

Episode 19:
Major characteristics of Oceans

Research & Write-up: –Dr. T V Venkateswaran

Character	Audio
Vasuda	...oh... I am narrating a story and look at Manav.. he is not at all paying attention... where did I stop?
Srishti	Mama.... You talked about how adisheshan was used as a rope to churn the great Samundra ... ocean
Vasudha	Yes yes... Manav often distracts my attention ... see as I was explaining on the one side were Devas and on the other Asurs.. they were using the Vasuki nag as the rope and mount meru as the churning rod
Manav	Using the snake as the churning rope... it beats me
Vivek	Ok Ok listen... this is puranic story... they will be as fantastic as Harry potter or any other fantasy... what do you expect
Vasudha	Ok Ok... when the ocean was churned it is said many many precious things came out of it... like you get butter from churning milk,...amrit and many other precious things came out of the great samudhra
Manav	Utter nonsense... what can you get by churning a ocean.. may be some dead fish... or jelly fish...
Vivek	..well... well... not quite and not that fast... yes! it is true that all the talk of amrit and such stuff are out of world. But ocean is a great treasure You know that ..
Manav	Just a immense water body... what else
Vasudha	Hi... don't talk that low of oceans... ocean is source of one of the important mineral that we eat... you know that... without that mineral our food will not taste ..
Vivek	Yeah.. sure... though we do also extract slat from rocks and salt mines, most of the world's salt comes from ocean you know that....
Srishti	Of course every one knows that... except Manav... rather manav forgets such things... things that we get easily is forgotten..
Vivek	mm... that is true... manav does not pay adequate respect to prakruti and the bounty that we drive out of it
	<Sound of door opening... >
Suryaprakash	Hi folks... are you all ready... shall we go.. t have brought the taxi.. we have to leave in a jiffy.. otherwise we will be late for the exhibition...

Scene II

Dr Sen	Namoskar Suryaprakahsji... welcome
Suryapraka	Thanks Dr Sen I am happy you could take time to meet us and explain the exhibition...
Dr Sen	Oh no it is not a bother at all.. it is a pleasure...
	This is my wife Vasudha... my son Vivek, Daughter Srishti and out chootu Manav..
	Hello...(each of them say hello or namaskar)

Vivek	Uncle... I am really excited to visit this exhibition... I am particularly keen to know about the deep sea circulation...
Manav	I am too keen... you know I have to do a school project.... I am hoping to gather interesting information..
Dr Sen	Yes yes... I am sure you will find this exhibition very interesting... let us go... come this way

Scene III

Dr Sen.	Watch your step...
Vasudha	Oh ... what a lovely picture...I mean graphic... all information about oceans... at one glance...
Dr Sen	Well... rather we call this aspect of our planet as Oceanosphere
Srishti	Oceanosphere? I have never heard of it... I know hydrosphere... biosphere...
Manav	...Look at this write up..what is written here... let me read... “The waters of the World Ocean are distinguished from fresh water by their differing physical and chemical properties. By well-defined differences and a complex exchange of energy and matter peculiar to the animal and plant kingdoms, a subclass of the Hydrosphere exists, called the “Oceanosphere” this is distinguished from the rest of the hydrosphere”
Dr Sen	Yes.. that’s right... hydrosphere is all the surface water bodies on earth surface... but oceanosphere is that part of the world ocean that has specific properties and system.. The Oceanosphere has a great influence on the formation and changes of the natural world.
Vivek	You mean water is salty and so on...
Dr Sen	Even so called fresh water may be slightly salty and contain mineral components... Oceanic water is a complex solution and there is a great diversity in its chemical composition.... Oceans are not just salty...It differs from fresh water by having a greater diversity of dissolved chemicals, and therefore, Oceanic water has different properties than fresh ...terrestrial water.
Vasudha	Look at this poster... let me read “Sea water has a number of unique properties that considerably distinguish it from other fluids. The most important physical properties of sea water are a high thermal capacity, high dissolving ability, density, low heat conductivity, transmission of light and sound and good electrical conductivity.”
Srishti	Manav... Manav... take your note book see this ... note this would be interesting and useful for your project
Manav	..mmm... The average salinity of waters of the World Ocean is about 35 per cent
Vivek	Hi Manav... pay attention...they have not written percent... salinity can not be 35% obviously... see the symbol... it is not the symbol of percentage.. though it look like one
Suryapraksh	Yes... yes... this is not percent symbol..
Dr Sen	This symbol which has a zero on top and two zeros with a slash in between stands for ‘parts per thousand’. This is the traditional way of measuring concentration of salt and other minerals in ocean

Vivek	If the concentration of salt is about 35 ppt means there would be about 35g of solid substances are dissolved in 1 kg of the water is that right
Dr Sen	Right...
Vasudha	Look at this panel... they have listed the substances found in ocean water... Sodium is about 10.7 ppt and Chlorine about 19.3 ppt. Of course they make up common salt sodium chloride.
Suryaprakash	Ocean water is salty... but not same everywhere... average salinity is 35... In coastal regions with significant river run off, salinity does not exceed 15-20 ppt. The salinity of deep and near bottom waters in the oceans about 35 ppt.
Dr Sen	High salinity that is about 35 ppt is encountered in surface waters at tropical latitudes, where evaporation is greater than at other latitudes. The lowest average salinity of oceanic waters that is about 29 ppt is observed in the summer in the Arctic Ocean. Salinity and temperature together affect the density of water. Many physical characteristics depend on density distribution, for example, water exchange processes, intermixing and sound transmission all are impacted by the salinity of the sea water...
Srishti	Oh look at this table... ocean water has even Magnesium, Calcium, Potassium, Strontium, Sulphates (SO ₄), Hydrocarbons, Bromine, Fluorine and Boric acid.
Dr Sen	Not only that ocean too has trace levels of iron even gold!
Manav	Gold... Ocean water has gold... wow
Vivek	Oh Manav you can only think of gold... and get excited about it...
Suryaprakash	...ok... let us move to the next pavilion.. hurry up

Scene IV

Dr Sen	Come into this pavilion... as you can see this is about the ocean currents... The continuous motion of water is a major characteristic of the World Ocean...
MaNAV	Yes... waves... I have seen.. ocean never rests... I know
Surya	Ah ah... he is not talking about the waves or surf... he is talking about the movement of water mass in the open sea...
Vasudha	see this chart... wow... ocean water really moves his way.. ... winding around the globe...
Dr Sen	Yes.. Circulation of surface waters is now one of the most investigated topics. Circulation of ocean water permits the interconnected currents to widen, and increases the speed and volume, thereby mixing the waters of the world ocean...
Vasudha	Manav... note these... these are currents in Indian Ocean... this information will be useful for your school project... Agulhas Current, East Madagascar Current, Equatorial Counter Current, Indonesian Through-flow, Leeuwin Current, Madagascar Current, Mozambique Current, Somali Current, South Australian Counter Current, South Equatorial Current, Southwest and Northeast Monsoon Drift (or Indian Monsoon Current), West Australian Current and West Wind Drift ..write them in your note book... it will be useful.

Vivek	Well... Manav.. the west wind drift is also called AAC.... ACC is the largest current on the globe. This is also called West Wind Drift. It is about 2,500 km wide with a maximum speed of 0.4-0.5 m/sec. The greatest speed of these currents are in the order of 2-3 m/sec.
Suryaprakash in fact the speed of currents are rather very slow. For example, Antarctic Bottom Water (AABW) travelling into the Pacific Ocean from the south requires ten years to arrive!
Srishti	This picture is indeed very grand... such big currents on the surface of the ocean.. I can see the AAC... it is here.. but I wonder how come the water mass move... perpetually?
Suryaprakash	mmm.. my dear... obviously the Sun is the prime mover...
Vivek	That is right... it is the energy from the sun that makes the movement possible ...
Dr Sen	Solar heating cause water to expand. You might be surprised to know that near the equator the water is about 8 centimetres high than in middle latitudes.... This cause a very slight slope and water wants to flow down the slope...
Srishti	... but I read that it is wind that cause the waves..
Dr Sen	Sure... winds also drive the currents... Winds blowing on the surface of the ocean push the water. Rather due to the friction between the wind and the surface of water, water mass starts to move... as the wind blows and moves water... water will pile up in the direction the wind is blowing. Gravity will tend to pull the water down the "hill" or pile of water against the pressure gradient.... The water body then stars to move... thus currents are generated...
Suryaprakah	Look at this place... in this chart of ocean currents... it is written North Atlantic Gyre..
Dr Sen	Yes... Gyres are formed due to the movement of water mass coupled with the rotational motion of Earth. As Earth is a rotating sphere there is a psedo force called Coriolis Force.. that deflects an moving object to its right in northern hemisphere and to left in southern hemisphere. .. Coriolis Force intervenes in the ocean current and cause the water to move to the right in the northern hemisphere around the mound of water. These large mounds of water and the flow around them are called Gyres. The produce large circular currents in all the ocean basins. There are number of gyres in the globe...
Srishti	Yes.. Yes... from this map I can identify North Pacific Gyre... look here .. this is Subtropical gyre... near the south polar region... Weddell Gyre...
Suryaprakash	In olden days the sailors had an idea of these currents... ships would drift... logs would drift in the oceans due to these currents and wind coupling...
Vivek	I was told that it was Benjamin Franklin who guessed the presence of Gulf stream between America and England ...

Vasudha	... look at this panel.. it is about Benjamin Franklin.. let me read what is written on the poster... On examination of the ship records Benjamin Franklin found that onward journey from Europe to America took two weeks longer than the return journey. Compiling the drift data from various ships that sailed the Atlantic he was able to accumulate information on the ocean currents. From these data he identified the 'Gulf Stream', which he called a 'river in the ocean', which he depicted in a map prepared in 1769.
Srishti	Mum... lets go to the next exhibit...

Scene V

Vasudha	Look at this chart.. world map with deep ocean currents... look how the deep ocean current snakes around the world...
Manav Why we saw about ocean currents in the earlier panel... why again...
Dr Sen	What we saw earlier was about surface currents.. what we are going to see in this panel is deep ocean current...
Suryaprakash	In fact surface currents or movement of water only make up about 10% of all the water in the ocean. Surface currents are generally restricted to the upper 400 meters of the ocean... there is more than what meets the eye....The movement of deep water that is below 400 meters in the ocean basins form a large system of ocean currents... they are very important..... they are deep ocean currents
Vivek	Yes ... this deep ocean current is also called as conveyor belt...
Vasudha	Let me see.. the conveyor belt seems to begin in the central Pacific from there it travels past the north coast of Australia and around the southern tip of Africa before moving up into the Atlantic. I can see that as the deep current heads up the Atlantic it turns into the Gulf Stream.
Prakurthi	Mum... look here... the Conveyor Belt transfers warm water from the Pacific Ocean to the Atlantic as a shallow current, and returns cold water from the Atlantic to the Pacific as a deep current that flows further south.
Vivek	You know why that happens?... why cold water from Atlantic is deep ... The Gulf Stream carries salt into the high latitude North Atlantic where the water cools. The cooling and the added salt cause the waters to sink in the Norwegian Sea thousands of meters below the surface..... This is the formation of Atlantic Deep Water...In fact such sinking mass of water that impels the conveyor belt in the first place...
Suryaprakash	Don't think all these happens in a jiff. The deep water travels slowly through the oceanic abyss.... Eventually the deep water mixes upward to the surface in different parts of the world as much as 1,000 years later.
Dr Sen	In fact as the deep ocean current passes Europe, the surface water evaporates and the ocean water cools, releasing heat to the atmosphere. This release of heat is largely responsible for the relatively warm temperatures enjoyed by Western Europe.... Without this deep ocean current most of Europe would be a very cold place...

Vivek	I see.. wow that is how the ocean water circulate... let me see.. The surface water is cooled in sub-polar regions of the World Ocean. Upon freezing, the salts are removed and this process increases the salinity of the adjacent water. As a result, the water becomes denser and descends. Mmmm so I can see in this map that the areas where these deep waters are generated are in the Greenland Sea in the north and the Weddell and Ross Seas adjacent to Antarctica in the south. Well... then deep water mass from these sub-polar regions are dispersed into the world ocean... have I understood correct uncle?
Dr Sen	... in a nut shell...
Suryaprakash	mm... I was told that the global warming could upset the world currents and it may cause serious damage ...ice age may return
Vivek	... that is indeed true... as the globe becomes warmer and warmer the ice in poles would melt... that would bring more fresh water to North sea.... Will dilute the salty water of north sea... as the water is diluted it would not sink and the whole conveyer belts my stop working...
Manav	Is that so? Like in the film day after tomorrow ?
Dr Sen	... well The Day after tomorrow is a film... so it is exaggerated... but some scientists are of the opinion that global warming could shut the conveyer belt of ocean currents ... that would mean heat from the tropics would not be taken to poles and the temperature in the northern tropical zone could fall drastically... This would result in a cooling of Western Europe as well as in the eastern part of North America where average temperatures could plunge by up to 5°C – about the same difference between the global average temperature during the last Ice Age and today. ...
Srishti	Oh That means it is because of the conveyer belt of ocean currents that temperature is transported to higher latitudes.. is that so...
Dr Sen	Well said.. Acting like a conveyor belt, deep water circulation plays a key role as oceans absorb, store, and redistribute vast amounts of the Sun's heat around the globe...for example it brings the warmth of the Pacific to Atlantic

Scene VI

Manav	... Papa Papa look at this.. this section is about 'pageantry of sea and air'...
Dr Sen	Yes yes.. we have tried to display how interaction between atmospheres and sea is crucial...
Srishti	Yes.. I know ... rain occurs due to evaporation from sea...
Manav	Why only sea... any water body...
Vivek	Yes.. all water bodies do contribute to the total atmospheric water content... how ever the place of oceans are unique... World Ocean annually produces atmospheric precipitation of about 458,000 km ³ ;
Vasudha	Manav note this interesting information...86% of global evaporation and 78% of global precipitation occur over the ocean...

Dr Sen	Manav... You would have read about the Indian monsoon... Indian monsoon is due to interplay of sea and low atmosphere... as the trade winds blow across the Indian ocean towards Indian sub-continent it picks up water... I mean moisture from the ocean... it is this moisture that rains over India during the monsoon season...
Suryaprakash	In fact in a manner of speaking, two very thin skins of fluid cover the surface of our planet: our atmosphere, a low density layer consisting mainly of gases, our oceans a higher density layer consisting mainly of water.
Dr Sen	Nicely said... However the two layers are not completely distinct. Exchanges of water, gases, particulate matter, heat and momentum are continually taking place across the interface between them. These exchanges have a profound effect on the development of our weather systems, and in the longer term, the progress of climate variability and change.
Praruthi	Read this... Ocean is also a heat sink... it stores the global warming gas.. carbon dioxide ..
Vasudha	... interesting... The oceans are main reservoirs of readily available carbon dioxide, an important greenhouse gas. The cold, deep water in the ocean is the main reservoir of dissolved carbon dioxide.
Vivek	You know why cold water stores more carbon dioxide? See when you open a very very cold soda can it does not fiz that easily... cold soda.. water can hold carbon dioxide... but a warm soda can froths immediately once you open the bottle...
Dr Sen	Carbon dioxide in the atmosphere interacts with sea water and produces carbonates and dissolves in sea water.. in the deep we have cold water that can hold much more carbon dioxide than the warm surface part of the ocean.
Surya prakash	Also the living organisms on sea surface absorbs carbon dioxide...organisms like phytoplankton inhale carbon dioxide and exhale oxygen. Carbon is trapped. The dead organism falls into the deep and thus large amount of carbon is trapped inside the sea...
Dr Sen	Come this way to next hall.. this about origin of life...let us move

Srishti	I am amazed...Why the grass is green... how come we have this question in this exhibition on oceans... I wonder...
Manav	I know the answer... it is due to chlorophyll .. So grass is green due to chlorophyll.. isn't it?
Dr Sen	In a way true...The photosynthetic pigment chlorophyll absorbs every colour wavelength to varying degrees. The most efficient photosynthetic wavelengths are blue wavelengths measuring about 450 nanometres... that is the blue region of the spectrum.
Vivek	I have read that Photons, or packets of light energy, contain different amounts of energy based on their wavelengths, and shorter wavelengths contain more energy than longer wavelengths. Thus, the shorter blue wavelengths pack more of an energetic punch. This provides added advantage to plants...

Dr Sen	Plants prefer blue light not only for the efficiency of the wavelengths, but also because blue light played an integral role in the origin of photosynthesis.
Vasudha	Yes Yes... I can read about it in this poster... Before photosynthesis developed, the early Earth had little oxygen. That meant the Earth also did not have an ozone layer to protect life from the damaging ultraviolet radiation of the sun. Early life on Earth lived underwater, relying on the ocean for UV protection. However, the ocean also filtered out the longer wavelengths of visible light. Thus, the only wavelengths available for the earliest photosynthetic pigments were the shorter wavelengths of blue light.
Srishti	Oh Is that so? I am wonderstruck ... grass are green because only blue light can penetrate sufficiently inside the ocean! Wow.
Satyaprakahs	Yes indeed while other wavelengths are absorbed, blue penetrates much more deep. Red, long-wavelength rays are completely absorbed in the surface layers of the water. The predominant part of the scattered spectrum is green - indigo. At great depths, only the short-wavelength blue colours penetrate.
Vivek	Let me read this poster...Light exposure on the Ocean surface depends on the altitude of the Sun, transparency of the atmosphere, cloud cover and weather disturbances. Sunlight on the Ocean surface is refracted and enters in the water, with a minor amount being reflected back into the atmosphere. Passing through the water, sunlight is dispersed at the expense of absorption and dispersion. More than 60% of transmitted light-energy is absorbed in the upper meter of sea water. In depths greater than 1,000 m, light has occasionally been detected, but only with the help of sensing devices....
Srishti	So... as the other wavelengths are absorbed.. only blue light penetrate ... hence if any organism develops a systems for harnessing the sunlight, then it is prudent to be maximum around the blue wavelengths....
Dr Sen	Yes.... That is so... in fact the chlorophyll absorbs all other colours other than green. As the green light is reflected back the grass and all leafs appear green. It absorbs blue light and generates food for itself.
Suryaprakash	Why the grass is green is a legacy of origin of life... in particular plant ancestor... early plant life that originated in ocean were adopted to the specific condition...
Vasudha	What a wonder... the whole world looks green... because of blue ocean!... I think Manav you have a catchy title for your school project... green leaf from blue ocean... how is that...