—51 at <https://tra.extension.colostate.edu/stem-k12/stem-resources/>

- [Late Cretaceous Climate](#)
- [Late Jurassic Climate](#)
- [Middle Triassic Climate](#)
- [Late Permian Climate](#)
- [Late Carboniferous Climate](#)
- [Early Carboniferous Climate](#)
- [Middle Devonian Climate](#)
- [Silurian Climate](#)
- [Middle & Late Ordovician](#)
- [Middle and Upper Cambrian](#)

MATERIALS

- computer with internet and printer
- your timelines *
- markers
- glue stick
- scissors

WEBSITES

- Smithsonian: <https://www.smithsonianmag.com/science-nature/travel-through-deep-time-interactive-earth-180952886/>
- Scotese: <http://scotese.com/climate.htm>

* See 53.Paleontology1 for directions to make a timeline: <https://tra.extension.colostate.edu/stem-k12/stem-resources/>

- Note that a description of the climate is below the map. Right click on the map, copy the map, and paste it in a word document.
- Click on the picture. In Word's top menu bar, click:
 - "Picture Format."
 - * Resize image to 5.25" width, 3.00" height.
 - * Click "Position" and select top/left, top/right, bottom/left, or bottom/right to move the picture into a different **quadrant** of the paper. You will fit 4 maps per page.
- Continue copy/pasting/resizing/placing each map until you have copied all 14 maps listed in blue in the middle column.
- You will have 4 pages, with the last page only half used. On the Scotese website, on any map page, click "MAP LEGEND." Copy/paste/resize, and place in the 4th page, and resize to fit in the area that isn't used by maps.
- Print all 4 pages single sided.
- Cut out each map and glue on the appropriate Period in a column on the left side next to labeling of each Period.
- Glue the legend at the top, above all the maps.
- There is a description of the climate under each map. Go back to the Scotese website, and note that you did not copy all the maps, only about half of them. For example:
 - Early Devonian:** Generally dry conditions prevailed across much of North America, Siberia,

- China and Australia during early Devonian. South America and Africa were covered by cool, temperate seas.
- Middle Devonian:** During the Middle Devonian the Equator ran through Arctic Canada. Coals began to accumulate as land plants flourished in the equatorial rainy belt. Warm shallow seas, under cloudless skies, covered much of North America, Siberia and Australia.
- Late Devonian:** During the Late Devonian, Pangea began to assemble. Thick coals formed for the first time in the tropical rainforests in the Canadian Arctic and in Southern China. Glaciers covered parts of the Amazon Basin, which was located close to the South Pole.
- Include all three descriptions of the Devonian climate, even though you only printed one map of Middle Devonian.
- The Carboniferous is divided into two major subdivisions, Pennsylvanian (Upper Carboniferous) and Mississippian (Lower Carboniferous). The Late Carboniferous Climate map is Pennsylvanian and the Early Carboniferous Climate map is

TIMELINE

Below is a to-scale model of your timeline for the Era Paleozoic.

If you have not yet made your timeline, you can find the instructions on Paleontology 1: Basics, pages 16-19 located at this website:

<https://tra.extension.colostate.edu/wp-content/uploads/sites/9/2019/08/53.-Paleontology-1.pdf>

Paleozoic	Permian 252 - 299 MYA	
	Carboniferous Upper (Pennsylvanian) 299 - 323 MYA	
	Carboniferous Lower (Mississippian) 323 - 359 MYA	
	Devonian 359 - 419 MYA	
	Silurian 417 - 443 MYA	
	Ordovician 443 - 485 MYA	
	Carboniferous 485 - 540 MYA	

LEGEND

	WARM	COOL
Tropical	Coal Bauxite Laterite	Cool Temperate Coal & Tillites
WET	Warm Temperate Kaolinite (& coal & evaporite) Crocodiles Palms & Mangroves	
DRY	Arid Evaporite Calcrete	Cold Tillite Dropstone Glendonite

"Paratropical" = High Latitude Bauxites

Example of Paleozoic Timeline:

Map

Description of climate during that Period found with each map on the Scotese.com climate map pages

Lion King's song "Circle of Life plays softly in the background...

Nants ingonyama bagithi Baba
(Sithi uhm ingonyama) yeah,
ingonyama
Nants ingonyama bagithi baba
(Sithi uhm ingonyama)
Ingonyama (Ingonyama)
Siyo Nqoba (Ingonyama)

<https://www.youtube.com/watch?v=GibiNy4d4gc>)

Mood set—check!

Scientists recognize 5 mass extinction events in the Phanerozoic **Eon** (defined on pg. 1):

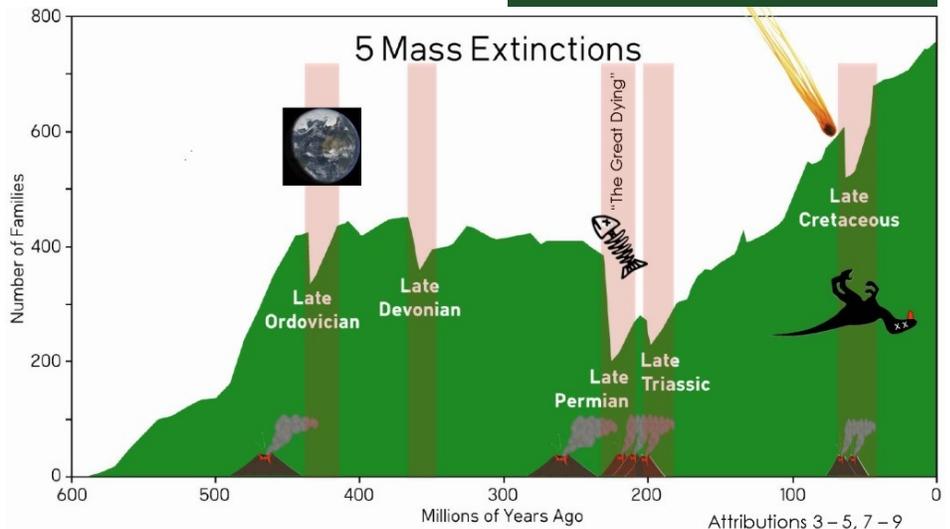
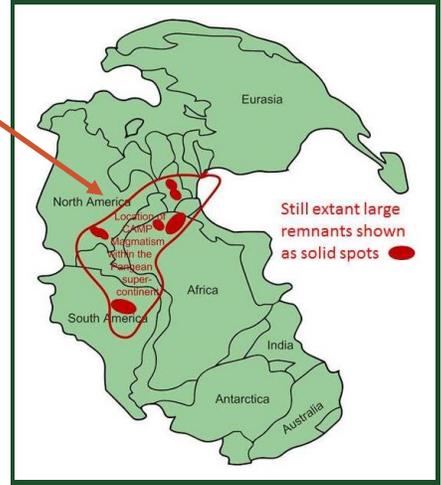
- **Late Ordovician:**
 - 445 **MYA**
 - 86% of all species extinct
 - possible causes: volcanic activity, intense ice age followed shortly by a warm period 1 million years later
- **Late Devonian:**
 - 360 **MYA**
 - 75% of all species extinct
 - possible causes: rapid environmental and climatic changes
- **Late Permian** also known as the Great Dying:
 - 250 **MYA**
 - 85% of all species extinct (estimated that 95% of marine life went extinct)
 - possible causes: formation of **Pangaea**, vast inland deserts, shorelines disappeared, ocean chemistry disrupted, atmosphere crashed, oxygen levels dropped, and, the second largest known volcanic eruptions (**Siberian Traps**) lasted for one million years, and covered an area of 3 million square miles!

- **Late Triassic**
 - 200 **MYA**
 - 85% of all species extinct
 - possible causes: changes in the ocean's chemistry and the largest know volcanic eruptions, Central Atlantic magmatic province (CAMP; see map to the lower right), covered an area of 9 million square miles!
- **Late Cretaceous**
 - 65 **MYA**
 - 76% of all species extinct (end of dinosaurs)
 - possible causes: meteor impact and one of the largest volcanic eruptions (**Deccan Traps**) located in India covered 600,000 square miles up to 6,600 feet thick!

Examine the graph on page 11.

POWER WORDS

- **MYA:** acronym for Million Years Ago
- **Pangaea:** supercontinent that included all current land masses
- **trap:** geologic term for rock formation with step like hills



MATERIALS

- computer with internet access and printer
- color pencils or markers
- scissors
- print datasheet on page 10
- your timeline
- page 11 graphs (optional to print)

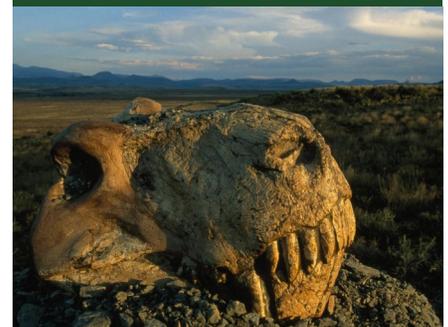
Directions:

- This is an internet scavenger hunt for information! Start by watching: https://www.youtube.com/watch?v=FIUes_NPa6M
- Print the table on page 10. Use it to collect information about each of the 5 major extinction events during the Phanerozoic **Eon** (definition pg. 1). You are looking for evidence of what caused each event. You may have one, some, or all the causes listed.
- Look for information from universities or museums. Other sources may not be based in science and peer-reviewed literature. Universities and museums hire scientists who move science forward. Other sites may have good information. Then again, they may not. People are sometimes convinced of an idea and promote it as fact. While you are learning about the concepts behind paleontology, it helps you to know that the information is supported by research. For example:
 - University of California, Berkeley's Museum of Paleontology
- Record the causes in the table. For example, if the extinction event had volcanoes, climate change (the more abrupt, the more catastrophic), ocean and atmospheric chemistry changes, check those boxes. There is enough room to jot a few notes, too. You can keep additional notes on the back of your table.
- Find images of organisms

- that died during that event. For example, trilobites, which were extremely successful throughout the Paleozoic, died out at the end of the Permian.
- Copy/paste the images in a Word document. Size them about 2-3" inches.
 - Print the images, cut them out and paste them on your timeline just below the extinction event boundary. Record the causes for that extinction event with the images.
 - What are the most common causes of triggering extinct events?
 - Sometimes these causes do not trigger an extinction event. Can you develop an hypothesis why it did not trigger an extinction event?
 - What do you notice about Eras (Paleozoic, Mesozoic, and Cenozoic), the Periods (Cambrian, Ordovician, Silurian, Devonian, Carboniferous, Permian) and extinction events?
 - Why have scientists divided time with **Eons, Eras, and Periods?**
 - Why did scientists divide the Paleozoic from the Mesozoic, and the Mesozoic from the Cenozoic?
 - Are all of the five extinction events correlated with climate change?

POWER WORDS

- **chronostratigraphy:** the branch of geology concerned with establishing the absolute ages of strata
- **correlated:** have a mutual relationship or connection, in which one thing affects or depends on another.
- **era:** a major division of time that is a subdivision of an eon and is itself subdivided into periods
- **period:** a major division of geological time that is a subdivision of an era and is itself subdivided into epochs, corresponding to a system in **chronostratigraphy**



Gorgonopsis sp. died out in Permian

- What other trends do you notice?

Example of the Permian Extinction Event on your timeline

	<p>Permian 252 - 299 MYA</p>	<p>Late Paleozoic/Permian: Extinct life forms (trilobites, many marine life) went extinct. The Permian-Triassic extinction event was the most severe in Earth's history, with 90% of all life on Earth dying. It was caused by the impact of a meteorite.</p> <p>Early Permian: Many of the Permian life forms survived to the present day. The Permian-Triassic extinction event was the most severe in Earth's history, with 90% of all life on Earth dying. It was caused by the impact of a meteorite.</p>
--	---	--

Event Cause	Late Ordovician	Late Devonian	Late Permian "The Great Dying"	Late Triassic	Late Cretaceous	Today
Global Cycles / Sea Level Changes						
Ocean Chemistry						
Atmospheric Chemistry						
Climate						
Oceanic Oxygen Levels						
Volcanic Activity						
Asteroid Impact						

Geologists estimate past climate through indirect methods. For example, specific conditions must exist for various rocks to form. Glaciation events leave a specific signature. Dating igneous rocks in that strata (layer deposited at the same time) provides how old the rock. Eventually a picture emerges of different climates throughout the world, and the picture of world climate begins to emerge.

Late Cretaceous

Just like in the “who dunnit” stories, scientists search for clues and develop a hypotheses based on those clues. As more clues emerge, we modify our hypothesis to best explain what happened with all the clues.

ORANGE ARROWS INDICATE A MASS EXTINCTION EVENT.

Late Triassic

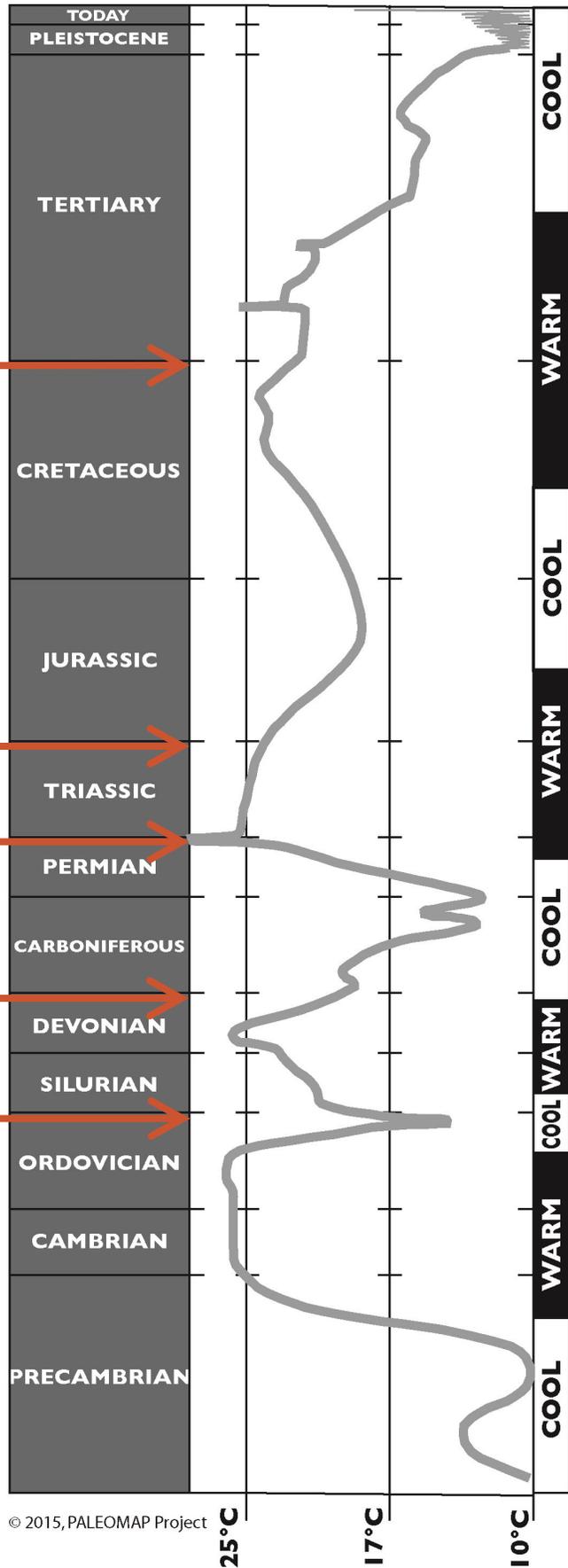
Late Permian

Late Devonian

Late Ordovician

In the Earth’s infancy, 4.6 billion years ago, the sun’s output was also different. Astronomers’ evidence supports that solar irradiance (radiant energy in light and heat) was about 1/3 lower than it is today.

The most accurate climate reconstructions are preserved in glaciers found in Greenland and Antarctica. We are much more confident of recent past climates because of the trapped gases. The oldest glacier (Antarctica) is 1,000,000 years.



© 2015, PALEOMAP Project

The Precambrian would have had many devastating events, but the early fossil record is very spotty. About 4 **BYA**, the Late Heavy Bombardment was a time when asteroids collided with everything in the inner solar system (from the Sun to Mars). This debris ranged from tiny to planet sized. Scars from these impacts are clear to see on Mercury and our Moon. With only a trace atmosphere, these two bodies do not have winds to erode their record.

Any bacterial life would have been obliterated in large-scale collisions. The oldest known fossil is from about 3.5 **BYA** when the Earth was about 1 billion years old. It looks very similar to a bacterium today called cyanobacteria. This organism produces sugar from sunlight (photosynthesis). In 2015, scientists described 4.1 billion year old rock in Australia with remains of life in the form of carbon.

Another major occurrence was the poisoning of the atmosphere. This is hypothesized to have been the greatest extinction event of all times, but only bacteria and **archaea** were present on Earth.

It is possible to use **mutations** in DNA to clock time. It is a

rough measure, since different species have different rates of **mutation**. Geneticists have estimated the last universal common ancestor possibly from deep thermal vents to 3.5—3.8 BYA. That does roughly agree with the oldest known fossil cyanobacterium (image below left). A living cyanobacteria species is imaged below.



In this activity, you will complete your Precambrian timeline.

Directions:

- When you first made your timeline templates, you did basic divisions of time. You should have indicated the major Eon Divisions of Hadean (3 meters), Archean (7.5 meters), and Proterozoic (9.8 meters). If necessary, measure and draw a line making each division of those Eons.
- **1 cm = 2 million years.**

POWER WORDS

- **archaea:** microorganisms similar to bacteria in size and simplicity of structure but radically different in molecular organization
- **BYA:** Billion Years Ago
- **mutation:** a mistake or change in DNA by deleting, inserting, or rearranging a section of a gene (See [https://tra.extension.colostate.edu/stem-k12/stem-resources/Paleontology 3: Time/ Kin](https://tra.extension.colostate.edu/stem-k12/stem-resources/Paleontology%203%20Time%20Kin), pages 18 for more information on DNA)
- **nucleotide:** the basic structural unit of DNA that has 4 molecules, adenine, thymine, guanine, and cytosine, the “letters” in DNA that code an organism

- Start at the bottom, the formation of the Earth, the Hadean. It is 3 meters long (4.6 to 4 BYA).
- **Hadean Eon**
 - 4.6 BYA (*At the bottom of your timeline*) Formation of the Solar System from a large cloud of gas and dust around the



MATERIALS

- Precambrian timeline (adding machine tape— see <https://tra.extension.colostate.edu/stem-k12/stem-resources/> , 53.Paleonotology 1, pgs. 16-19 for directions)
- markers
- metric tape measure or meter stick

sun. No rocks from Earth's infancy have been found, and it is assumed that they have been recycled to igneous rocks. Earth hot surface solidified.

- 4.5 BYA (measure 50 cm from the bottom) Formation of the moon by impact with a Mars sized planet. (<https://www.amnh.org/explore/videos/space/formation-of-the-moon>)
- 4.4—4.0 BYA (measure another 50 cm (total 100 cm from the bottom) Long thought that comets (a major component is water) slamming into the Earth during the Early Heavy Bombardment brought water to Earth. Earth needed to cool enough to allow water to remain. Current research supports that primordial Earth composition included water. It wasn't until the Earth cooled that it could condense to liquid.
- **Archean Eon**
 - 4.0 BYA Beginning of the (300 cm (3 meters) from the bottom of your timeline). First life (bacteria and/or archaea (also known as archaeobacteria).
 - 3.5 BYA (measure 250 cm (2.5 meters) from your last line) photosynthetic bacteria, and first evidence of oxygen
- **Proterozoic Eon**
 - 2.5 BYA (measure 500 cm (5 meters) from your last line) to begin the Proterozoic Eon. Oxygen

Crisis—evidence that atmospheric gases flipped from methane/ ammonia to an oxygen atmosphere.

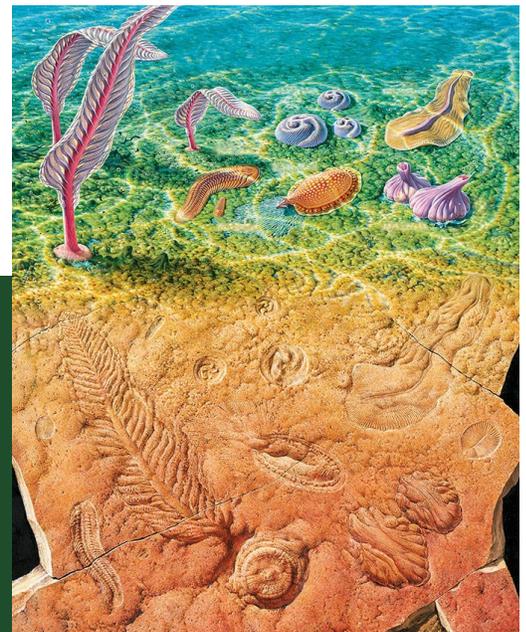
- 2 BYA (measure 250 cm (2.5 meters) from your last line) Eukaryotes (complex cells with a **nucleus** housing DNA in **chromosomes**). We have eukaryote cells.
- 1.5 BYA (measure 250 cm (2.5 meters) from your last line) Evidence of multicellular life forms.
- 1 BYA (measure 250 cm (2.5 meters) from your last line) first evidence of sexual reproduction
- 540 MYA (measure 230 cm (2.3 meters) to the top of your adding machine timeline. This is the end of the Proterozoic **Eon**. Include in the descriptions: Earliest plants, Ediacaran **biota**, beginning of the Cambrian Explosion (multicellular organisms developed hard parts, like shells. From infrequent fossils of soft bodied organisms like the Ediacaran **biota** (image on right), fossil evidence becomes much more common with

POWER WORDS

- **biota**: the animal and plant life of a particular region, habitat, or geological period
- **chromosomes**: a threadlike structure of nucleic acids and protein found in the nucleus of most living cells, carrying genetic information in the form of genes
- **fauna**: the animals of a particular region, habitat, or geological period
- **nucleus**: a dense organelle present in most eukaryotic cells, typically a single rounded structure bounded by a double membrane, containing the genetic material
- **solidify**: make or become hard or solid

organisms that have hard parts, like shells.

Ediacaran fauna fossils are found world-wide, soft-bodied animals that lived from 635—542 MYA just after the Snowball Earth.



We have been exploring ideas of a rewarding, fun career for you.

<https://tra.extension.colostate.edu/stem-k12/stem-resources/>

- 53.Paleontology 1: Take an interest survey (what do you like to do?) pages 31-33
- 54.Paleontology 2: Score your interest survey, pages 50-51
- 55.Paleontology 3: Explore your interests by developing a project, page 22.

This month, you will take a personality test. Personality tests provide insight in how you **perceive** the world, and how those **perceptions** influence your decisions. One of the first and most famous tests is Myer-Briggs, that evaluates responses on a scale of 4 different criteria:
 “E” Extraversion—“I” Introversion
 “S” Sensing—“N” Intuition
 “T” Thinking—“F” Feeling
 “J” Judgement—“P” Perception

The tests then provides a 4 letter code with 16 different combinations:

ESTJ	ENTJ	ISTJ	INTJ
ESTP	ENTP	ISTP	INTP
ESFJ	ENFJ	ISFJ	INFJ
ESFP	ENFP	ISFP	INFP

Each “type” has different strengths and weaknesses. It doesn’t mean that you are just that trait, but it means you rely

on it more than the opposite trait. For example, when I make decisions, I am rational and use logic. I am a “T” rather than a “F”. I am, however, also very empathetic. I make better decisions when I do not rely just on my feelings.

Most personality tests use similar criteria as the Myers Briggs test, like the one you can take. It is free and online.

Directions:

- Click on the link in the green box to the right. This will take you to 16 Personalities Free Personality Test. It is similar to the Myer Briggs test.
- Answer as honestly as you can, even when the answer is embarrassing. No one will see the test except for you. The more honestly you answer, the more accurate the results.
- Answer each question. Try not to use the center button, the neutral answer. Even slightly liking or disliking will give you better results.
- When you have completed the test, it will give you an answer of your traits.
- Try taking the test once a day for several days. You may be surprised that your answers will change, and you could get different results.

POWER WORDS

- **empathy:** the ability to understand and share the feelings of another
- **perceive:** become aware or conscious of (something); come to realize or understand
- **perception:** the ability to see, hear, or become aware of something through the senses

MATERIALS

- computer with internet access
- <https://www.16personalities.com/free-personality-test>
- <https://careerinstem.com/personality/>
- Over several days, you will see similar traits emerge. Capture those results and keep them in your career journal.
- Check out one more website after you are done. This site connects different STEM careers with your personality.
- Have fun! After all, you are exploring the most interesting person in the world—YOU!

Extraverting	Introverting	Sensing	Intuiting	Thinking	Feeling	Judging	Perceiving
Initiating	Receiving	Concrete	Abstract	Logical	Empathetic	Systematic	Casual
Expressive	Contained	Realistic	Imaginative	Reasonable	Compassionate	Planful	Open-ended
Gregarious	Intimate	Practical	Conceptual	Questioning	Accommodating	Early Starting	Prompted
Active	Reflective	Experiential	Theoretical	Critical	Accepting	Scheduled	Spontaneous
Enthusiastic	Quiet	Traditional	Original	Tough	Tender	Methodical	Emergent

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- Doug Garcia, Colorado State University Creative Services Communication Coordinator/ Designer
- Special Thanks: Ashley Pereria, Career in STEM: <https://careerinstem.com/>

CITATIONS

Information:

- Climate through time: <http://scotese.com/climate.htm>
- Mass Extinctions: <https://www.mtcares.org/science-of-warming/denialist-myths-debunked/global-warming-is-causing-extinction-of-some-life/>; https://en.wikipedia.org/wiki/Central_Atlantic_magmatic_province; https://evolution.berkeley.edu/evolibrary/article/massextinct_08;
- Career Explorations: <https://careerinstem.com/>

Images:

- Mosasaur: <http://bonerooms.blogspot.com/2018/07/cleveland-museum-of-natural-history.html>
- Cladograms: <https://www.sciencefriday.com/wp-content/uploads/2017/09/Cladogram.jpg>; <https://s3.amazonaws.com/user-media.venngage.com/387319-4f3fd5053ff2e8aa6cc81abebbd521a8.gif>
- Timeline temperature: <http://scotese.com/climate.htm>
- Timeline mass extinction events: <https://skepticalscience.com/Earths-five-mass-extinction-events.html>
- Smithsonian Hadean Earth: <https://www.smithsonianmag.com/science-nature/travel-through-deep-time-interactive-earth-180952886/>
- Climate Legend: <http://scotese.com/legend.htm>
- 5 Mass Extinctions: <https://www.mtcares.org/science-of-warming/denialist-myths-debunked/global-warming-is-causing-extinction-of-some-life/>
- CAMP: https://en.wikipedia.org/wiki/Central_Atlantic_magmatic_province
- Cyanobacteria: <https://ucmp.berkeley.edu/bacteria/cyanofr.html>; <https://mounikakalwa33.files.wordpress.com/2012/12/cyanobacteria.jpg?w=300&h=240>
- Earth timeline: https://en.wikipedia.org/wiki/Late_Heavy_Bombardment
- Permian Extinction: <https://www.washington.edu/news/2018/12/06/biggest-extinction-in-earths-history-caused-by-global-warming-leaving-ocean-animals-gasping-for-breath/> ; <https://www.nationalgeographic.com/content/dam/science/photos/000/009/923.ngsversion.1509199279224.adapt.1900.1.jpg>
- Ediacaran biota: <https://www.sciencemag.org/news/2016/10/how-earth-s-oldest-animals-were-fossilized>

Answer from page 4 :

- you, your mother, your grandmother, and 16 greats = 19 generations
- 19 generations x average 90 years = 1,710 years
- 2019 (this year) - 1,710 years = the year 309, or the 4th Century (it is now the 21st Century)