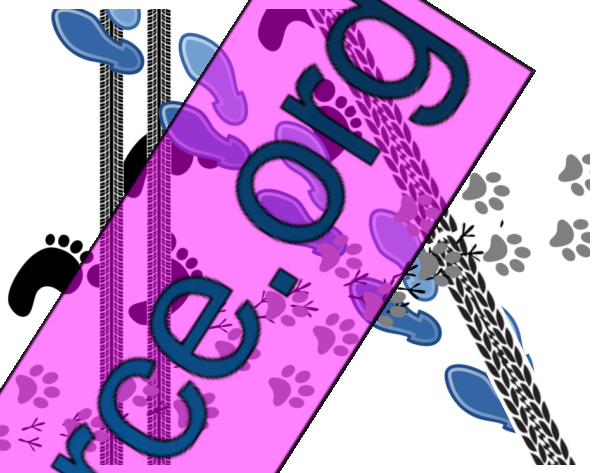
Name: _____

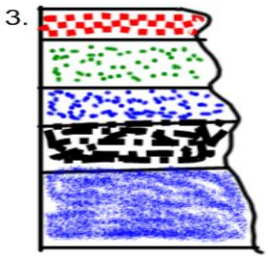
Dating the Relative Ages of Rock Strata



Relative dating is not about taking a cousin out on a date, but rather dating objects based on information you might know about them. To the right is an example that demonstrates the principle of relative dating. Each of these tracks were laid down at a different time. By analyzing the image you can tell the order in which the tracks were made. Tracks were made by: a cat, a bird, a barefoot lady, a businessman, a tiny clown car, and a motorcycle.

1. **Write a narrative of the sequence of events.**

2. **Define rock strata/stratum. If you don't remember what strata is look it up.**



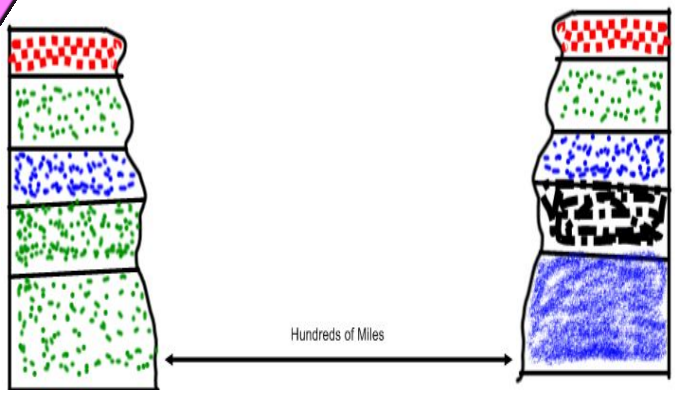
There are many techniques used to relatively date rock stratum. One of these methods is the **Law of Superposition** which states, "in undisturbed layers of rock, the oldest rocks are on the bottom and get younger in age as you move up the rock layers."

3. **On the image to the right, number the rock strata from oldest to youngest.**

Another relative dating method involves using "**Index Fossils**." Index fossils help demonstrate how organisms might have changed, migrated and evolved over time. Index fossils are important in determining the ages strata. If we can find out about how long ago specific fossils lived, then we can use that information to help date strata. A 2 million year old fossil found in a layer of limestone means the limestone layer was forming 2 million years ago.

In order to be an index fossil, the following rules must apply.

- **Lived only during short periods of time.**
- **Very abundant**
- **Geographically widespread.**



If we have two layers of limestone hundreds of miles away from each other, we can use index fossils to see that they were deposited at approximately the same time or not. The image to the right is an example of why index fossils are important when dating rocks. Ask yourself, " What is the relative age of the bottom layer of the left sequence compared to the right bottom sequence? We can't really tell without fossils of known ages. This is also called **Rock Correlation**.

Go to the following website: http://EarthScience.xyz/GC You will see layers of rock found in the Grand Canyon.. We don't really know how old these layers are so we need to find some index fossils. The task is to find the relative age of the rock strata around areas A, B, C, and D, on the image, finding fossils that you can use as index fossils. Use the attached geologic time scale or go to http://EarthScience.xyz/GeoTime and the Fossil Book to help identify the fossils found in the strata: http://EarthScience.xyz/FossilBook1

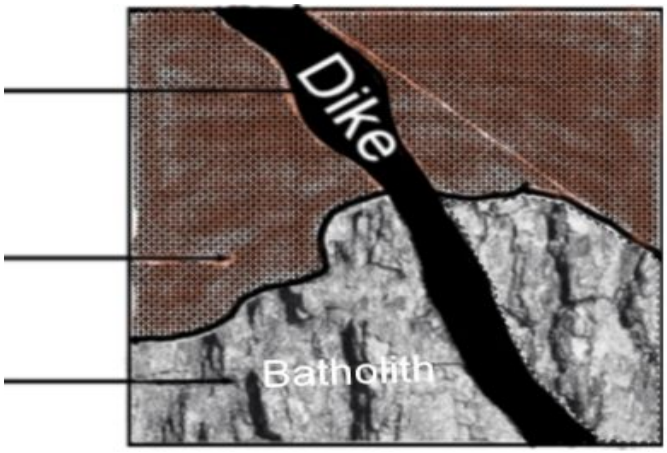
4. **What are the relative ages or periods of the rock strata for A, B, C, and D?**

B. **C.** **D.**

Another method of finding the relative ages of strata, is to understand the **Cross-Cutting Law** which states: “Any feature that cuts across a body of rock is younger than the rock that it cuts across.” Faults can offset layers, which tells us that the fault happened after the layer was deposited. Intrusive magma, like dikes, batholiths, and sills show that the layers had to have been there before magma could intrude.

Look at the following images and on the lines number each event from oldest rock layer to youngest rock layer. The #1 is oldest.

5.

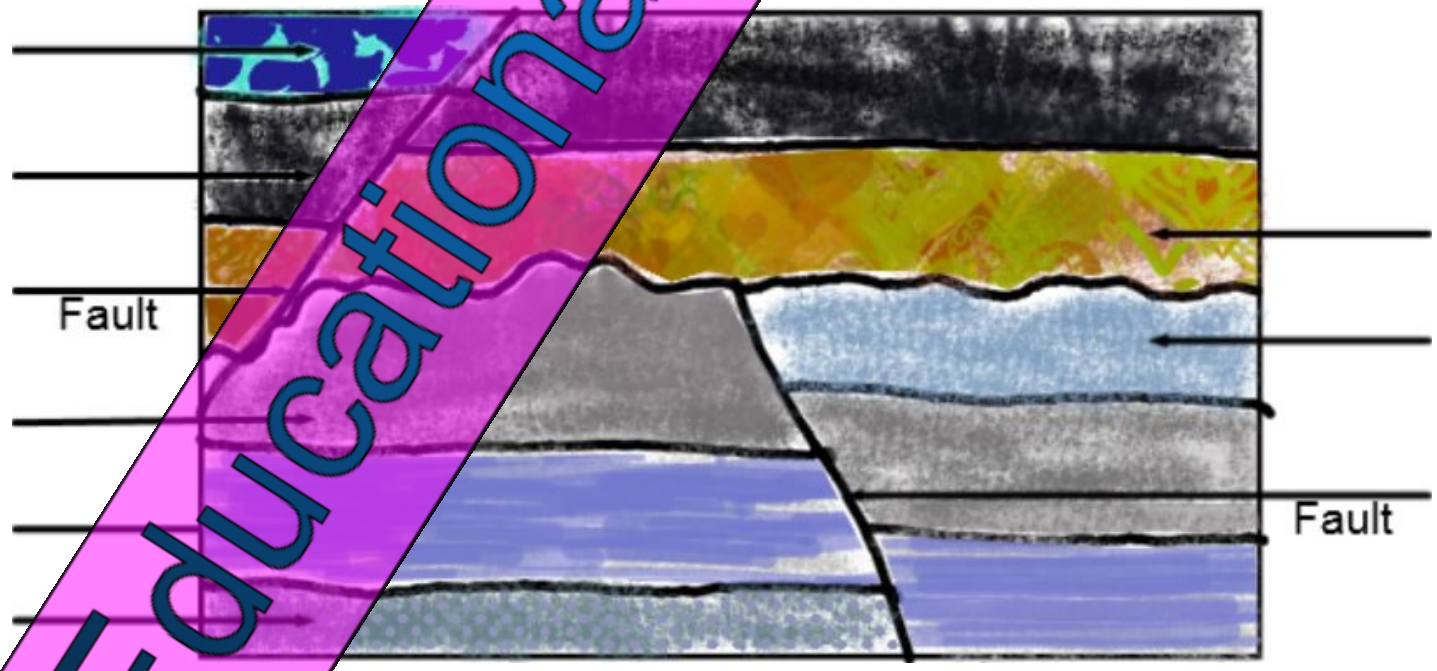


6.

Understanding what **unconformities** are is also important in relative dating. Sometimes a stratigrapher, someone who studies rock strata, will discover strata missing because of weathering and erosion at some point in time. These gaps in relative time are called **unconformities**. There are three types of unconformities.

The first type of unconformity, is a **disconformity**. A disconformity is an erosional surface within a horizontal sedimentary sequence.

7. Look at the following image and on the lines, number each event from oldest rock layer to youngest rock layer. #1 is oldest. Don't forget to number the faults.

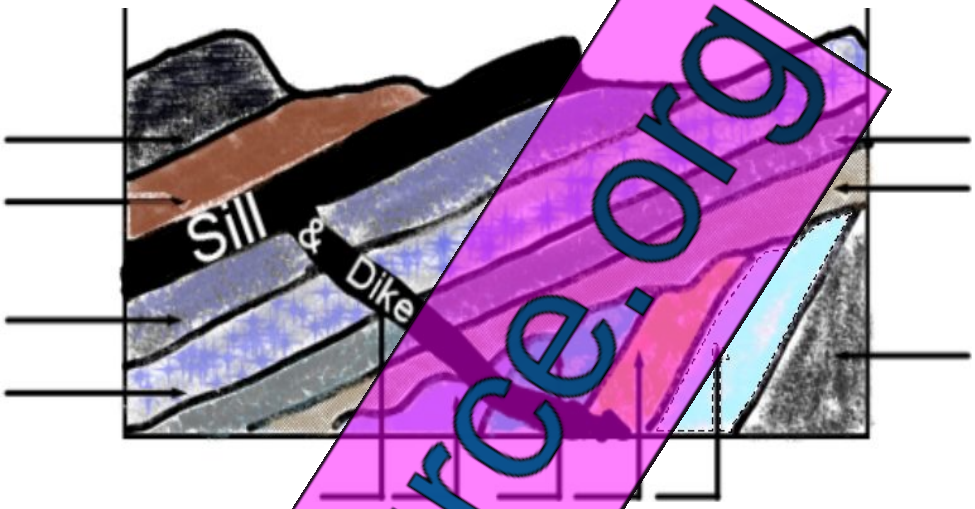


8. Highlight or trace over the disconformity.

The second type of unconformity is called an **angular unconformity.** This occurs when rocks are tilted and folded, then eroded, and then other layers are deposited on top.

9. **On the lines of the image to the right, number each layer from oldest rock to youngest rock. The #1 is the oldest.**

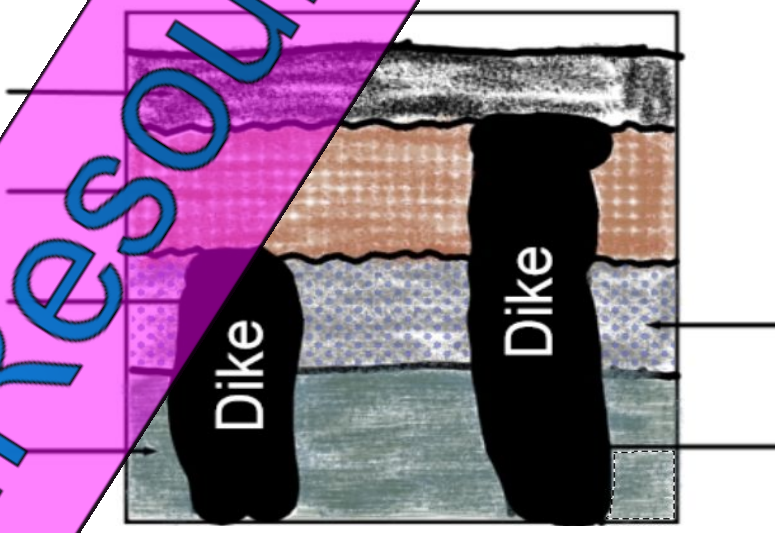
10. **Highlight or trace over the angular unconformity?**



The third type of unconformity, is the **nonconformity**. A nonconformity happens when igneous or metamorphic rock are uplifted, exposed, weathered, and then new layers of rock are deposited on top.

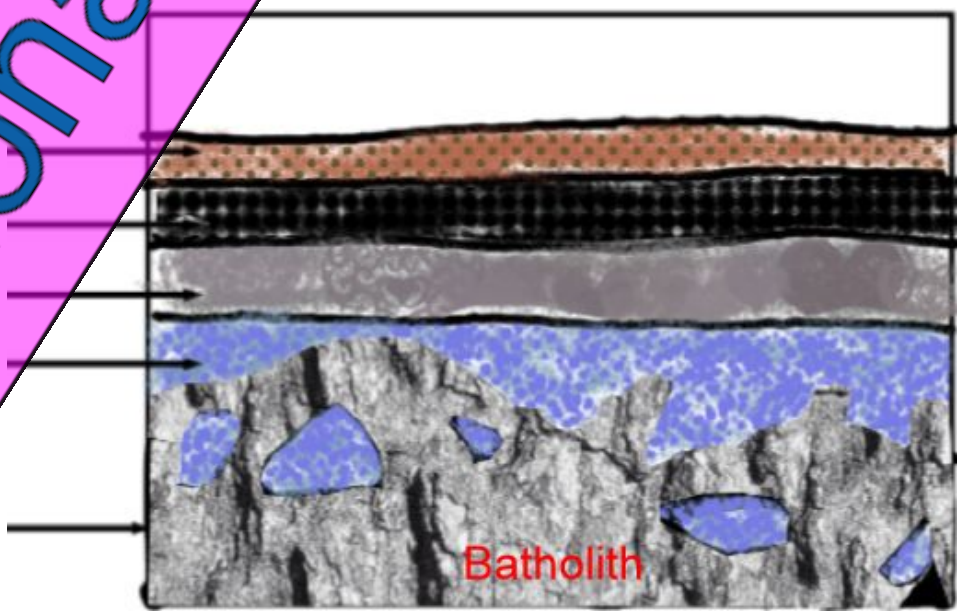
11. **On the lines of the image to the right, number each layer from oldest rock to youngest rock. The #1 is oldest.**

12. **Highlight or trace over the nonconformities?**



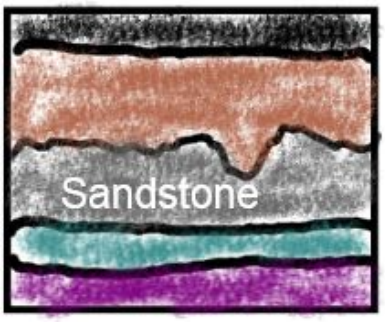
Another part of unconformities is the **Law of Inclusions**. Inclusions are fragments of another rock included in another layer of rock. It states that "this fragment must be older than the rock layer it is found in."

13. **On the image place an "X" on all of the inclusions and then give each layer a number based on its relative age. The number "1" will represent the oldest layer.**



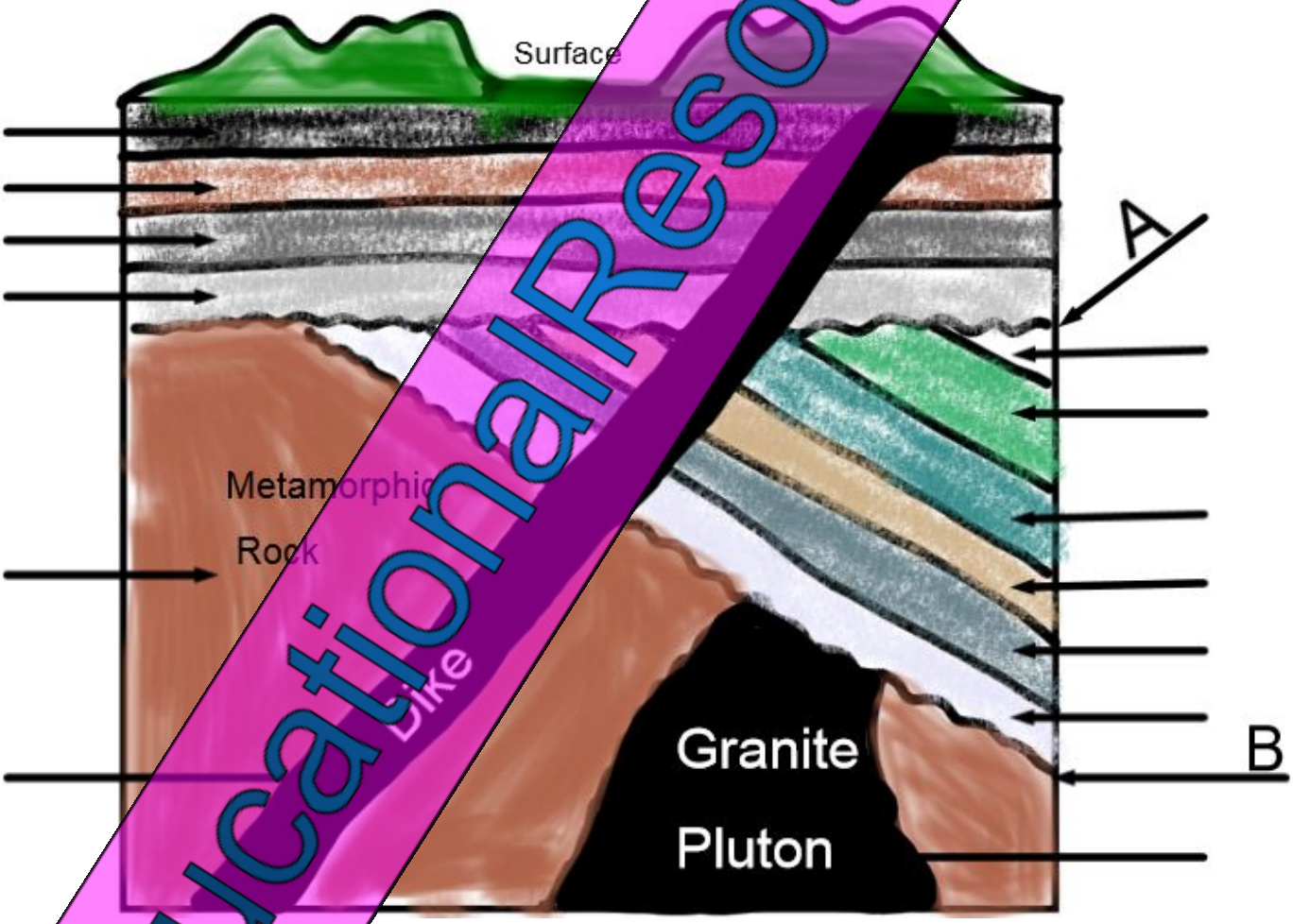
14. Below there are examples of each of the three types of unconformities. Label the unconformities below each image as either an angular unconformity, nonconformity, or a disconformity.

.



You should now have a good understanding of relative dating and be able to relatively date strata based on the Law of Superposition, index fossils, unconformities, inclusions, and cross cutting relationships.

15. In the image below demonstrate your understanding by numbering the correct geologic historical sequence of events. Start with #1 as being the oldest rock stratum.



16. What type of unconformity is found at letter "A"?

17. What type of unconformity is found at letter "B"?

Geologic Time Scale

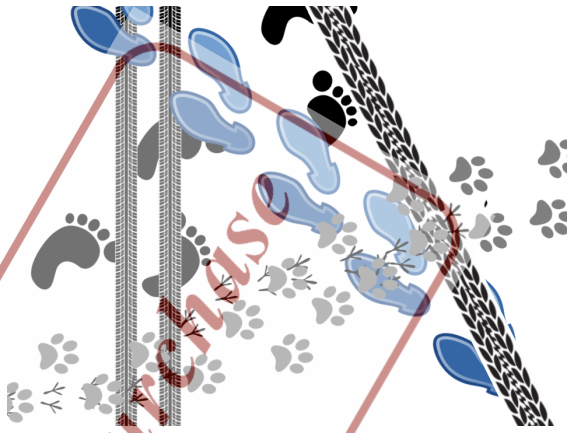
Precambrian		Paleozoic						
Archean	Proterozoic	Cambrian	Ordovician	Silurian	Devonian	Mississippian	Pennsylvanian	Permian
4-2.5 Billion	2.5 Bil.-540 Mil.	540-490 Mya	490-445 Mya	445-423 Mya	423-372 Mya	359-331 Mya	323-30[illegible] Mya	299-[illegible] Mya
Bacteria, microfossils, Fossils Rare	Multi-celled eukaryotes, Fossils Rare	Chordates, Trilobites, Worms, Sponges, brachiopods, anomalocarids, fungi, algae	Cephalopods, corals, brachiopods, bivalves, nautiloids, trilobites, ostracods, bryozoa, crinoids, cystoids, starfish, graptolites, conodonts all appear, green plants	Vascular plants, millipedes, fishes, sea-scorpions,	Mosses, horsetails, ferns, seed-bearing plants, trees, wingless insects, amphibians,	Land vertebrates, rhizodonts, sharks, trilobites and nautiloids die [illegible]	Winged insects, reptiles,	Pelycosaurs, therapsids, 95% of life goes through an extinction level event.
Ontario, Quebec, Antarctica land is formed	Australia forms, oxygen in air, Parts of North America and Africa	Land continues to form, an Ice age	An ice age ends	England, Ireland, scotland, Scandinavian Mountains	Appalachian Mountains formed, Mountains in North Africa	Large Glaciers	Europe and Asia building mountains	Pangea forms, Appalachians get larger, Glaciation,

Mesozoic			Paleozoic		
Triassic	Jurassic	Cretaceous	Paleogene	Neogene	Quaternary
252-209 Mya	201-152 Mya	145-[illegible] Mya	66-28 Mya	23-4 Mya	3 Mya-Present
Dinosaurs, ichthyosaurs, nothosaurus, pterosaurs, mammals, crocodiles, modern corals, modern insects,	Conifers, abundance of dinosaurs, first birds and lizards, bivalves, ammonites, sea urchins,	Flowering plants, new insects, modern fish, new dinosaurs, modern sharks, placental mammals	Modern and large mammal families, whales, grasses, large mammals, extinction of dinosaurs,	Horses, mastodons, apes, widespread forests,	Humans, agriculture, stone age, bronze age, iron age,
Andes Mountains form, central Asian mountains, New Zealand	Pangea breaks up, Sierra Nevadas, CO2 is 4-5 times higher than present	Continued land mass breakups, Rocky Mountains	Himalayas and Alps begin, Greece forms, Ice Age, CO2 lowers	Ice Ages, Carpathian Mountains, CO2 Lowers	Drastic temperature changing events, volcanic winters, Ice ages, Sahara Desert, North American Glaciers, Rise in CO2

Name: _____

Dating the Relative Ages of Rock Strata

Relative dating is not about taking a cousin out on a date, but rather dating objects based on information you might know about them. To right is an example that demonstrates the principle of relative dating. Each of these tracks were laid down at a different time. By analyzing image you can tell the order in which the tracks were made. Tracks made by: a cat, a bird, a barefoot lady, a businessman, a tiny clown car, a motorcycle.



the

the

were

and

the

1. **Write a narrative of the sequence of events.**
   a.

2. **Define rock strata/stratum. If you don't remember what strata is look it up.**
   a.

There are many techniques used to relatively date rock stratum. One of those methods is the **Law of Superposition** which states, "in undisturbed layers of rock, the oldest rocks are on the bottom and get younger in age as you move up the rock layers."

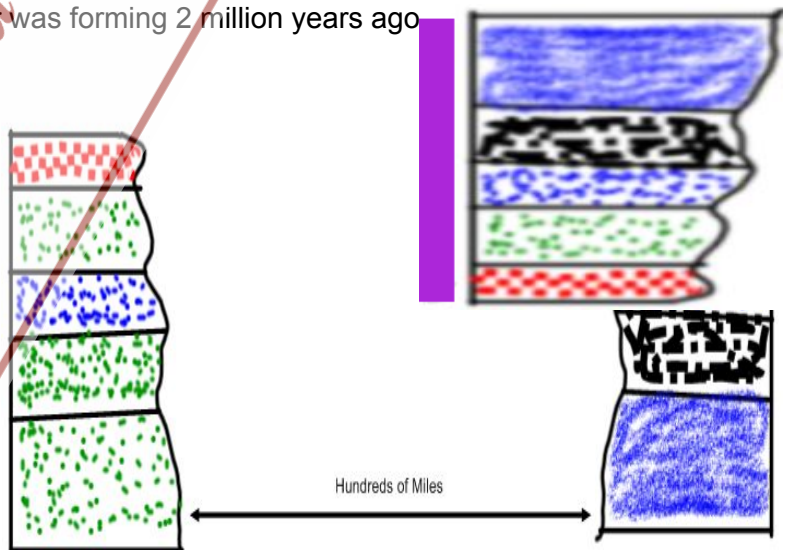
3. **On the image to the right, number the rock strata from oldest to youngest.**

Another relative dating method involves using "**Index Fossils**." Index fossils help demonstrate how organisms might have changed, adapted and evolved over time. Index fossils are important in determining the ages strata. If we can find out about how long ago specific fossils lived, then we can use that information to help date strata. A 2 million year old fossil found in a layer of limestone means the limestone layer was forming 2 million years ago.

In order to be an index fossil, the following rules must apply.

- **Lived only during short periods of time.**
- **Very abundant**
- **Geographically widespread.**

If we have two layers of limestone hundreds of miles away from each other, we can use index fossils to see that they were deposited at approximately the same time or not. The image to the right is an example of why index fossils are important when dating rocks. Ask yourself, " What is the relative age of the bottom layer on the left sequence compared to the right bottom sequence? We can't really tell without fossils of known ages. This is also called **Rock Correlation**.



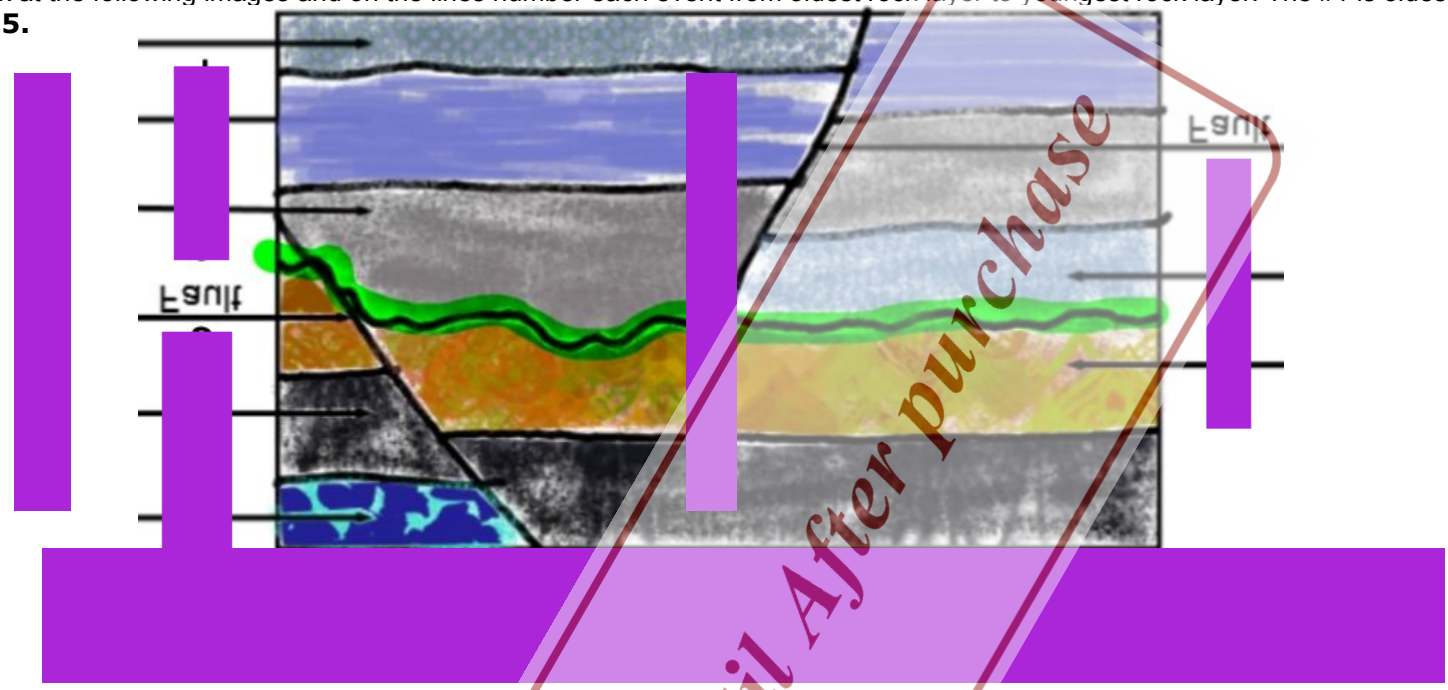
Go to the following website: **http://EarthScience.xyz/GC** You will see layers of rock found in the Grand Canyon.. We don't really know how old these layers are so we need to find some index fossils. The task is to find the relative age of the rock strata around areas A, B, C, and D, on the image, finding fossils that you can use as index fossils. Use the attached geologic time scale or go to **http://EarthScience.xyz/GeoTime** and the Fossil Book to help identify the fossils found in the strata: **http://EarthScience.xyz/FossilBook1**

4. **What are the relative ages or periods of the rock strata for A, B, C, and D?**

Another method of finding the relative ages of strata, is to understand the **Cross-Cutting Law** which states: “Any feature that cuts across a body of rock is younger than the rock that it cuts across.” Faults can offset layers, which tells us that the fault happened after the layer was deposited. Intrusive magma, like dikes, batholiths, and sills show that the layers had to have been there before magma could intrude.

Look at the following images and on the lines number each event from oldest rock layer to youngest rock layer. The #1 is oldest.

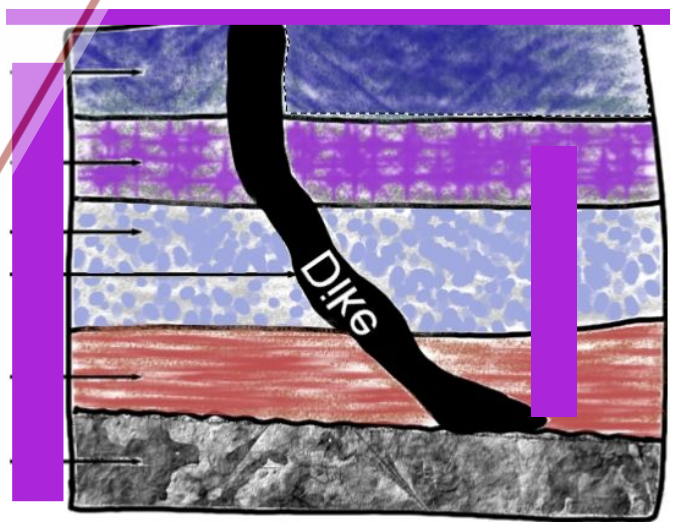
5.



Understanding what **unconformities** are is also important in relative dating. Sometimes a stratigrapher, someone who studies rock strata, will discover strata missing because of weathering and erosion at some point in time. These gaps in relative time are called **unconformities**. There are three types of unconformities.

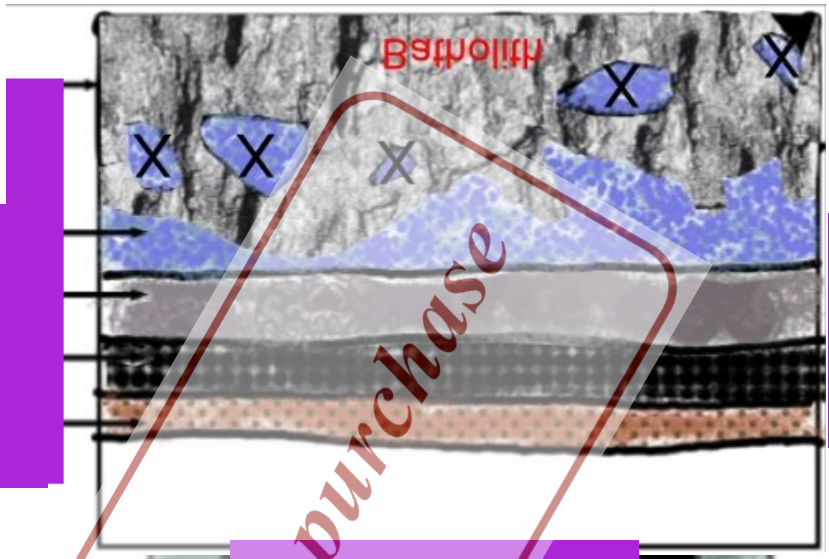
The first type of unconformity, is a **disconformity**. A disconformity is an erosional surface within a horizontal sedimentary sequence.

7. Look at the following image and on the lines, number each event from oldest rock layer to youngest rock layer. #1 is oldest. Don’t forget to number the faults.



8. Highlight or trace over the disconformity.

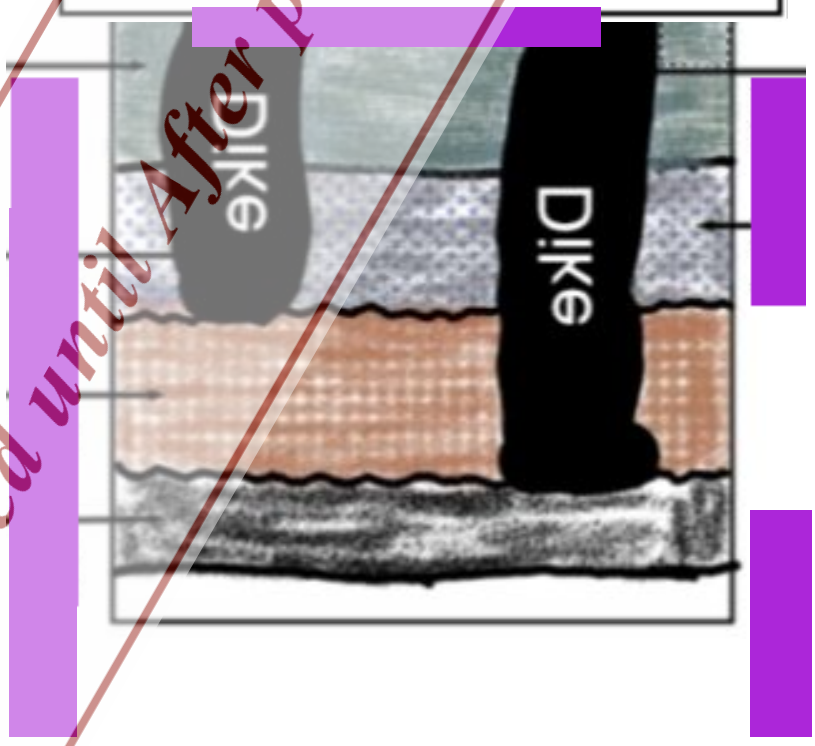
The second type of unconformity is called an **angular unconformity.** This occurs when rocks are tilted and folded, then eroded, and then other layers are deposited on top.



9. **On the lines of the image to the right, number each layer from oldest rock to young**
   a. [redacted]

10. **Highlight or trace over the angular unconformity?**

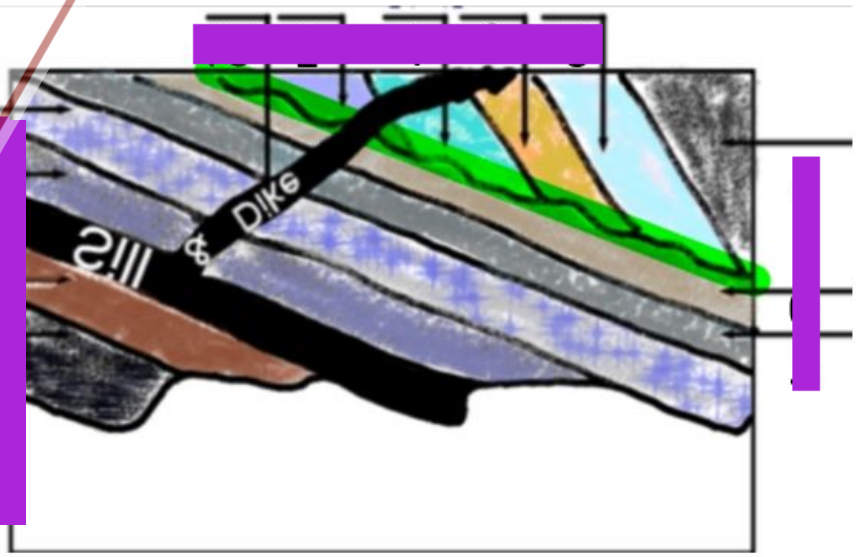
The third type of unconformity, is the **nonconformity**. A nonconformity happens when igneous or metamorphic rock are uplifted, exposed, weathered, and then new layers of rock are deposited on top.



11. **On the lines of the image to the right, number each layer from oldest rock to youngest rock. The #1 is oldest.**
   a. [redacted]

12. **Highlight or trace over the nonconform**

Another part of unconformities is the **Law of Inclusions**. Inclusions are fragments of another included in another layer of rock. It states that "th fragment must be older than the rock layer it is fo in."



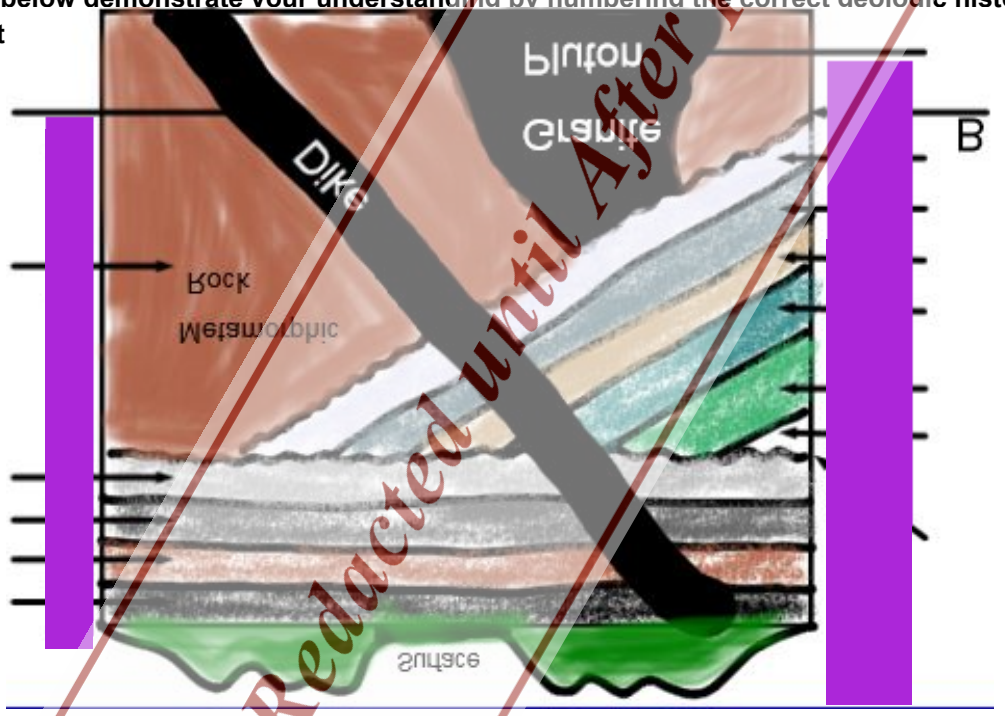
13. **On the image place an "X" on all of th**

14. **Below there are examples of each of the three types of unconformities. Label the unconformities below each image as either an angular unconformity, nonconformity, or a disconformity.**

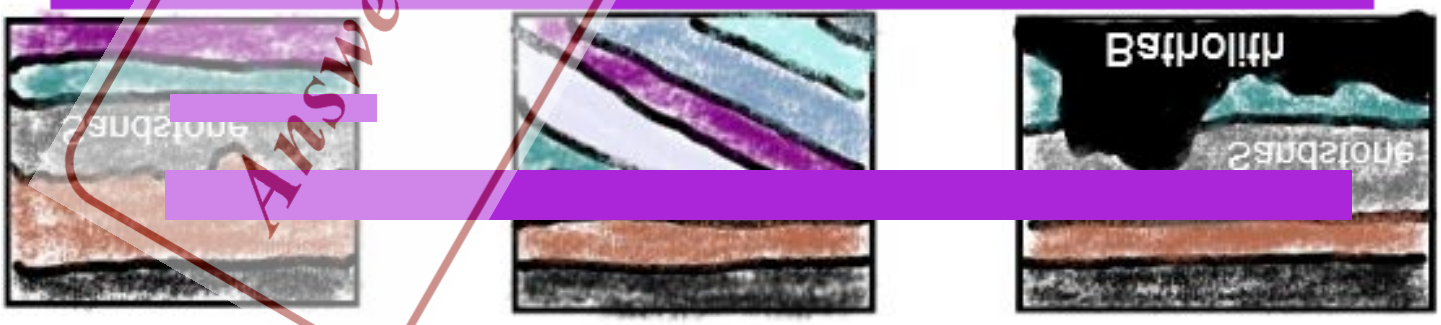
.

You should now have a good understanding of relative dating and be able to relatively date strata based on the Law of Superposition, index fossils, unconformities, inclusions, and cross cutting relationships.

15. **In the image below demonstrate your understanding by numbering the correct geologic historical sequence of events. Start**



a. **The story goes like this.**



Teacher Notes

1. **I let my students work in groups of 1, 2, or 3, but, because I want them to all have the practice and an ability to debate and question, they all get and turn in their own paper.**
    a. **The discussion for the most part goes well.**
2. **This assignment takes 50 minutes and depending on the class, spills into another class hour.**
3. **After they have finished the assignment, we discuss the vocab that they should now know as well as some other images and examples from my website.**
   http://earthscience.xyz/RealtiveDating
4. **I also, for fun, read an article about a fake dinosaur. I preface it by telling them that another super dinosaur was found. Then I read the article. It is amazing how many students don't see that it is fake. By the end, I am busting up laughing so hard, that they get it. This article is the first linked image on the website mentioned above.**