Presenter Notes

<u>PRESENTER NOTE:</u> Provide a brief introduction. Perhaps explain what got you interested in the industry, or what you find intriguing about gems and jewelry, or what subjects in school helped you to become who you are today. This is an opportunity to connect with the audience and to help them feel comfortable.

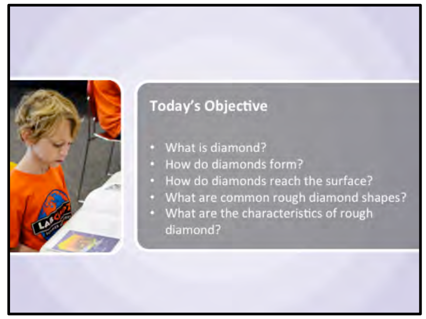
What is a rock? ***Allow time for answers.***

What makes a rock different from a gemstone? ***Allow time for answers.***

How do diamonds get from the ground to the jewelry store? ***Allow time for answers.***

We'll look into these questions and much more during the presentation. Please ask any questions you think of!

****Click to go to next slide***



Diamonds have a long history as beautiful objects of great worth and desire.

A diamond has to go through a lot before it ends up in a piece of jewelry.

Today we'll look into some of these questions:

What is diamond?

How do diamonds form?

How do diamonds reach the surface?

What are the characteristics of rough diamond?

What are the common rough diamond shapes?

PRESENTER NOTE: Tell students to ask questions as you go along. Feel free to add personal stories that may relate to each career as you discuss the information.

Click to display next slide

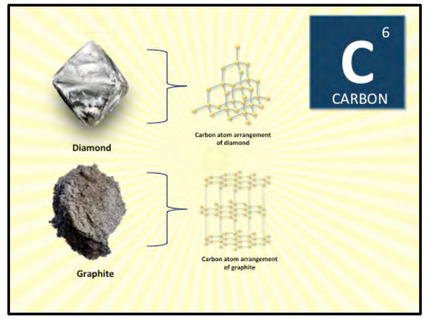
PRESENTER NOTE: This slide has multiple images. When prompted in these presenter notes, click in the center of the slide to display the additional image(s).

So what are diamonds made of? ***Allow time for answers**
Diamonds are made of carbon. ***Click to display next image**

Carbon is an element, like hydrogen, oxygen, and all of the other elements.
An element is something that cannot be broken down into simpler components.
Carbon is one of the most abundant elements. ***Click to display next image***
Diamond isn’t the only material that’s made of carbon: Graphite is, too.

Did you know that pencils have almost always used graphite, not lead?

***Click to display next slide**



Although diamond and graphite are both made of carbon, the difference between the two is the way their carbon atoms fit together.

Atoms are the basic units that make up an element.

The carbon atoms in graphite have weak bonds, which allow movement between the layers of atoms.

This movement results in graphite being soft and slippery, which makes it an excellent lubricant.

Graphite is used in pencils, where its softness allows it to rub off easily onto paper.

<u>PRESENTER NOTE</u>: Let's help the students understand this concept with a quick activity.

Ask the students to put their hands together and rub them back and forth, like they would when trying to get warm.

Ask them: Do your hands slide easily? ****Allow time for students to do this and respond***

Yes, they do. That's how the carbon atoms are arranged in graphite (your pencil).

Now, have them clasp their hands together and try to slide them back and forth.

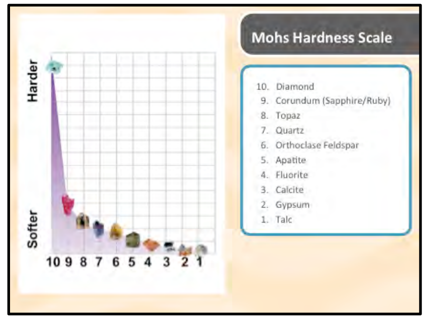
Ask them: Do they still slide back and forth easily?****Allow time for students to do this and respond***

No, they don't. The carbon bonds in diamond are arranged much more tightly, like your fingers.

This makes the bond—and therefore the diamond—much, MUCH stronger.

SO much stronger that diamond is the hardest mineral substance on earth.

****Click to display next slide***



Hardness refers to a mineral's resistance to being scratched.
The system for measuring a mineral's hardness was developed by a German professor and mineralogist named Dr. Friedrich Mohs.
The Mohs Hardness Scale ranges from 1 to 10.

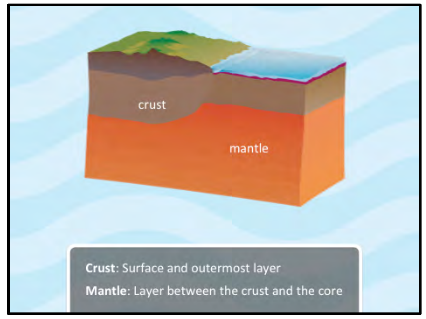
- 1 is the softest mineral, for example, talc. Think of baby powder—some baby powder is made of talc!
- Talc can be scratched using your fingernail.
- 10 is on the other end of the scale and is the hardest mineral.
- Diamond is 10 and can scratch everything below it.

PRESENTER NOTE: Here's an example of how hardness works:
Have you ever heard someone say that only diamond can scratch glass? ***Allow time for students to respond**
This is not true! Diamond WILL scratch glass, but so will any material that has a hardness greater than glass (5–6 on the Mohs scale).

***Click to display next slide**

So now that we know ***WHAT*** diamonds are, we need to figure out how they are formed.
This is an image of a diamond in the rock that carried it from where it formed, to where it was mined.
Diamonds are formed deep within the earth, so let's take a closer look at the earth for a moment.

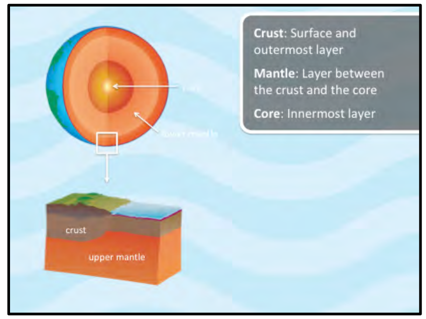
***Click to display next slide.**



The earth's first layer is the crust.
It's a layer of hard, strong rock that's extremely thin compared to the layers beneath it.
We live on the outside edge of the crust.
Its thickness ranges from about 3 to 25 miles (5 to 40 kilometers), although it can be much thicker under mountain ranges.
The crust is thinnest under the oceans (oceanic crust).

Beneath the crust is the mantle, which is made up of two sections.

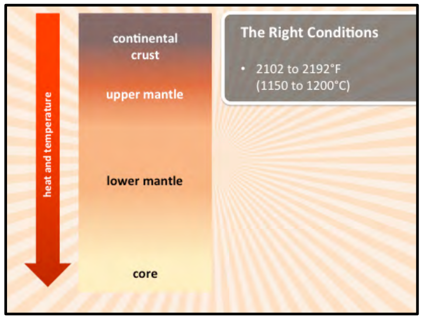
Click to display next slide



The mantle is divided into two sections: the upper mantle and the lower mantle.
The lower mantle is close to the core, while the upper mantle is close to the crust.
Structurally, the mantle is rocky near its outer surface and more fluid at its deeper levels.
The earth's core consists of a molten (melted) layer and a solid center.

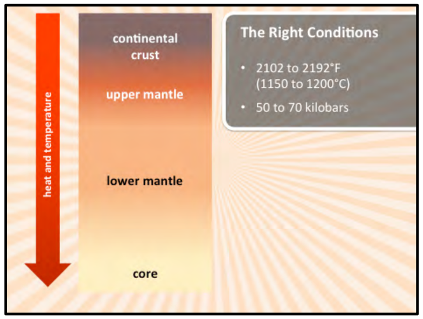
Now that we have a simple understanding of the earth, let's look at the specific conditions required for diamond formation.

***Click to display next slide**



Tremendous heat and temperature are required to form diamond, and the perfect conditions are very unique.
The temperature range for diamond formation is 2102°F to 2192°F (1150°C to 1200°C) .
That is basically the temperature of LAVA!

Click to display next slide

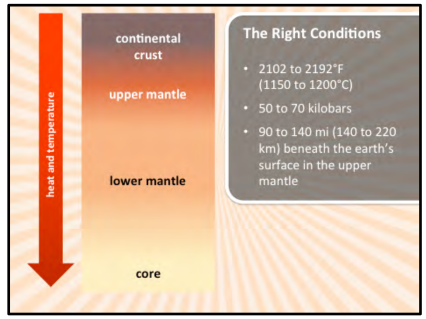


The pressure range required for diamond formation is between 50 and 70 kilobars.

A kilobar is a unit that scientists use to measure extremely high pressure.
One atmosphere is equal to the weight of the earth's **atmospheric pressure** at sea level.
One atmosphere is slightly more than one ***bar***.
So a kilobar = 1,000 bars or almost 1,000 atmospheres.

In other words, the pressure of 1kilobar is 1000 times greater than the weight of the earth's atmospheric pressure at sea level. To put that into perspective, it takes just over 17 bar to crush an aluminum can. Now remember that it takes 50 – 70 THOUSAND bar to create a diamond!

****Click to display next slide***

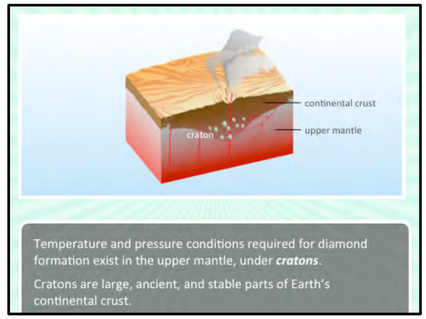


These temperature and pressure conditions exist in very limited areas of the earth's upper mantle, between 90 and 140 miles (about 140 and 220 kilometers) beneath the surface.

At that depth, these ideal conditions work together to force carbon atoms to form the extremely strong bonds found in diamond crystals.

These locations in the earth have a specific name.

Click to display next slide



These locations are called cratons.
They are found under large, geologically stable parts of the crust.
Geologically stable means that the area has a lower risk of things like volcanic activity or earthquakes.

The conditions under a craton are stable enough to preserve diamonds for hundreds of millions of years after formation.

****Click to display next slide***

This map shows the distribution of cratons around the world.

Notice that cratons exist only under continental landmasses.

There are no cratons under the oceans, because oceans are unsuitable for diamond formation.

It's also important to note that some of them contain diamond-bearing deposits, and some don't.

Click to display next slide

Now when we look at the diamond sources around the world, we'll see that they correspond to the location of known cratons. Here are just SOME of the diamond sources around the world. ***Click to display diamond sources on the map***

<u>**PRESENTER NOTE**</u>: Below is information on the locations shown. There are many other diamond sources not listed.
CANADA: The Diavik diamond mine is located in the arctic tundra of northern Canada. Diamonds are found both on the surface and underground.
WESTERN USA: The Kelsey Lake diamond mine is located on the border of Wyoming and Colorado. It is now closed.
VENEZUELA: There are artisanal diamond mining operations in Venezuela and Guyana. These are smaller diamond mining operations that require much human labor.
BRAZIL: While Brazil does not produce as much diamonds as other locations, there are lots of large, fine diamonds sourced from Brazil.
AFRICA: There are many operational diamond mines across the African continent. Mines can be found in South Africa, Namibia, Botswana, Angola, Sierra Leone, and other countries.
INDIA: At one time, India was a major source of diamonds. Production is much lower today, but India has emerged as one of the primary diamond cutting centers in the world.
CHINA: While not a major contributor, China does have operational mines.
RUSSIA: Mines in Russia contribute a large number of diamonds to the industry. Most are located in remote areas.
AUSTRALIA: The Argyle mine, located in Western Australia, provides the largest amount of diamonds by volume.
Click to display next slide

After formation, if conditions remain constant, diamonds might remain underground for **hundreds of millions** of years before they're carried to the surface.

Diamond deposits are found in two types of rock called *kimberlite* and *lamproite*.

It's important to remember that kimberlites and lamproites aren't the rocks that diamonds form in—they merely carry already-formed diamonds to the surface.

***Click to display next slide**

PRESENTER NOTE: This slide contains an animation that will play automatically. Be sure to allow the animation to play all the way through. Read the comments below as the animation plays.

The geologic process that delivers materials—including diamonds—to the earth's surface is called emplacement.

The partially molten layer of the mantle is in constant motion.

- If the mixture of chemical elements is right, the magma will form kimberlite or lamproite.
- If, as it rises, it meets an already-existing deep fracture in the crust, it will continue to move upward.
- If the rising kimberlite or lamproite passes through a diamond deposit, it will pick up and carry already-formed diamonds.

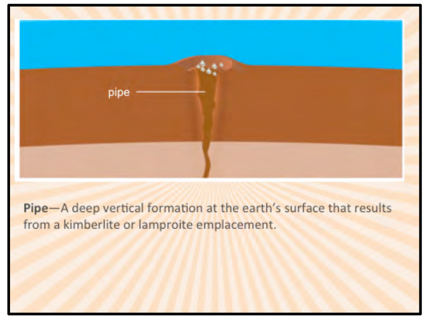
As the upward-moving rock mixture rises toward the surface, the pressure above it decreases.

- With less pressure holding it down, the magma gradually picks up speed.
- By the end of the journey, it's moving very fast.
- Scientists estimate that within the last 1.5 miles (2.5 km), its speed is about 186 miles (300 km) per hour.

The decrease in pressure also allows some of the fluids in the magma to expand into gases.

- Those gases are mostly water vapor and carbon dioxide, so they act like the gases in a shaken bottle of club soda or champagne.
- The combination of speed and expanding gases is powerful enough to force the rising rock mixture to explode through the surface.
- The expansion of gases and the speed of delivery are important for the survival of the diamonds.
- This combination would happen if they were exposed to high temperature along with decreased pressure for a long period.

Click to display next slide



As kimberlite blasts through the crust, it creates a deep carrot-shaped formation called a *pipe*.

The kimberlite—or lamproite—doesn't flow out of the pipe like lava from a volcano.

It solidifies while it's still very hot, so by the time it reaches the surface it has changed from liquid to solid.

The explosion is a mixture of solid rock, ash, and gases.

After the material explodes through the overlying rock, most of it falls back into its pipe, along with the diamonds it's carrying.

What's left is a deep diamond-bearing pipe, topped off by a shallow crater.

It might be millions of years before someone discovers it and begins building a mine.

***Click to display next slide**

Kimberlites are widespread—in the 1990s, there were about 6,000 of them known worldwide.

But fewer than 1,000 of them contained any diamonds.

Of those, only about 50 had enough diamonds to be economic, and only about 20 are still being mined today.

With statistics like that, you can see why diamonds are considered rare and precious.

So we've learned what diamonds are, how they form, and how they reach the surface.
But how can we recognize diamond when searching for these locations?

PRESENTER NOTE: This is an aerial image of the Diavik diamond mining operation in Northern Canada. There are four kimberlite pipes in the mining complex.

Click to display next slide

PRESENTER NOTE: This slide has multiple images. When prompted in these presenter notes, click in the center of the slide to display the additional image(s).

When you think of what a diamond looks like, you probably picture a sparkling, shiny, colorless stone, like this one. ***Click to display next image***
Not all diamonds are the same. In fact, most diamonds lack the qualities to be considered for use in jewelry.
Diamonds are categorized broadly into three categories:
Gem quality
Near gem quality
Industrial quality

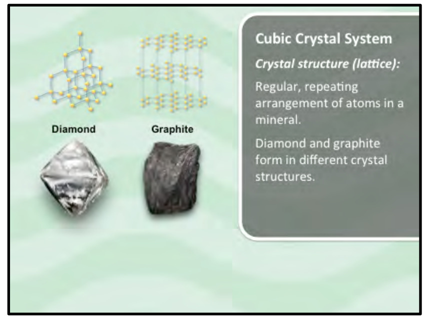
The reality is, a very small portion of the earth's diamonds are considered to be GEM QUALITY.

Click to display next slide

PRESENTER NOTE: This slide has multiple images. When prompted in these presenter notes, click in the center of the slide to display the additional image(s).

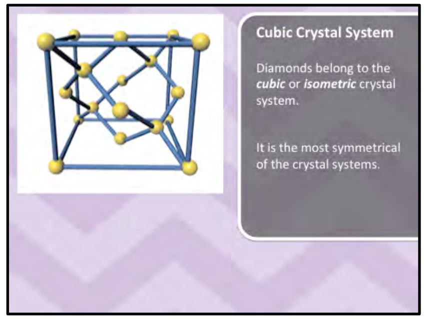
About 15% of all diamonds pulled from the earth are gem quality.
39% are considered near gem quality.
46% are industrial quality.

IMAGE 1: These rough diamonds are from Brazil. The large rough diamond in the center is 7.46 carats (ct.).



Earlier, we mentioned that diamond and graphite are both made of carbon.
We also learned that the arrangement of the atoms affects the HARDNESS of the material.

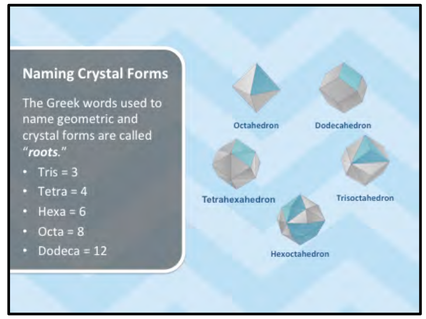
Regular, repeating patterns of atoms form an internal arrangement called the *crystal structure* or *crystal lattice*.
Crystal structure greatly affects a mineral's characteristics.
The diamonds in a million-dollar tiara and the graphite in a 10-cent pencil are made of exactly the same element—carbon—and the same kinds of atoms.
Diamond and graphite form in different crystal structures.



PRESENTER NOTE: This slide features an animation that will play automatically.

Mineralogists and gemologists classify crystals by their geometric properties and the symmetry of their internal crystal structures.
The categories are called *crystal systems*.
Diamonds belong to the cubic system, also called the isometric system.
The cubic system is the most symmetrical: Well-formed cubic crystals are evenly proportioned and balanced.

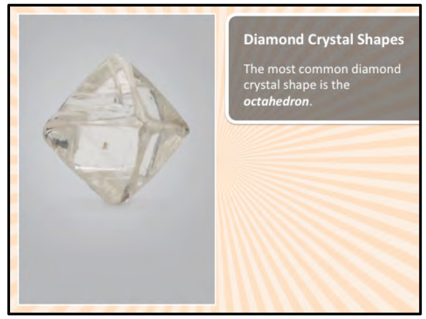
[Instructor note: Animation plays automatically.]



Mathematicians and mineralogists created the names for geometric and crystal forms by using the Greek words for numbers and shapes.

The Greek words are called "roots."
Once you recognize the Greek roots, you'll be able to recognize the words made from them.
Add the base word "hedron," which means "face."

Click to display next slide



The basic crystal shape of a mineral is called its *habit*.
The habit of gem diamond is most often the *octahedron*.

On the previous slide, we learned that “octa” means “eight” and “hedron” means “faces.”
So we know that the octahedron is a form with eight triangular faces.

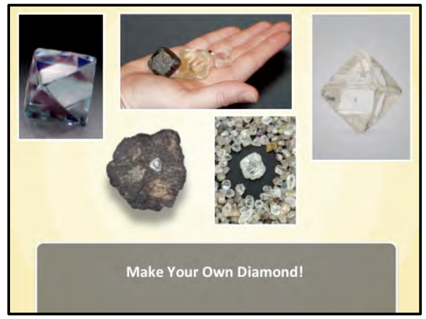
Click to display next slide

Perfect diamond octahedrons are among the most striking of all mineral crystals.

The industry refers to a well-shaped, transparent, octahedral diamond crystal with sharp, square edges as a *glassie.*

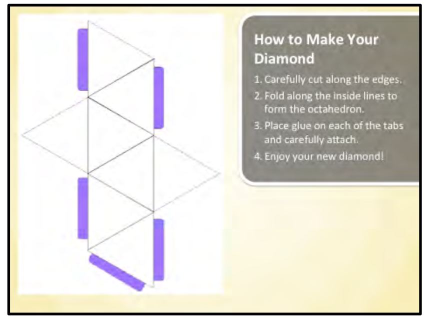
The most common habit of gem diamond is the octahedron, but perfectly shaped octahedral rough is rare.

***Click to display next slide**



So who wants to make their own diamond?
We're going to do an activity where you can construct an octahedron!

Remember that an octahedron has EIGHT FACES – and is the most common diamond crystal shape.



PRESENTER NOTE:
Distribute the printed sheets.
Distribute glue to each table.
Feel free to demonstrate how to fold the octahedron, or simply walk around the room and assist as necessary.

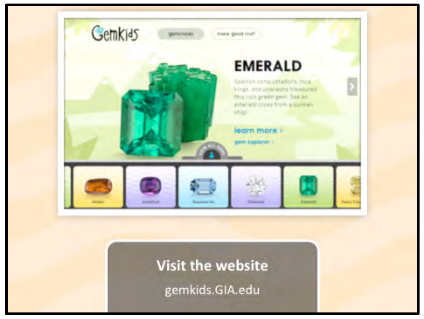
If some finish more quickly than others, you can give them another, or you can give them one of the more difficult dodecahedron forms to try.

GIA is both a school and a laboratory.
People come from all over the world to study at GIA.
Established in 1931, GIA is the world's foremost authority on diamonds, colored stones, and pearls.
A public benefit, nonprofit institute, GIA is the leading source of knowledge, standards, and education in gems and jewelry.

PRESENTER NOTE: This slide contains 3 images. See below for information about each image:

IMAGE 1: Jewelry manufacturing arts courses teach how to make and repair jewelry, using both traditional and computer software design. ***Click to show next image**
IMAGE 2: GIA also teaches the science of gemology and gem identification, including how and where minerals grow, and how to identify a stone's internal features that we call inclusions. ***Click to show next image**
IMAGE 3: The GIA laboratory has a research department where they have the difficult task of identifying all different types of gem material and some materials that are not even gems, e.g., glass or plastic.
This is Dr. James Shigley. He is one of GIA's top researchers.

***Click to go to next slide**



Students, parents, and teachers have easy access to interactive gemology and geology education through GIA's GemKids website.

The website features a Gem Explorer which highlights popular gems and provides fun facts about color, history and lore, name origin, and much more!
There is also a Gem Glossary which offers descriptions and definitions for a wide range of gemological and geological terms, including pronunciations!

When you have a chance, enter gemkids.GIA.edu in your web browser and check it out!