Episode 14

How Flowers Bloom

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News on television: Playing against South Africa yesterday India piled up a huge total. South Africa need 300 runs to win and they have eight wickets left. With this we come to the end of our Sports Bulletin. Now for the temperatures in the four metros: Delhi—Maximum 15^0C, Minimum 5^0C; Mumbai—Maximum 30^0C, Minimum 22^0C; Kolkata—Maximum 26^0C, Minimum 20^0C; Chennai—Maximum 32^0C, Minimum 22^0C. With this we come to the end of this bulletin. Namaskar.

Vasudha	(shouts) Srishti, please come and help me. Breakfast is ready.
Srishti	(shouting) Coming, mummy.
Vasudha	Hold this plate carefully, it is hot. Give this to papa.
Srishti	Okay.
Manav	Papa, what does this maximum and minimum temperature mean?
Suryaprakash	Manav, do you know at what time the sun is right above our head?
Manav	Yes papa, about 12 'O clock in the afternoon.
Suryaprakash	Yes, correct. At this time through the process of radiation the sun's rays fall directly on the earth.
Manav	So, at this time wherever the sun's rays fall there the temperature is the maximum?
Suryaprakash	Ideally it should be like that. But in the afternoon between 2 to 3 the temperature is the maximum because by that time the earth has become hot and starts radiating energy. Besides, the sun is also heating up the earth.
Manav	Then what about minimum temperature?
Suryaprakash	This temperature is between 5 and 6 in the morning, that is, just when the sun is about to rise or when it is at the horizon. Okay, where is today's paper?
Srishti	Papa, read the newspaper later. Breakfast is ready.
Vasudha	Manav get your breakfast plate also.

Vasudha	(brings breakfast) Take this Manav, be careful there are some parathas for Vivek also.
Manav	Ohh! (makes a sound)
Vivek	What happened to Manav.
Manav	Mummy gave me a hot plate.
Vivek	Did you burn your hand?
Manav	No, bhaiya, I did not burn my hand. But bhaiya, the paratha was hot, but how did the plate get hot?
Vasudha	Manav what happened?
Srishti	Mummy, Manav touched a hot paratha.
Manav	Mummy, not the paratha but the plate. You deliberately gave me a hot plate.
Vivek	It's okay, Manav. The paratha was hot but the cold steel plate also became hot when it came into contact with the paratha.
Manav	How did that happen?
Vivek	When a hot object comes into contact with a cold object, the atoms in the cold object start moving fast and collide with each other leading to transfer of energy from one atom to the other. Such objects are called heat conductors and the process is called conduction.
Vasudha	Okay, finish your breakfast fast.
Suryaprakash	Please give me one more paratha.
Manav	Papa, be careful, you also have a conductor, lest it transfer its energy to you.
Suryaprakash	(laughs) What conductor? Oh, the hot plate!
Vivek	Yes papa, he is talking about those objects in which energy flows.
Suryaprakash	Oh, I see. Okay let's finish our breakfast.
Manav	Mummy, give me more curd.
Vasudha	It is better if you don't eat curd because it is winter and also since yesterday you have a cold.

Manav	I don't know how long the winter will last. Papa what are summer and winter?
Suryaprakash	Son, on the earth wherever it is summer the temperature of the land is high and less at places where there is winter.
Srishti	But papa, I read that the sun always provides energy with the same intensity.
Manav	Does that mean in summers the sun gives out more energy and in winters less?
Suryaprakash	(laughing) No Manav, it is not like that. While the earth is revolving around the earth it is also rotating on its axis. But while rotating its inclination is not always the same, rather it is inclined at an angle of 23 and a half degrees. This causes the seasons. While rotating the portion of the earth that is tilted towards the sun has summers and the other half has winters.
Srishti	Yes papa, that is why when the northern part of the world is experiencing winters countries such as Australia in the southern part of the world have scorching summers.
Suryaprakash	Very good, Srishti. Now finish off your breakfast.
Srishti	Papa, take us out somewhere.
Suryaprakash	Okay, but where would you like to go?
Vivek	Papa, in the Science City the Department of Ocean has organized an exhibition. Let's go and see that.
Srishti	Yes papa, let's go.
Suryaprakash	Today is Sunday, will the exhibition be open today?
Vivek	Yes papa, I saw in the newspaper today—its timing is from 9 in the morning till 6 in the evening.
Srishti	Papa, let's go.
Suryaprakash	Okay, okay, but ask your mummy also.
Vasudha	Why ask me, I will also go. All of you go and get ready, I have made hot water ready.

Srishti	Come on, come on, let's be fast.
Vasudha	Manav, go and take a bath, the water is warm.
Manav	This is too hot. Vivek bhaiya, the heating rod is heating up water in the lower portion of the bucket, then how is this entire water becoming hot?
Vivek	Come on take a bath, Manav. You have to understand everything today itself?
Manav	Please tell me bhaiya.
Vivek	See Manav, whenever a part of a liquid or a gas is heated, that part becomes lighter and rises up and its place is taken up by the rest of the colder gas or liquid. As this process continues, the entire gas or liquid gets heated up.
Manav	This process is also called conduction?
Srishti	Yes, this process is called conduction. You forgot, didn't Islam uncle tell you about this?
Vivek	Correct, Srishti.
Vasudha	You people have again started off with your science. If you want to go see the exhibition then get ready fast.
Change in Scene	
Suryaprakash	Brother, which other bus goes to Science City?
Traveller 1	405 and 415 numbers.
Traveller 2	(after listening to their conversation) You want to go to Science City? You take bus number 420, 405 goes to the museum and 415 to Virat Bazar.
Suryaprakash	Are you sure?
Traveller 2	I think it is 420 but better ask the water vendor.
Suryaprakash	(to the water vendor) Which bus goes to the Science City?
Water vendor	I don't know, Sir. I have come here since yesterday only.

Vivek	You see Srishti, this man is better than the two gentlemen there, at least he is saying clearly that he doesn't know.
Srishti	Bhaiya, just ask the person standing near you.
Vivek	Uncle, which bus goes to Science City?
Travellet 3	If you have to go to Science City then you will get the bus from the opposite bus stop. Take bus number 416, it will take you straight to the Science City. I just returned in that bus.
Vivek	Thank you Uncle. Papa, we have to go to the opposite bus stop.
Suryaprakash	Okay, cross the road carefully.
Vasudha	Manav, be careful.
Manav	Yes, mummy. I am thirsty also.
Srishti	There is the water vendor.
Vasudha	Vivek, go and buy a bottle of water.
Vivek	Okay.
Vivek	(to the shopkeeper) Give me a bottle of water.
Shopkeeper	Here, take this, it will be 12 rupees.
Vivek	But this bottle costs 10 rupees.
Shopkeeper	Now the prices have gone up.
Vivek	Okay, take this money and give me a bottle.
Manav	(after drinking water) Bhaiya, our country is surrounded on three sides by water, even then drinking water is scarce.
Vivek	Manav, sea water is very salty. Normally, 1 litre of sea water contains 35 grams of salt. That is why we cannot drink it.
Manav	70 percent of the earth is covered with water, so are the seas of no use?
Vivek	You will get the answer to this question at the exhibition. Let's go to the bus stop.
Vasudha	Vivek, fast, the bus is coming. (sound of bus stopping)
Suryaprakash	Come on, everybody take care. (sound of moving bus)

Suryaprakash	(to the conductor) Four tickets for Science City please.
Conductor	Yes, here it is, it will be 20 rupees.
Suryaprakash	Please tell us when the bus reaches Science City.
Conductor	Yes, definitely.
After some time	
Conductor	Okay, the Science City bus stop has come, please get down. (sound of bus stopping…people getting down)
Suryaprakash	Looks like a big show, there are so many people.
Vivek	Yes papa, it has been in the news for quite some time.
Srishti	See Mummy, they are selling craft material also.
Vasudha	Yes, we will see it when we return.
Vivek	Papa, the entry is from that side.
Sound of patriotic song and hustle-bustle inside the exhibition	
Manav	Bhaiya, let's move from this side.
Suryaprakash	Come on.
Manav	Papa, what is this model?
Vivek	Some expert is explaining something about this model.
Expert 1	This model is about the sun, which is the source of all energy. It shows how the sun's energy reaches the earth.
Manav	Uncle, can you please explain in detail?
Expert 1	This tells how the sun's rays before reaching the earth have to pass through several layers of the atmosphere. This way almost half the rays are absorbed by clouds. After some of the rays are absorbed by clouds, water vapour and carbon dioxide the rest is reflected back into space.
Manav	Where does the absorbed energy go?
Expert 1	Son, this absorbed energy increases the temperature of the atmosphere.

Srishti	Uncle, how much of the energy is absorbed by the clouds, dust particles etc?
Expert 1	About 35 percent of the solar energy that reaches the upper layer of the atmosphere is reflected by clouds and tiny dust particles, so neither does it heat up the surface of the earth nor the atmosphere. This reflected energy is called cloud albedo. The rest of the energy reaches the earth.
Vivek	What is albedo?
Expert 1	The difference between the radiation absorbed by an object and the radiation reflected back is known as albedo.
Expert 2	Some amount of radiation is reflected by the surface of the earth also, for example, from the ice covered mountains in the polar countries.
Expert 1	The radiation reflected by the earth and the clouds together constitute the planetary albedo. The albedo of the earth is about 30 percent.
Vivek	The earth has sand, ice, grass, forests and seas, so is the albedo of every area the same?
Expert 1	The albedo depends on the angle at which the sun's rays strike the earth's surface. The albedo of ice is between 70 and 90, which is the highest.
Vivek	So, how much solar energy reaches the earth?
Expert 1	If suppose 10 units of energy is being released from the sun, then only 47 units is reaching the earth. Which means 53 percent of the energy is reflected back.
Vivek	Okay, 53 percent goes back? (laughing)
Expert 1	Yes, son.
Vivek	What happens to the energy reaching the earth?
Expert 1	This has been explained in the next model.
Manav	Papa let's go there.

Vivek	Let's go to that model. It's a working model. (sound of motor running)
Srishti	Uncle, please tell us about this model.
Expert 2	This model tells us about what happens to the energy reaching the earth.
Srishti	(seeing the model) What do these lines signify?
Expert 2	As you know, the earth has different geographical structures like mountains, valleys, oceans, rivers and oasis. All these structures absorb and reflect energy in varying amounts. Due to this the temperature of the surface of the earth rises and due to the reflected energy that of the atmosphere. There is always enough amount of water vapour in the atmosphere. This water vapour absorbs a major part of the energy and then sends this energy to the earth. In this manner water vapour and gases present in the atmosphere cause the greenhouse effect.
Srishti	So, is water vapour harmful?
Expert 2	No son. It is a boon for life on earth. It prevents the sun's rays and also the ultraviolet rays from reaching the earth and in a similar manner blocks the energy reflected from the earth into the space.
Vivek	That must be increasing the temperature of the atmosphere.
Expert 2	Yes, it converts the area around the equator into something like a boiler. This energy through the process of convection gets transferred to the polar areas and from the polar areas this energy is once again returned back to space. In this manner the average temperature of the earth remains around 15^0C and the cycle continues in this manner.
Vivek	This means that almost the same amount of energy is reflected back as the amount of energy reaching the earth.
Expert 2	Yes, that is exactly what happens.
Manav	Bhaiya, energy gets reflected from the earth, but how does that

	happen in the case of seas.
Vivek	Ask uncle.
Expert 2	Yes, I have heard you. The least amount of energy is reflected back from the surface of the sea.
Vivek	This means that the sea absorbs the maximum amount of energy. What happens to this absorbed energy?
Expert 2	You have asked a very good question but you will get the answer to it there.
Vivek	Okay uncle, thank you.
Manav	Come on, let's go there.
Vivek	Yes, let's go.
(sound from stall—"Come here, come here")	
Manav	See, there's the model.
Srishti	Let's go and ask there.
Expert 3	This models tells us that on the sea surface the sun's rays strike at an angle of 60 degrees or more and that reflection is the minimum.
Vivek	The seas absorb the energy.
Expert 3	Yes, in this condition the light rays penetrate up to a distance of 45 metres.
Srishti	So, is there no life beyond a depth of 45 metres.
Expert 3	It is true that the sun is a source of energy for all life forms. Some sea dwelling animals can survive upto a depth of 200 metres such as jelly fish that survives upto a depth of 65 metres.
Vivek	But from where do they get energy?
Expert 3	Nature has vested every life form with abilities that allow them to adapt to different situations.
Manav	So are they able to manufacture their own light?
Expert 3	Yes, that is true, such animals have bioluminescent capabilities.
Manav	Wow, that is so great, one's own light.

Srishti	So Uncle, the sea hides many secrets?
Expert 3	Yes, the more you look around the more new discoveries you will make. It was due to the seismic activities on the beds of oceans and also due to the energy coming out from the earth that many life forms established themselves near such regions.
Manav	Can I see a jellyfish here?
Expert 3	Yes son, many sea dwelling animals have been exhibited in the last stall.
Suryaprakash	Your effort is quite commendable. The children are getting to know very interesting information.
Expert 3	Thank you. There also you will get very good information.
Suryaprakash	Let's go on.
Expert 4	Welcome. In the earlier model you had seen that the sun's rays penetrate upto a depth of 45 metres in the seas. In this manner the variation in temperature of the surface is important. The change in temperature reduces with increasing depth.
Manav	So is the temperature of the surface of various oceans different?
Expert 4	Yes, the tropical regions have a temperature of 25^0C while the temperature of polar regions varies from 0 to 5^0C.
Vivek	Yes, I have read that in comparison to polar regions, five times more solar energy is received by tropical regions.
Expert 4	Yes, you are right. In the atmosphere free energy is available in larger quantities over the polar regions than over the tropical regions.
Suryaprakash	This means that in the tropical areas the sea absorbs a major part of the solar energy. And a major part of the energy gets reflected from the polar regions.
Srishti	Is there any relation between the seas of the tropical regions and polar regions?
Expert 4	All the three processes occur in the sea waters—conduction,

	convection and vapourization. It is due to convection that sea currents start flowing from the warm tropical regions to the cooler polar regions. In this manner the average temperature of seas remains constant. The seas of the tropical areas absorb more energy and through sea currents release this energy in the cooler regions, this way there is no increase in the average temperature of the sea surface.
Vivek	Uncle, at places where there are no seas, that is, where there are other structures, what happens there?
Expert 4	You must be aware that it takes longer to heat up the sea surface than it does to heat up a hill. That is why other structures reflect more energy than the seas. For instance, land heats up quickly and also cools down quickly. Whereas seas take more time to heat up as well as cool down.
Manav	But uncle why does this happen?
Expert 4	Because the latent energy of water and land is different.
Manav	What does latent heat mean?
Expert 4	Latent heat is the energy required to increase the temperature of one gram of a substance by 1^0C.
Vivek	Thank you uncle. Let's go Manav.
Manav	Bhaiya, I was thinking that seas have no role to play in our life but now I know that it has a major role in maintaining a balance in temperature in the atmosphere.
Vivek	Yes Manav, you are right. All the systems related to the seas, atmosphere and solar energy are in fact inter-related. That is why we have life on earth. If even one system is damaged, life on land and in water would be threatened.
Suryaprakash	Come on, let's go and see there.
Manav	Look, mummy is buying something, I am going there.
Suryaprakash	Stay with mummy.

Manav	Okay.
Vivek	Look, here many types of fishes and other animals have been exhibited.
Suryaprakash	Yes son, they have been exhibited very well.
Srishti	Look, some objects and food products available from the seas are exhibited here.
Suryaprakash	Children you want something to eat?
Srishti	N o, no, we will eat somewhere else.
Vivek	Papa let's go there, mummy is waiting.
Srishti	Hey, I wanted to go to the craft bazaar also.
Suryaprakash	Let's first see this exhibition and then we will go with mummy to the craft bazaar.
Manav	Mummy, please get me this toy.
Vasudha	You already have this toy, don't you?
Manav	No mummy, it has got damaged.
Suryaprakash	Come on, buy it.
Manav	What is the cost of this toy?
Toy seller	It is for twenty rupees.
Manav	Here, take this, give me one.
Toy seller	Take this.
Manav	Come on mummy, I have bought it.
Suryaprakash	Come on, let's eat something there and then go home.
(Scene change, sound of bus, sound of door of house opening)	
Suryaprakash	Children, how did you like the exhibition?
Srishti	Very nice papa.
Manav	Bhaiya, look this toy runs so fast.
Vivek	Srishti, what did you like?
Srishti	Bhaiya, today I got to know that in nature every substance has its

	own different role and that seas have a big role to play in our life.
Vivek	That is true.
Manav	Bhaiya, look my toy has stopped.
Vivek	(trying to start) Looks like its key is damaged.
Manav	It has got damaged so soon.
Srishti	If you run it like this it is bound to get damaged.
Manav	Bhaiya, why don't you open it and look inside?
Vivek	(after opening the toy) Its gears are damaged.
Manav	What is that?
Vivek	Look, this toy has three wheels with serrations, one of them is damaged.
Manav	Bhaiya, but then the remaining two should work.
Vivek	These wheels are arranged in such a manner that if one is damaged the remaining will also not work.
Srishti	Bhaiya, it is just like the systems of solar energy, atmosphere and sea where damage to one system causes damage in the other system also.
Suryaprakash	Very right, Srishti. Great.

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