

Do Now (2 minutes)

3/19

K

What I know about
Metamorphic Rocks

1.

2.

3.

W

What I want to find out
about Metamorphic Rocks

1.

2.

3.

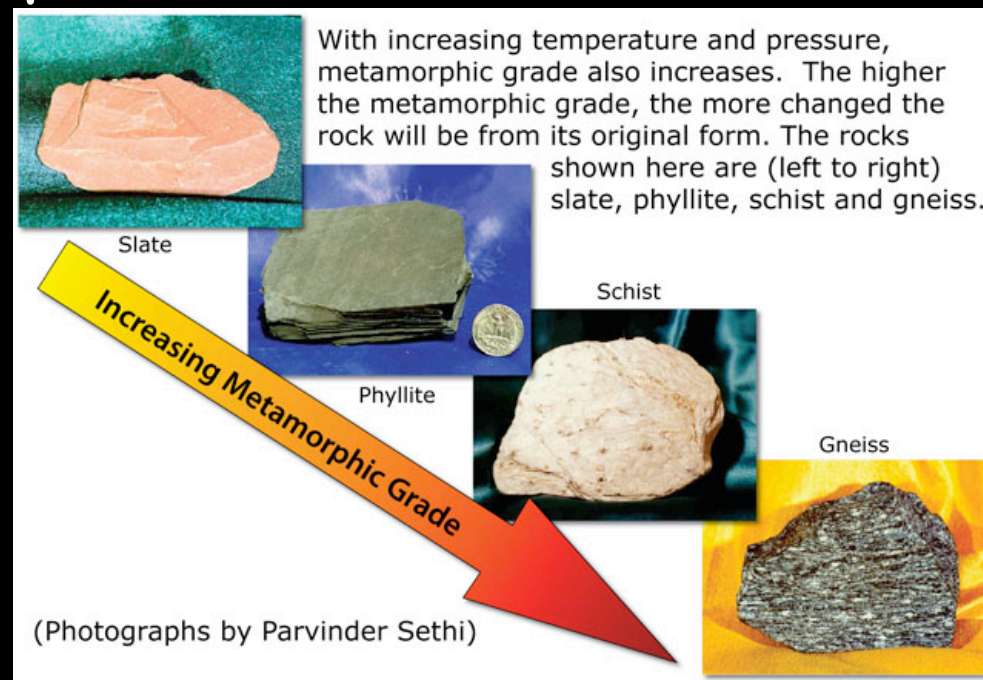
2:00

Metamorphic Rocks

What are metamorphic rocks and how do we classify them?

Metamorphic Rocks

- Metamorphic Rocks - parent rocks that have been altered by increases in temperature and pressure
- Parent Rock - preexisting rock from which metamorphic rocks are formed



Metamorphic Rocks

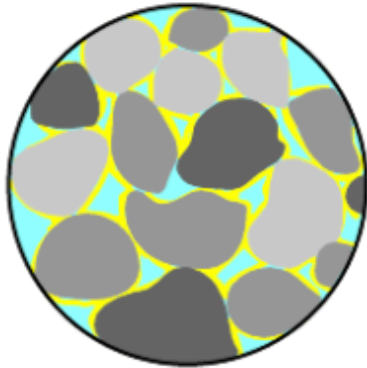
- Heat
- Rock expands when heated causing the atoms to break apart and move freely
- As temperature decreases atoms join with other atoms to form different compounds
- The result is a structural and chemical change
- They do not melt, they _____
when exposed to heat

Metamorphic Rocks

Heat

protolith

non-foliated metamorphic rock



5X

sandstone (*sed. rock*)
quartz sand grains
cement (silica)
void spaces



5X

quartzite
intergrown quartz crystals
(no void spaces)

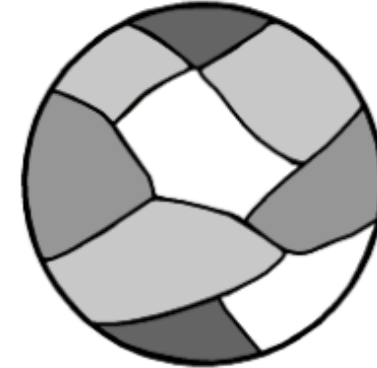
protolith

non-foliated metamorphic rock



5X

limestone (*sed. rock*)
shell fragments (calcite)
cement (calcite)
void spaces



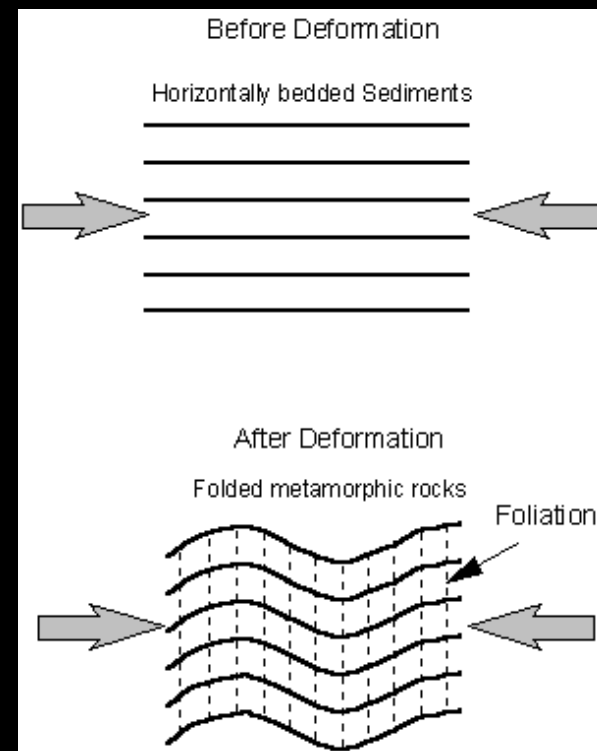
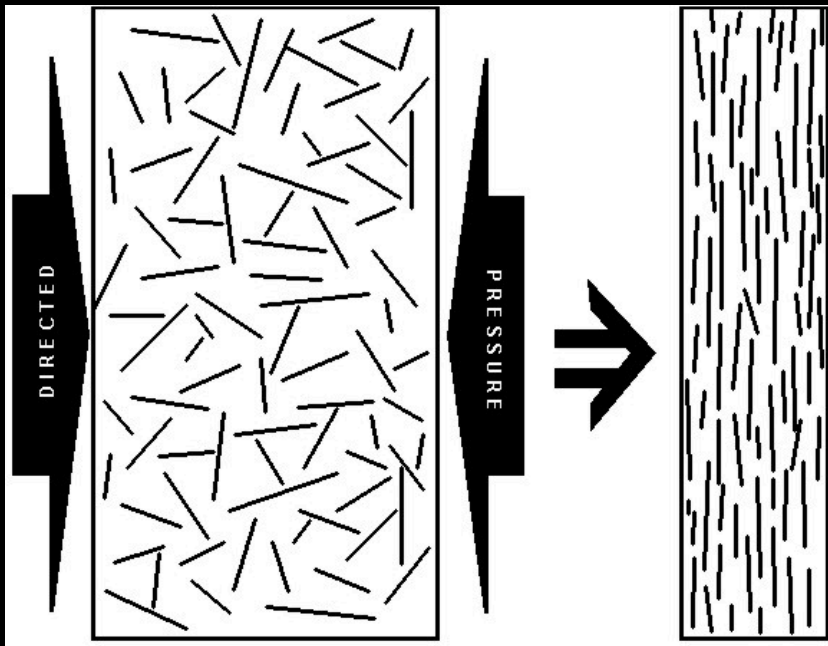
5X

marble
intergrown calcite crystals
(no void spaces)

Metamorphic Rocks

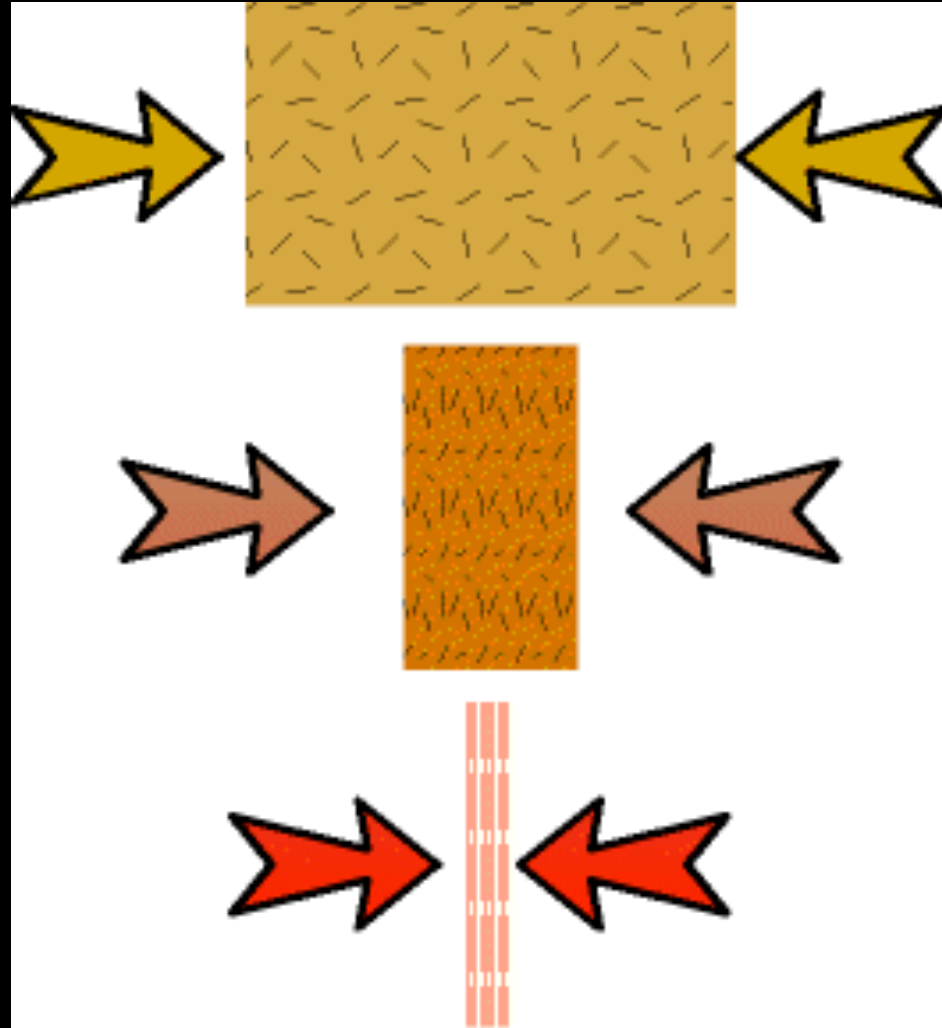
Pressure

- Under extreme pressure at great depths inside the Earth, atoms bonds are broken and rearranged into a denser and more compact structure



Metamorphic Rocks

Pressure



Metamorphic Rocks

Methods to classify metamorphic rocks:



Metamorphic Rocks

Earth Science Reference Tables

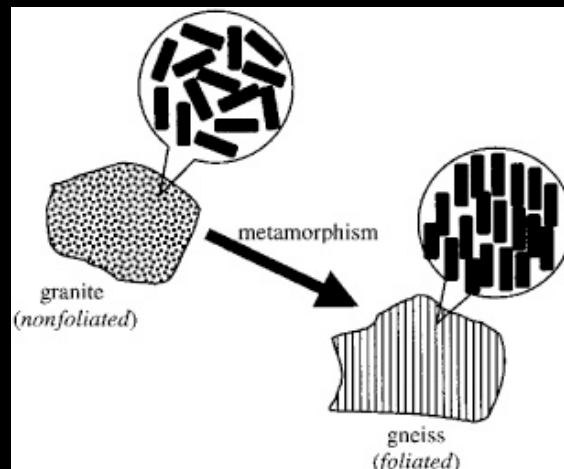
Scheme for Metamorphic Rock Identification

TEXTURE		GRAIN SIZE	COMPOSITION	TYPE OF METAMORPHISM	COMMENTS	ROCK NAME	MAP SYMBOL
FOLIATED	MINERAL ALIGNMENT	Fine	MICA QUARTZ FELDSPAR AMPHIBOLE GARNET PYROXENE	Regional (Heat and pressure increases)	Low-grade metamorphism of shale	Slate	
		Fine to medium			Foliation surfaces shiny from microscopic mica crystals	Phyllite	
		Medium to coarse			Platy mica crystals visible from metamorphism of clay or feldspars	Schist	
	BAND-ING	High-grade metamorphism; mineral types segregated into bands			Gneiss		
NONFOLIATED	Fine	Carbon	Regional	Metamorphism of bituminous coal	Anthracite coal		
	Fine	Various minerals	Contact (heat)	Various rocks changed by heat from nearby magma/lava	Hornfels		
	Fine to coarse	Quartz	Regional or contact	Metamorphism of quartz sandstone	Quartzite		
		Calcite and/or dolomite		Metamorphism of limestone or dolostone	Marble		
	Coarse	Various minerals		Pebbles may be distorted or stretched	Metaconglomerate		

Metamorphic Rocks

1. Texture

- Texture – the general appearance of the rock
- Foliation – when minerals rearrange in flat layers due to extreme pressure
- Banding – type of foliation where pressure separates minerals into alternating light and dark layers



Metamorphic Rocks

Gneiss has banded foliation



Granite
(Igneous)



Gneiss

Metamorphic Rocks

Gneiss has banded foliation



Metamorphic Rocks

Slate has banded foliation



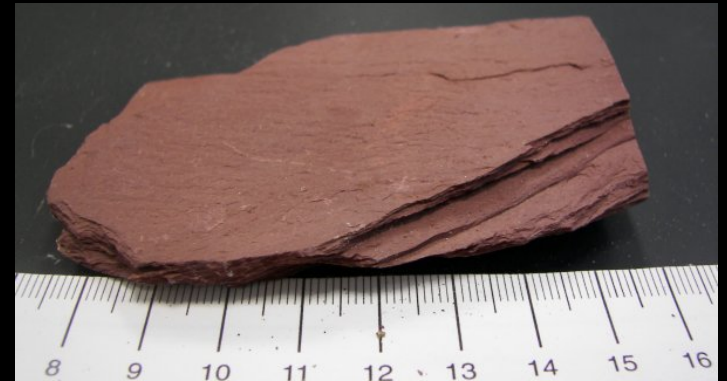
Shale
(Sedimentary)



Slate

Metamorphic Rocks

Slate



Metamorphic Rocks

Slate



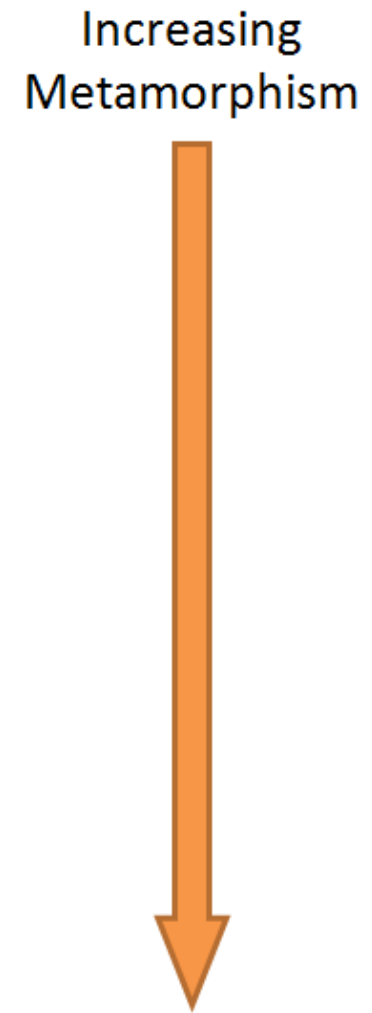
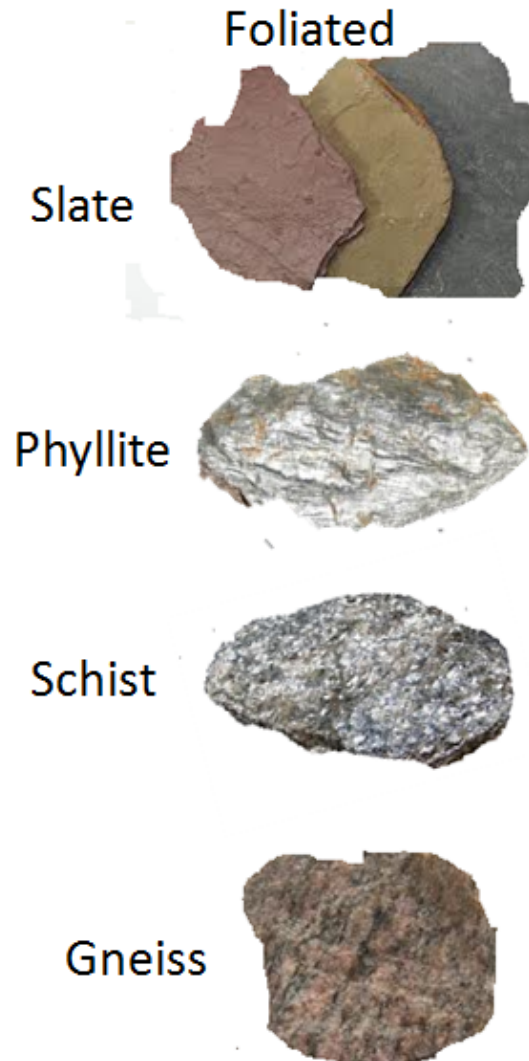
Metamorphic Rocks



Schist has
banded foliation



Metamorphic Rocks



Metamorphic Rocks

Texture

- Non-foliated - when minerals rearrange and change form, but do not form layers

Sandstone



Quartzite



Quartzite has no foliation (layers)

Metamorphic Rocks

Quartzite



Metamorphic Rocks

Texture

Marble has no foliation (layers)

Limestone



Marble



Metamorphic Rocks

Marble



Unfinished Marble

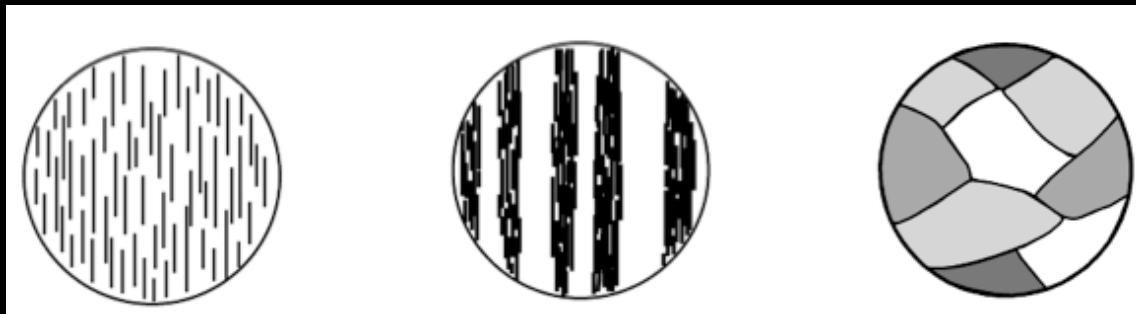


Finished Marble

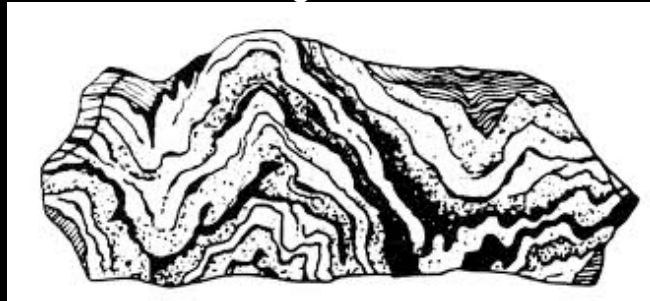


Metamorphic Rocks

Foliated, Banding or Non Foliated?



Metamorphic Rocks



Distorted Structure



Curving and folding of the foliation (bands)

Metamorphic Rocks

Earth Science Reference Tables

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	Coarse	Various minerals		Pebbles may be distorted or stretched	Metaconglomerate		

Metamorphic Rocks

2. Grain Size

- Grain Size - size of the individual grains in the rock



Metamorphic Rocks

2. Grain Size



**Medium
Grained Schist**



**Coarse Grained
Metaconglomerate**

Metamorphic Rocks

Earth Science Reference Tables

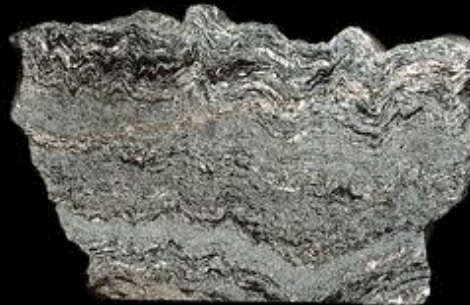
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Metamorphic Rocks

3. Composition

- Composition – the minerals that make up the rock



Metamorphic Rocks

3. Composition



Composition: Calcite
Rock: Marble



Composition: Mica
Rock: Slate

Metamorphic Rocks

Earth Science Reference Tables

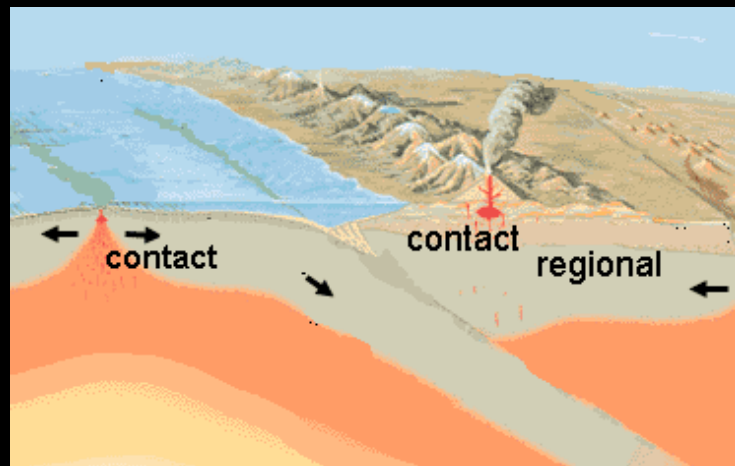
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Metamorphic Rocks

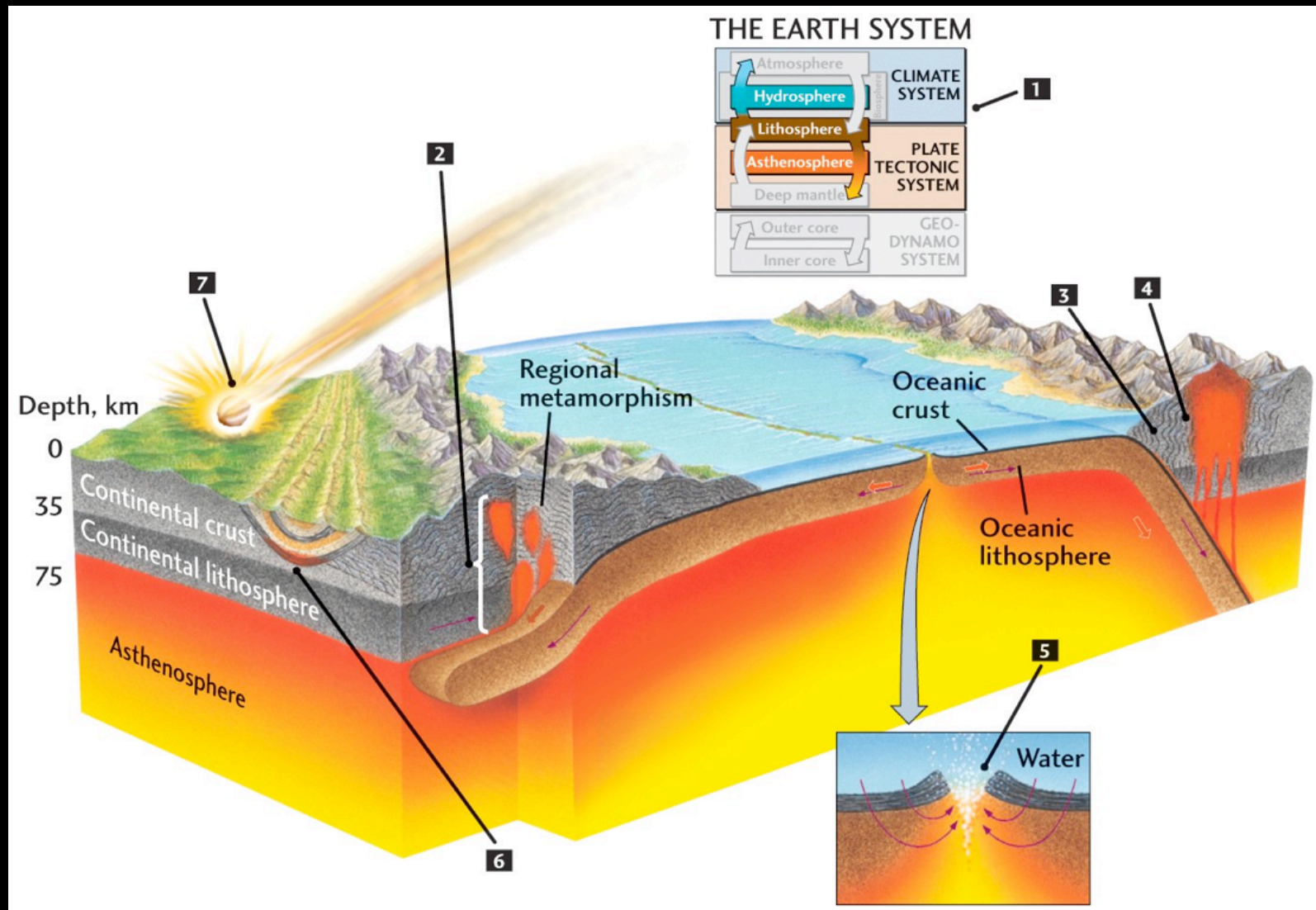
4. Type of Metamorphism

- Regional Metamorphism - process in which metamorphic rocks are formed over large areas due to temperature and pressure increases
 - Most metamorphic rocks form regionally under a mountain or deep inside the Earth



Metamorphic Rocks

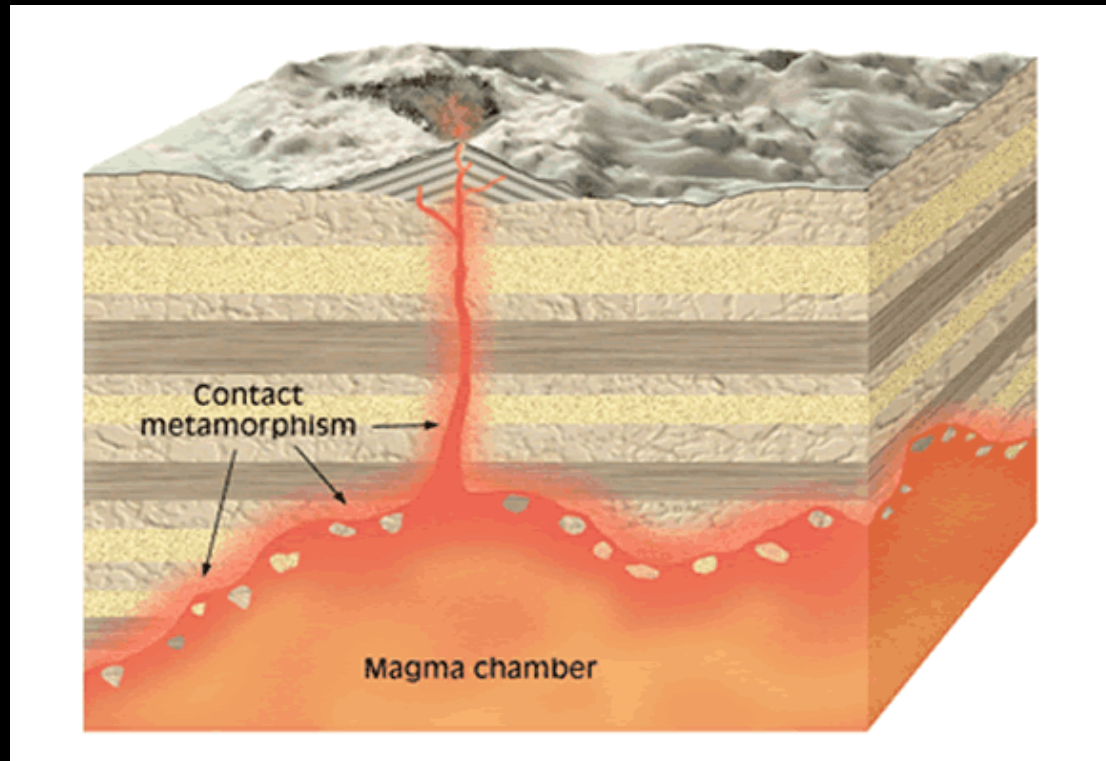
Type of Metamorphism



Metamorphic Rocks

Type of Metamorphism

- Contact Metamorphism - process in which preexisting rock changes when heat from magma or lava rearranges the minerals



Metamorphic Rocks

Earth Science Reference Tables

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Metamorphic Rocks

- Earth Science Reference Tables
- Texture
- Grain Size
- Composition
- Map Symbol
- Type of Metamorphism

Metamorphic Rocks

Review

▶ Inside the earth, existing rocks may be exposed to

_____.

▶ This heat and pressure _____ the rocks, changing them into something new.

▶ The result is a

_____.

▶ _____ occurs when rocks are burned (but not melted) by nearby magma.

▶ _____ occurs when the Earth's crust shifts, causing intense pressure, squeezing rocks.

METAMORPHIC ROCKS

Foliated

Nonfoliated



Gneiss

Intense pressure of regional metamorphism causes the minerals to align. The result is a **banded appearance**.

*HA! IGNEOUS ERODES
TO SEDIMENTARY!*

*NO NO NO. IGNEOUS
MELTS METAMORPHIC!*

*WHAT?! METAMORPHIC
ALTERS SEDIMENTARY!*



*THE UNDERSTANDABLY LESS POPULAR
GEOLOGY VERSION OF ROCK-PAPER-SCISSORS,
ROCK-ROCK-ROCK.*

Metamorphic Rocks

I know a rock is metamorphic if:

1. I see bands of light and dark minerals
2. I see distorted / folded, foliated structure
3. I see foliated “layers” of platy, flakey minerals like mica
4. I see a very hard, resistant, uniform, and weathered quartzite boulder

Metamorphic Rocks

Lab 3: Classifying Metamorphic Rocks



1. Red Slate



2. Grey Slate



3. Phyllite



4. Schist



5. Garnetiferous Schist

6. Gneiss



7. Anthracite Coal



8. Hornfels



9. Quartzite



10. Marble



11. Metaconglomerate



Use Pencil, Due at the end of class!

Metamorphic Rock Quiz Friday

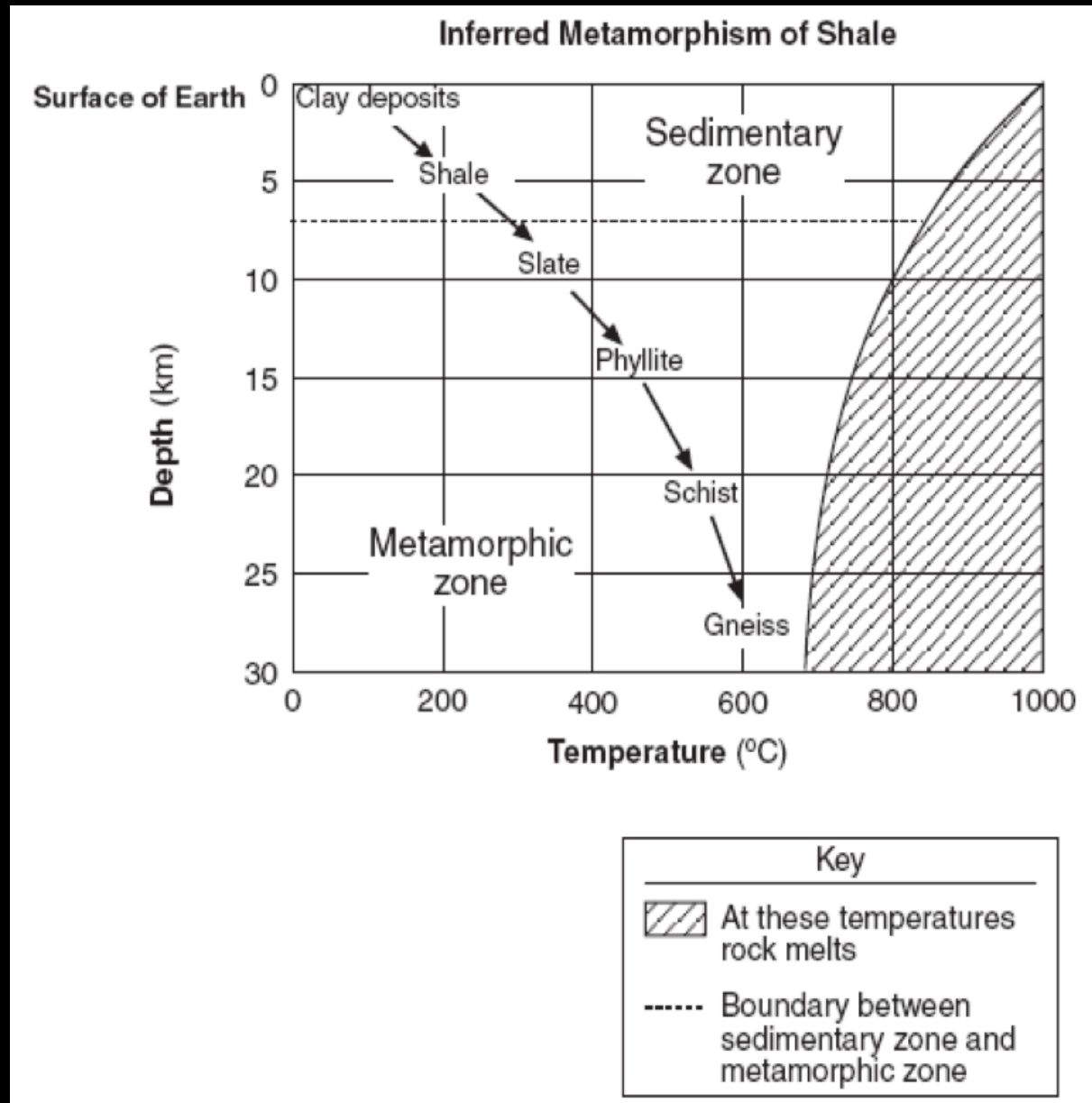
****Absolutely, NO FOOD OR DRINK****

Finish Homework Packet when done!

Metamorphic Rocks

Distorted layers of platy minerals and/or alternating bands of light and dark minerals and/or interlocking calcite x-tals and/or dense, hard quartz	Smooth, fine, looks like shale but is more dense, solid Shows 'slaty cleavage'	Greyish Black	SLATE
	Shiny surfaces, distorted 'layers' visible on sides	Grey/Greenish/Black	PHYLLITE
	Individual mica x-tals visible, shiny on surface, distorted 'layers' visible on sides	Silvery gray, brown	SCHIST
	Clear banding of light and dark colored minerals. Very 'solid'	White to Black	GNEISS
	Interlocking x-tals of calcite Looks 'frosty' or 'sugary'	Usually light	MARBLE
	<i>Very</i> hard, resistant. Weathered surfaces often very smooth, fractured surfaces very fine grained	Variable	QUARTZITE

Metamorphic Rocks



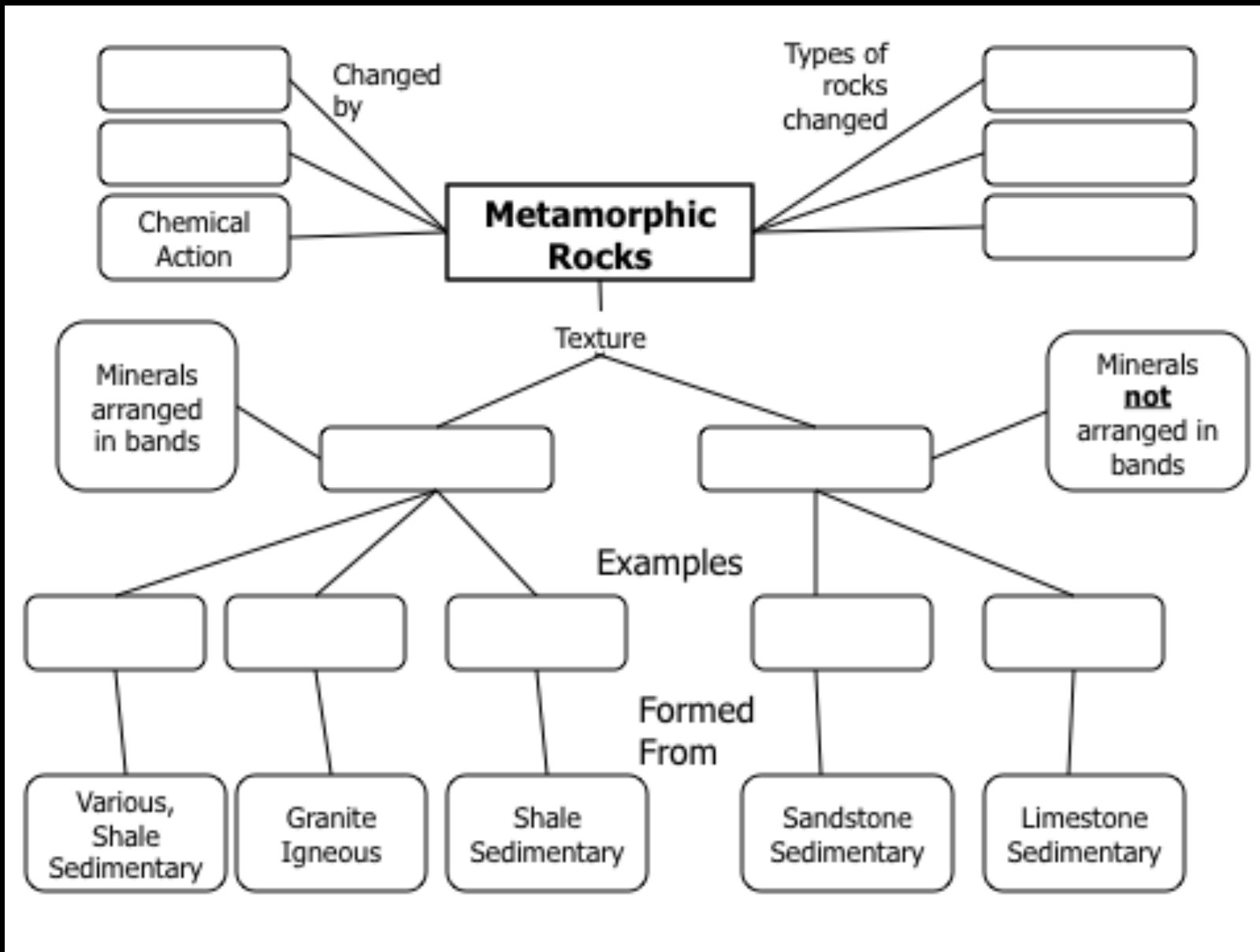
Metamorphic Rocks

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Metamorphic Rocks



Metamorphic Rocks

