<@Spauwe>COLOUR

<@Spauwe> In

<@Spauwe> GEMSTONES

<@Spauwe> to start of:

<@Spauwe> what is colour?

<@Spauwe> 1. A perception of certain electromagnetic energy by our (limited) ability

<@Spauwe> we use our eyes and brain to interpret incoming energy

<@Spauwe> and in, most cases, when we see colour the material displaying it has absorbed certain wavelengths from a full spectrum

<@Spauwe> (700nm to 400nm long wavelengths of electromagnetic waves)

<@Spauwe> 700 nm being what colour?

<Crystal> red

<@Spauwe> and 400 nm being?

<Crystal> violet

<@Spauwe> wavelengths shorter than 400 nm are called?

<Crystal> ultraviolet

<@Spauwe> and longer than 700?

<Crystal> infrared

<@Spauwe> cool

<Crystal> :)

<@Spauwe> now onto our brain and eyes

<@Spauwe> do you have a loupe handy?

<DragonStek> yes

<@Spauwe> grab it

<@Spauwe> got it?

<Crystal> ok

<DragonStek> yes

<@Spauwe> now in order to prove that we see unreal things look at the white on your screen through your loupe

<@Spauwe> what is it made up of?

<Crystal> how close are we supposed to be?

<DragonStek> little squares

<@Spauwe> close enough to see the squares

<@Spauwe> what colour are they?

<Crystal> got it

]<@Spauwe> a 10x will do it

<DragonStek> red yellow blue

<Crystal> multi

<@Spauwe> just three colours...

<@Spauwe> blue-green and red

<@Spauwe> correction: blue - green -red

<DragonStek> i see yellow

<@Spauwe> a simplification of the spectrum that makes up white light

<Crystal> that's not what Dragon saw

<DragonStek> yellow red blue

<@Spauwe> dragon is colourblind then... ghehe

<Crystal> lol

<DragonStek> ok

<@Spauwe> the java applet may have a different tint to it

<@Spauwe> now

<@Spauwe> check out something blue on the screen

<DragonStek> just blue and red

<DragonStek> opps my spacer is sticking

<@Spauwe> you'll find that the red is substituted by black

<@Spauwe> it's 'turned off'

<@Spauwe> red?

<@Spauwe> jeez

<DragonStek> ok thats black

<DragonStek> at times I can see red n blue

<DragonStek> and i can see black and blue

<@Spauwe> black and blue coincides with what I see

<@Spauwe> crystal?

<Crystal> my monitor is so far away I only looked at the white and came back to my keyboard

<@Spauwe> ghehe

<@Spauwe> ok

<@Spauwe> but you may get my drift

<Crystal> yes

<@Spauwe> in order to let us see white

<@Spauwe> the three most apparent colours of the spectrum are emitted

<@Spauwe> then to let us see blue we are bombarded with just blue and green/yellow

<@Spauwe> the red is switched of

<@Spauwe> instantly our eyes and brain convert that to blue

<@Spauwe> now onto gemstones

<@Spauwe> gemstones do the same thing

<@Spauwe> they 'take away' certain colours of the spectrum

<@Spauwe> and make us see a colour

<@Spauwe> The main question is gonna be

<@Spauwe> HOW do they take away certain colours?

<@Spauwe> there's 5 major causes of colours

<@Spauwe> today the first:

<@Spauwe> transition elements

<@Spauwe> dragon you read up on it today

<@Spauwe> can you name 'm?

<@Spauwe> there's 8 of 'm

<DragonStek> yes

<@Spauwe> bring 'm on

<DragonStek> iron , copper nickel manganese chromium , zinc,

<Crystal> ti, va, cr, mn, fe, cu and what's nickle? - not zinc listed

<@Spauwe> Zinc?

<DragonStek> nopps your right

<DragonStek> ti v cr mn fe co ni cu

<Crystal> duh, ni :)

<@Spauwe> Ti, V, Cr, Mn, Fe, Co, Ni, Cu

<@Spauwe> ghehe

<Crystal> I was lazy and didn't capitalize

<Crystal> and I had vanadium wrong :)

<@Spauwe> details...

<@Spauwe> bugger 'm

<Crystal> heh

<@Spauwe> now what happens when these elements occur in a crystal as dispersed IONS

<@Spauwe> ?

<@Spauwe> and are hit by white light?

<@Spauwe> (electromagnetic radiation)

<DragonStek> the color that wasnt absorbed

<Crystal> they cause color

<@Spauwe> their electrons get excited by certain frequencies/wavelengths

<@Spauwe> Brian is telling us the details on this these weeks

<@Spauwe> which I find very useful in understanding it all

<@Spauwe> but back to it

<@Spauwe> the energy that is used by the electron to get excited is taken from the residual light

<@Spauwe> causing that little square to be 'turned off'

<@Spauwe> and causing the perception of colour

<@Spauwe> by our stupid eyes and brain

<@Spauwe> we don't really see all that well

<@Spauwe> but ey, it works for me

<Crystal> heh

<DragonStek> hehe no choice

<@Spauwe> exactly

<@Spauwe> neither has that electron

<@Spauwe> if the right wavelength hits it, it gets excited

<@Spauwe> kind of like saying the right thing to doos

<DragonStek> lol

<@Spauwe> but after the chat doos goes back to his ground state

<Crystal> lol

<@Spauwe> so does the electron

<@Spauwe> the energy that was used to cause the excitement is now released again

<@Spauwe> how?

<Crystal> as heat

<@Spauwe> usually heat yes

<@Spauwe> and sometimes as?

[22:58] <DragonStek> color

<@Spauwe> better: light

<Crystal> one or the other

<@Spauwe> colour implies that we pick it up

<@Spauwe> light may be off the limits

<DragonStek> ok i got yeah

<Spauwe> Ruby for example displays a red unseen in many other red gems

<@Spauwe> this is caused my luminescence

<@Spauwe> (the emitting of light when the electron returns to its original state)

<@Spauwe> but most of this luminescence is in the infra red

<@Spauwe> but we half pick it up as something special

<@Spauwe> not every human is the same though

<@Spauwe> we don't all shut off at 700nm

<@Spauwe> some see 710, some see 695

<@Spauwe> same at the other side of the spectrum

<@Spauwe> Now it's not as straight forward as: when iron is present the colour will be blue

<@Spauwe> there's several factors that affect the percepted colour

<@Spauwe> 1

<@Spauwe> the element itself

<@Spauwe> Like Fe in peridot: green

<@Spauwe> Cu in azurite: blue

<@Spauwe> Cr in Ruby: red

<@Spauwe> but

<@Spauwe> it fully depends on valency as well

<@Spauwe> valency being the amount of electrons missing or being extra

<@Spauwe> Fe2+ causes blue in beryl

<@Spauwe> but Fe3+ causes yellow in beryl

<@Spauwe> A side question:

] <@Spauwe> where is this valency dependancy used in gem treatments?

<Crystal> by adding certain elements they can cause color by it adding an electron to an unpaired one

<@Spauwe> hmmz

<Crystal> uhh, maybe not...

<@Spauwe> try multiple choice:

<Crystal> better for me :)

<@Spauwe> A) diffusion

<@Spauwe> B) heat treatment

<@Spauwe> C) dying

<@Spauwe> D) coating

<DragonStek> heat treatment

<@Spauwe> E) none of the above

<Crystal> B

<@Spauwe> exactly

<@Spauwe> let's take aquamarine as an example

<@Spauwe> in nature it's usually found as a greenish blue stone

<@Spauwe> hence the name

<@Spauwe> blue green like the Mediterranean Sea water

<@Spauwe> now the blue is caused by the Fe2+

<@Spauwe> the green by the Fe3+

<@Spauwe> by heating the material we allow the Fe3+ to gain an electron

<@Spauwe> (don't ask me where it comes from)

<@Spauwe> ;)

<Crystal> it's a secret

<DragonStek> hehe i had to erase that

<Crystal> lol

<@Spauwe> but the green is lost and we end up with a nice blue

<@Spauwe> which nowadays is considered more valuable

<@Spauwe> stupid humans again: can't be satisfied with what they got

<@Spauwe> but ah well if it's feeding the kids ey...

<@Spauwe> so recap

<@Spauwe> there's 8 elements that will have their electrons excited by light waves that we can see

<@Spauwe> (others get excited as well but will not affect our perception of colour)

<@Spauwe> and the valency of those elements strongly affect what light wave will be absorbed

<@Spauwe> (again Brian is gonna show us the light on this)\

<@Spauwe> Then as a third factor: environment

<@Spauwe> an example to start with:

<@Spauwe> Fe2+ (again) in peridot causes us to see green

<@Spauwe> but in almandine garnet it will cause us to see red

<@Spauwe> this is due to the surrounding atoms

<@Spauwe> in this case: the distance and number of oxygen atoms around it

<@Spauwe> any other examples?

<DragonStek> Mn in beryl

<@Spauwe> causing?

<DragonStek> 2+MN = PINK

<DragonStek> Mn 3+= red

<@Spauwe> isn't that the valency thing?

<DragonStek> yes your right sorry

<@Spauwe> I was thinking of Cr3+

<@Spauwe> causing red in what? and green in what?

<Crystal> ruby, emerald + alexandrite

<DragonStek> beryl Cr3+ green

<DragonStek> yes

<@Spauwe> and corundum red

<@Spauwe> indeed

<@Spauwe> now there's something with that Cr that plays tricks with us

<@Spauwe> when you look through your spectroscope you'll find very similar spectra in emerald and ruby

<@Spauwe> but evolution has caused us to be very good in seeing slight differences in the green part of the spectrum

<@Spauwe> so it's easily tipped over from red to green

<@Spauwe> to that evolution thing: I made that up myself

<@Spauwe> I can see that the apes that saw that slight colour difference of the bush where the saber tooth was hiding reproduced a bit longer and better than the ones that didn't

<Crystal> heh

<@Spauwe> Since Cr3+ absorbs those parts of the spectrum that can quite easily be interpreted one way or the other the colour change of alexandrite is possible as well

<@Spauwe> incandescant light contains a higher amount of yellow and red than sunlight which contains a higher amount of blue - green

<@Spauwe> causing the stone to appear red in incandescent light and green in sunlight

<@Spauwe> it's a combination of our perception and the incident light

<@Spauwe> Now...

<@Spauwe> is there anything that you want to ask?

<Crystal> nope, you're doing great so far :)

<DragonStek> no im ok

<@Spauwe> and ready for more?

<Crystal> sure

<DragonStek> ok

<@Spauwe> The second cause of colour is called charge transfer

<@Spauwe> this is caused by electrons not just getting excited while orbiting their own nucleus

<@Spauwe> but by electrons getting excited that much that they 'jump' nuclei back and forth

<@Spauwe> same idea

<@Spauwe> incoming light causes the electron to get excited but it leaves orbit, circles another nucleus and then returns

<@Spauwe> over and over again

<@Spauwe> There's three sorts of charge transfers:

<@Spauwe> metal to metal transfers

<@Spauwe> metal to oxygen transfer

<@Spauwe> and charge transfers without metal ions

<@Spauwe> let's explain the first one by my favorite stone:

<@Spauwe> blue sapphire

<@Spauwe> caused by a charge transfer between Fe2+ and Ti 4+

<@Spauwe> if Fe2+ loses an electron on Ti4+

<@Spauwe> what do we get?

<@Spauwe> electron is 1-

<@Spauwe> multiple choice

<@Spauwe> a)fe+ and Ti3+

<@Spauwe> b) fe3+ and Ti5+

<@Spauwe> c) fe3+ and Ti3+

<@Spauwe> d)Fe+ and Ti3+

<Crystal> isn't that the same as A??

<DragonStek> hehe

<@Spauwe> Fe 2+ means it lacks two electrons

<Crystal> where's the 2+?

<@Spauwe> Ti4+ means it lacks four

<Crystal> I only see 3+ and just Fe

<@Spauwe> if the Fe lacking 2 electrons loses another it becomes 3+

<Crystal> I'm asking about the a and d choices

<@Spauwe> 3+

<@Spauwe> just made them up and forgot I listed that same option under d

<Crystal> oh, ok, thanks :)

<@Spauwe> now if the Ti lacking 4 electrons gets one from the iron

<@Spauwe> it'll become.....

<@Spauwe> ?

<DragonStek> 3

<@Spauwe> exactly

<@Spauwe> so we get a charge transfer from fe2+ and Ti4+ to Fe3+ and Ti3+ (answer c)

<@Spauwe> you see that?

<DragonStek> yes

<@Spauwe> it's confusing with the +/- stuff going on

<@Spauwe> but anyway

<@Spauwe> the energy that is needed for this charge transfer will not reach our eyes

<@Spauwe> we call it to be absorbed

<@Spauwe> and in this case we 'see' blue

<DragonStek> my favorite color

<@Spauwe> another example is iolite

<@Spauwe> but in this case two of the same elements with different valencies are exchanging electrons

<@Spauwe> Fe2+ and Fe3+ are the cause

<@Spauwe> they throw an electron back and forth using red light to do it

<@Spauwe> resulting in our perception of blue

<DragonStek> so they either take or they share

<@Spauwe> Onto the next sort of charge transfer (if the above bit is clear)

<@Spauwe> please ask if I'm not clear

<DragonStek> no i got it

<@Spauwe> when I'm not clear

<Crystal> I have to go soon

<@Spauwe> ok... we'll hit the pin for today and do charge transfer next week