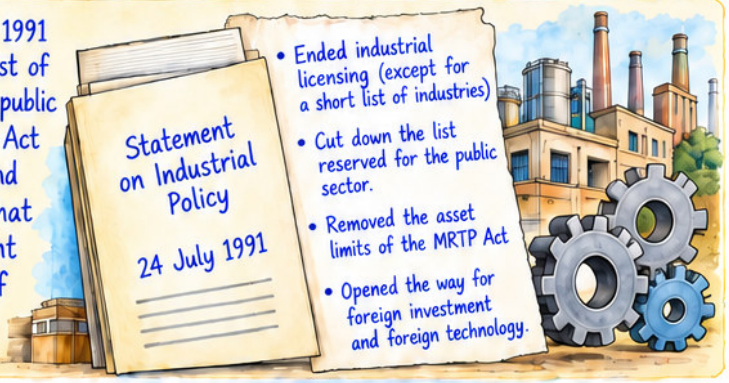
Background: the 1991 crisis (Topic 114)

The Statement on Industrial Policy of 24 July 1991 ended industrial licensing except for a short list of industries, cut down the list reserved for the public sector, removed the asset limits of the MRTP Act and opened the way for foreign investment and foreign technology. The examination asks what each measure did and how the 1991 statement differs from the resolutions and statements of 1948 to 1980.



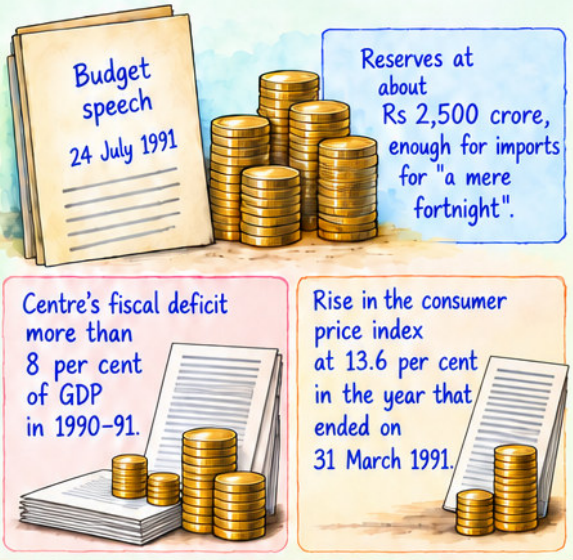
The 1990–91 crisis

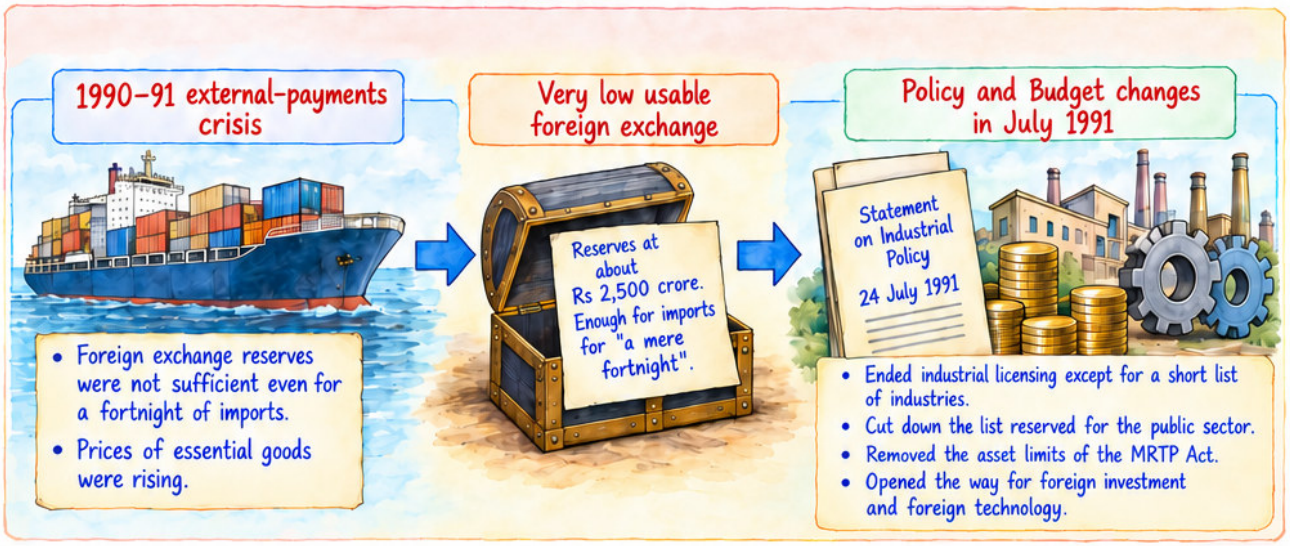
- In 1990–91 India faced a balance of payments crisis. The foreign exchange reserves were not sufficient even for a fortnight of imports, and the prices of essential goods were rising.
- India received US$ 7 billion as a loan from the World Bank and the International Monetary Fund (IMF), which expected liberalisation and fewer restrictions in return.



The Budget speech of 24 July 1991

- The Budget speech of 24 July 1991 put the reserves at about Rs 2,500 crore, enough for imports for "a mere fortnight".
- It put the Centre's fiscal deficit at more than 8 per cent of GDP in 1990–91, and the rise in the consumer price index at 13.6 per cent in the year that ended on 31 March 1991.



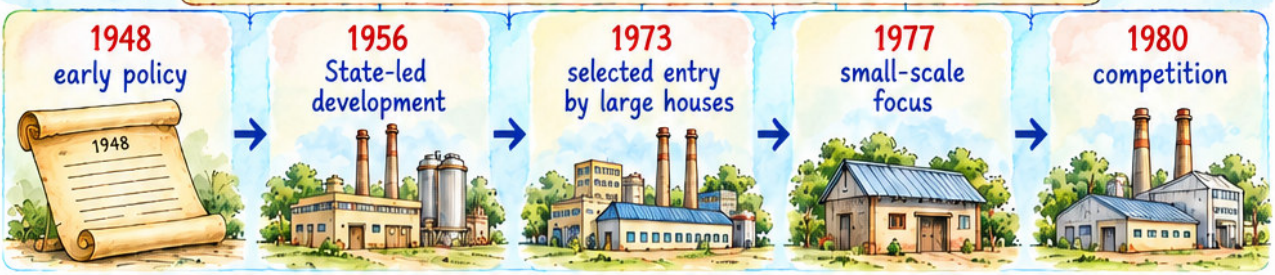


Sources: Day 16 Source Index | Topic 155 | Section 2.1

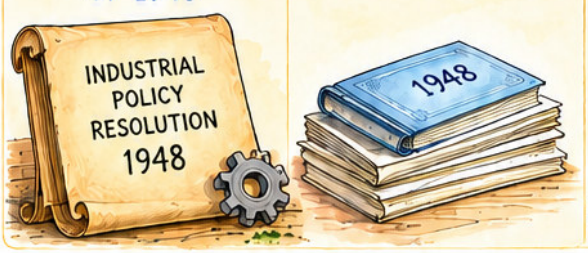
The earlier resolutions and statements (1/2)

Historical statements: 2 Feb 1973 • 23 Dec 1977 • 23 Jul 1980

1948 early policy → 1956 State-led development → 1973 selected entry by large houses → 1977 small-scale focus → 1980 competition

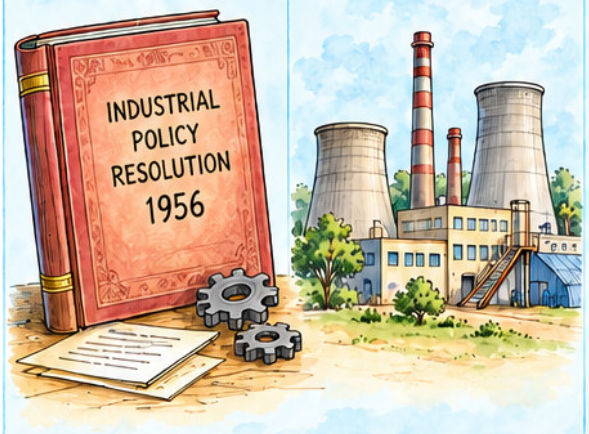


Policy	Date	Main features
Industrial Policy Resolution of 1948	6 April 1948	Set out the policy the Government proposed to follow in the industrial field. The 1956 Resolution opens by recalling it.





Policy	Date	Main features
Industrial Policy Resolution of 1956	30 April 1956	Three categories.



Schedule A: 17 industries, from arms and ammunition to the generation and distribution of electricity, whose future development would be the exclusive responsibility of the State.



Schedule B: a second category of industries which would be progressively State-owned; in them the State would generally take the initiative in establishing new undertakings, and private enterprise would be expected to supplement the efforts of the State.

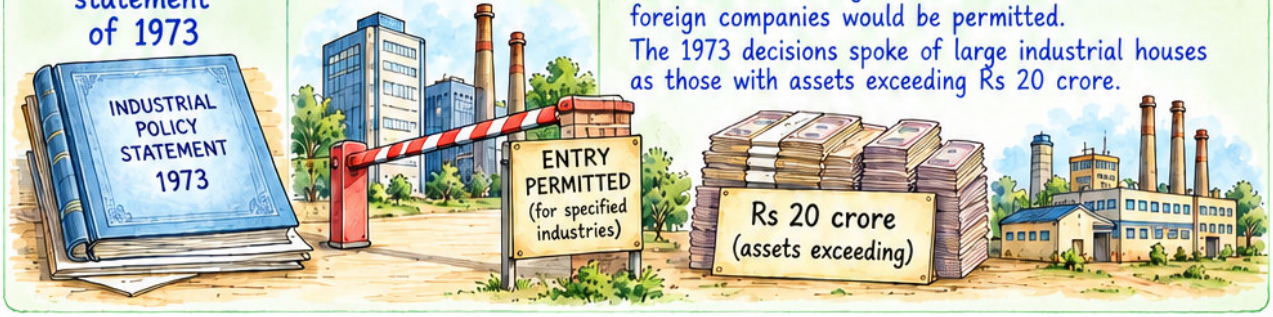


The third category: all the remaining industries, to be developed ordinarily through the initiative and enterprise of the private sector.



The State was to take on, step by step, a predominant and direct responsibility for setting up new industrial undertakings.

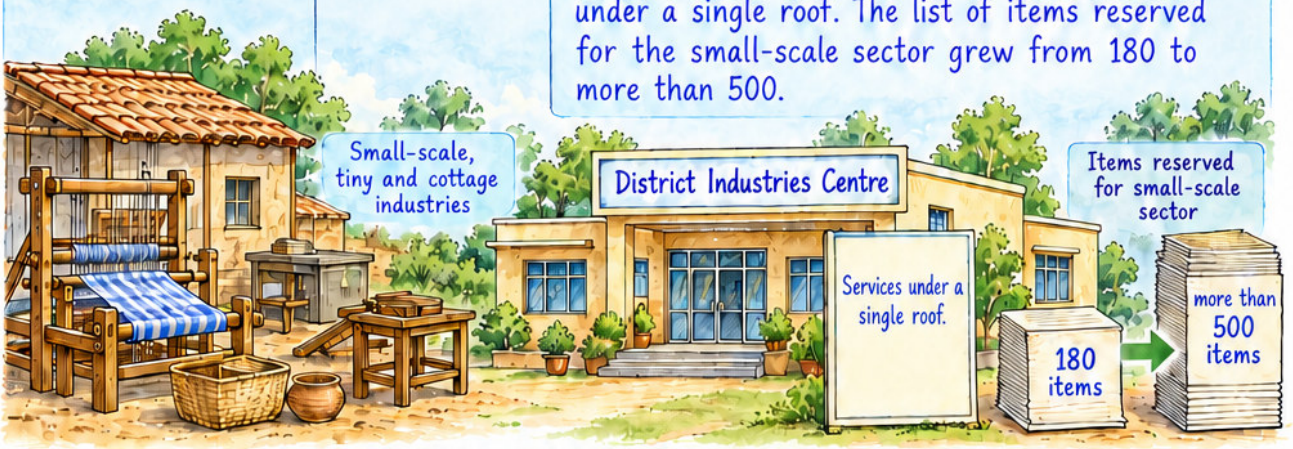
Policy	Date	Main features
Industrial policy statement of 1973	2 February 1973	Identified high-priority industries in which investment from large industrial houses and foreign companies would be permitted. The 1973 decisions spoke of large industrial houses as those with assets exceeding Rs 20 crore.



Sources: Day 16 Source Index | Topic 155 | Section 2.2

The earlier resolutions and statements (2/2)

Policy	Date	Main features
Industrial policy statement of 1977	23 December 1977	Laid emphasis on decentralisation and on the role of small-scale, tiny and cottage industries. A District Industries Centre was to give services under a single roof. The list of items reserved for the small-scale sector grew from 180 to more than 500.
Industrial Policy Statement of 1980	23 July 1980	Focused on the need for promoting competition in the domestic market. It also spoke of economic federalism through a few nucleus plants.



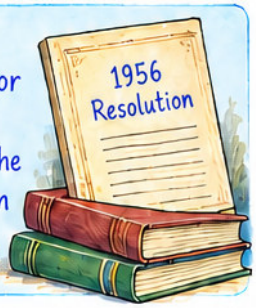


Historical statements: 2 Feb 1973 • 23 Dec 1977 • 23 Jul 1980

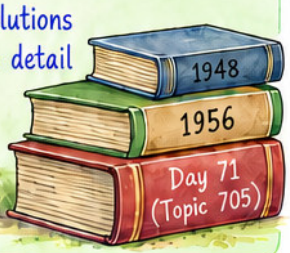
1948 early policy → 1956 State-led development → 1973 selected entry by large houses → 1977 small-scale focus → 1980 competition



The 1991 statement recalls that in the 1950s and 1960s the public sector was seen as the main instrument for controlling the commanding heights of the economy, and that the 1956 Resolution gave primacy to the role of the State.



Industrial policy resolutions of 1948 and 1956 in detail come on Day 71 (Topic 705).



Sources: Day 16 Source Index | Topic 155 | Section 2.2

Licensing, location and the public sector in 1991 (1/2)

Industrial licensing

The statement was issued by the Ministry of Industry on 24 July 1991.

Industrial licensing was abolished for all industries except those specified. Annex II listed 18 industries that still needed a compulsory licence:

1. coal and lignite;
2. petroleum (other than crude) and its distillation products;
3. distillation and brewing of alcoholic drinks;
4. sugar;
5. animal fats and oils;
6. cigars and cigarettes;
7. asbestos products;
8. plywood and other wood-based products;
9. raw hides, skins and leather;
10. tanned or dressed fur skins;
11. motor cars;
12. paper and newsprint (except bagasse-based units);
13. electronic aerospace and defence equipment;
14. industrial explosives;
15. hazardous chemicals;
16. drugs and pharmaceuticals;
17. entertainment electronics;
18. white goods.



Reasons for the short list

The short list was kept for reasons of security and strategy, social reasons, hazardous chemicals, the environment and elitist consumption.

Items reserved for small-scale units stayed reserved.



Licensing after subsequent reforms (2025–26)

Four industrial-licensing categories remain in DPIIT's dated list:

1. cigars/cigarettes and manufactured tobacco substitutes;
2. electronic aerospace and defence equipment;
3. industrial explosives; and
4. specified hazardous chemicals.

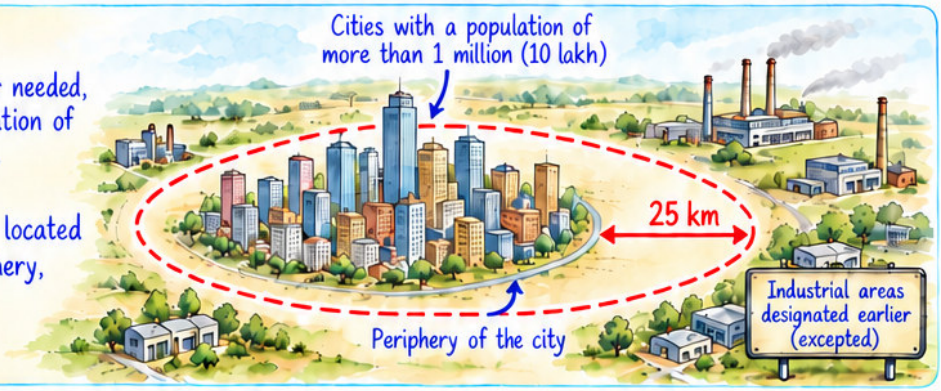
"Electronics" alone is not a separate blanket category.

Delicensing does not remove applicable sectoral, safety or state-law permissions.

Location

Central approval was no longer needed, except in cities with a population of more than 1 million (10 lakh).

There, industries other than non-polluting ones had to be located outside 25 km of the periphery, except in industrial areas designated earlier.

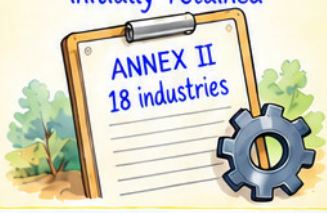


Industrial licensing changed over time

Before 1991
broad industrial licensing



1991 Annex II
18 licensing categories initially retained



2025–26
four industrial-licensing categories remain



Sources: Day 16 Source Index | Topic 155 | Section 2.3

Licensing, location and the public sector in 1991 (2/2)

Public sector

areas where security and strategic concerns predominate would continue to be reserved for the public sector. The 1991 reserved list had eight entries, reduced from Schedule A's 17 in 1956. Annex I, reproduced in official Press Note 9 of 2 August 1991, lists:

The eight entries in the 1991 reserved list (Annex I)

1. arms and ammunition and allied defence equipment, defence aircraft and warships



2. atomic energy



3. coal and lignite



4. mineral oils



5. mining of iron ore, manganese ore, chrome ore, gypsum, sulphur, gold and diamond



6. mining of copper, lead, zinc, tin, molybdenum and wolfram



7. minerals in the Schedule to the Atomic Energy (Control of Production and Use) Order, 1953



8. railway transport



The public sector was not barred from other areas.

Strategic focus and autonomy

The public sector was to focus on essential infrastructure, oil and mineral exploration, strategic manufacturing such as defence equipment, and technology development. Strong enterprises would get more autonomy through memoranda of understanding, and part of the Government's holdings in their equity would be disinvested.









Later changes

reservation was narrowed to specified atomic-energy activities and core railway operations, with private participation in other railway activities. By the Department of Atomic Energy's 29 January 2026 update, the SHANTI Act allows licensed private nuclear facilities while reserving sensitive activities such as enrichment, spent-fuel management and heavy-water production to the Centre.



Reserved to the Centre

- Enrichment
- Spent-fuel management
- Heavy-water production

Licensed private nuclear facilities allowed under the SHANTI Act.

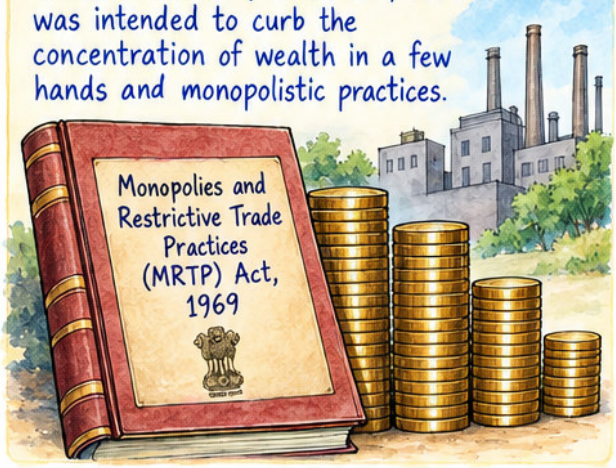
Keep this later position separate from the original eight-entry reservation list of 1991.

Sources: Day 16 Source Index | Topic 155 | Section 2.3

MRTP Act and the Competition Act

The MRTP Act, 1969

The Monopolies and Restrictive Trade Practices (MRTP) Act, 1969 was intended to curb the concentration of wealth in a few hands and monopolistic practices.



Pre-1991: Asset threshold and pre-entry scrutiny

The MRTP Act required certain large companies (MRTP companies) and dominant undertakings to obtain the Central Government's prior approval for their investment decisions.



1991: Removal of threshold limits and pre-entry scrutiny

The 1991 statement removed the threshold limits of assets for MRTP companies and dominant undertakings. The pre-entry scrutiny of their investment decisions was no longer required.



Focus on unfair and restrictive practices

The emphasis moved to controlling unfair and restrictive practices, rather than making the monopoly houses take the Central Government's prior approval for expansion.



MRTP investment-control changes in 1991 did not immediately repeal the Act

Pre-1991 — MRTP asset threshold and pre-entry scrutiny

→ **1991** — these investment controls removed

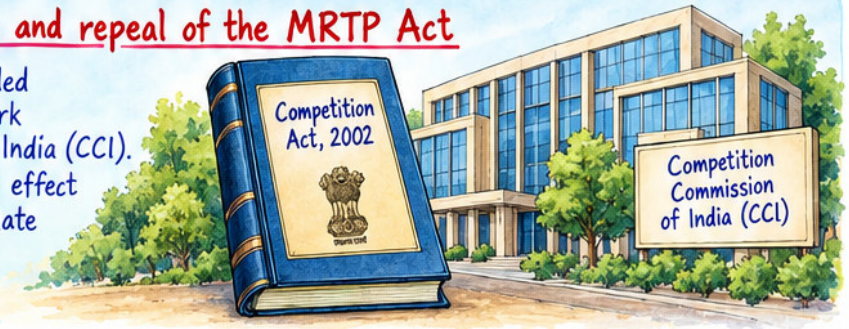
→ **Competition Act, 2002** — later competition-law framework

→ **1 September 2009** — MRTP Act repeal took effect



The Competition Act, 2002 and repeal of the MRTP Act

The Competition Act, 2002 provided the new competition-law framework and the Competition Commission of India (CCI). The MRTP Act was repealed with effect from 1 September 2009; do not date its repeal to 2002.

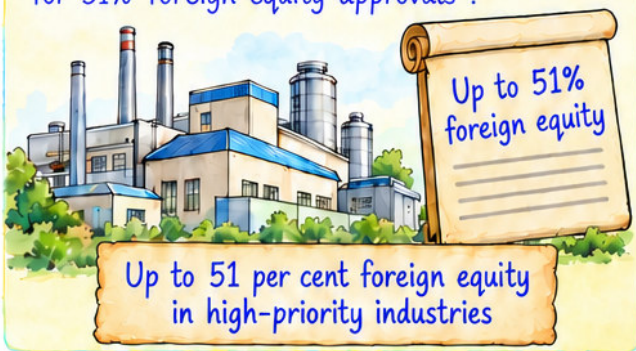


Sources: Day 16 Source Index | Topic 155 | Section 2.4

Foreign investment, foreign technology and phased manufacturing

Foreign direct investment (FDI)

approval would be given for direct foreign investment up to 51 per cent foreign equity in high-priority industries. Annex III listed 34 such categories, under the title "List of industries for automatic approval of foreign technology agreements and for 51% foreign equity approvals".



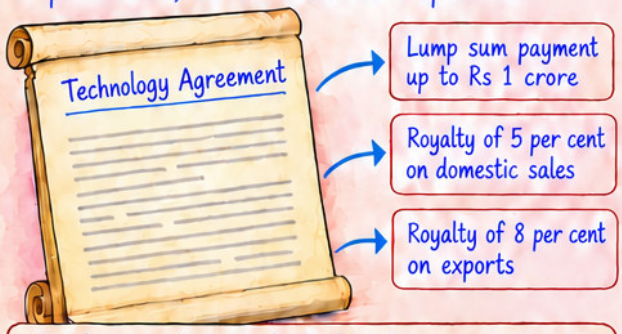
Investment facilitation

the 1991 policy provided for a special Empowered Board to negotiate with a number of large international firms. This was a route for negotiating major investment proposals, alongside the policy's automatic-approval provisions. Separately, the Foreign Investment Promotion Board (FIPB) was abolished in 2017-18 following the Budget decision of 1 February 2017.



Foreign technology agreements

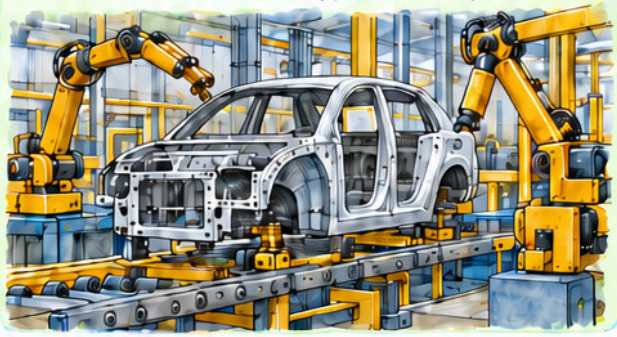
in the Annex III industries they got automatic permission up to a lump sum payment of Rs 1 crore, a royalty of 5 per cent on domestic sales and 8 per cent on exports. Total payments were limited to 8 per cent of sales over 10 years from the agreement date or 7 years from commencement of production, as the statement specifies.



Total payments were limited to 8 per cent of sales over 10 years from the agreement date or 7 years from commencement of production, as the statement specifies.

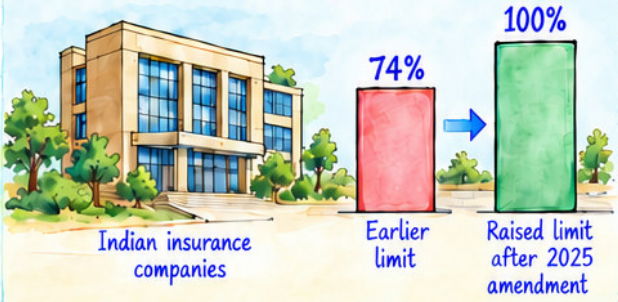
Phased manufacturing programmes

the system of phased manufacturing programmes, run case by case by administrative order to raise local content, would not apply to new projects.

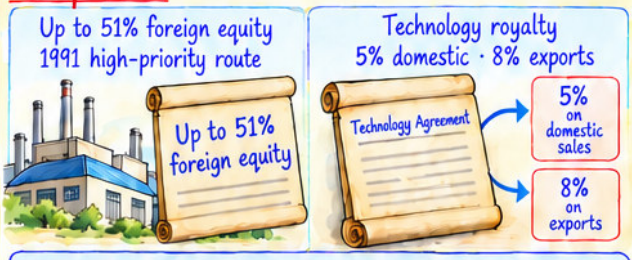


Later FDI, dated

the 51 per cent rule belongs to the 1991 high-priority-industry policy. Subsequent DPIIT policy amendments and applicable law govern later caps. Under the 2025 insurance-law amendment, as confirmed in the Government's 23 April 2026 update, the limit for Indian insurance companies rose from 74 to 100 per cent. This is a later sector-specific change, not a 1991 measure (Topic 90; detailed FDI policy: Topic 543).



Comparison



Historical 1991 measures; not current universal FDI limits

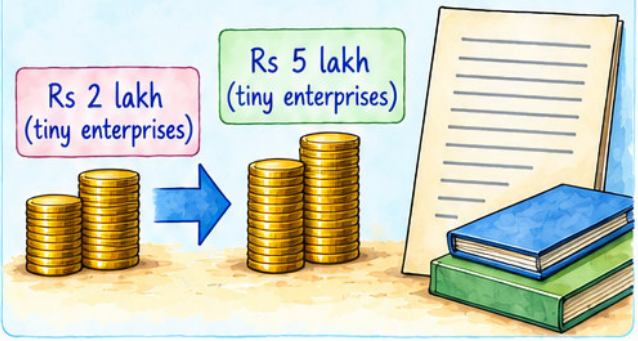
Sources: Day 16 Source Index | Topic 155 | Section 2.5

Small-scale reservation and its end

Reservation meant that certain items could be made only by small-scale units. The 1977 statement had raised the list from 180 items to more than 500.



Separate policy measures for small, tiny and village enterprises followed on 6 August 1991. They raised the investment limit for tiny enterprises from Rs 2 lakh to Rs 5 lakh, and shifted the emphasis away from subsidised or cheap credit, except for specified target groups.



Dereservation progressively opened formerly reserved products to larger producers.



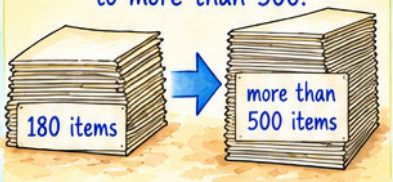
The then Department of Industrial Policy and Promotion (DIPP, now DPIIT) de-reserved the remaining 20 items by notification S.O. 998(E) dated 10 April 2015. All the items reserved earlier for exclusive manufacture in the small-scale sector have now been de-reserved (Ministry of MSME, Lok Sabha, 28 July 2022). The MSME sector comes on Day 39 (Topic 385).



Timeline of key developments

1977

The 1977 statement had raised the list from 180 items to more than 500.



6 August 1991

Separate policy measures for small, tiny and village enterprises.



10 April 2015

The remaining 20 items de-reserved by notification S.O. 998(E) dated 10 April 2015.



Sources: Day 16 Source Index | Topic 155 | Section 2.6

The Budget, the rupee and the outcomes

The 1991 Budget

presented by the Finance Minister, Manmohan Singh, on 24 July 1991, the same day as the statement. It said "we have announced important changes in industrial policy".



The rupee

The Budget speech refers to the exchange rate adjustments of 1 and 3 July 1991.

In 1991 the rupee was devalued as an immediate measure to resolve the balance of payments crisis, and this led to an increase in the inflow of foreign exchange.



Historical sequence; later growth data have their own vintages

1 and 3 July 1991 exchange-rate changes → 24 July 1991 industrial policy → 24 July 1991 Budget

Outcomes of the reforms

Outcome	Before the reforms	After the reforms
End of the licence raj	Licensing over most industry	18 industries in Annex II in 1991; a shorter list now.
GDP growth (per cent a year)	5.6 in 1980-91	6.4 in 1992-2001; 7.8 in 2002-07; 8.2 in 2007-12
Industry growth (per cent a year)	7.1 in 1980-91	6.5 in 1992-2001; 9.4 in 2002-07; 7.4 in 2007-12
Foreign investment (FDI and FII)	About US$ 100 million in 1990-91	About US$ 30 billion in 2017-18
FDI inflows	Not given for 1991	US$ 45.14 billion in 2014-15; US$ 84.83 billion in 2021-22, called a record in September 2024; US$ 70.95 billion in 2023-24
Foreign exchange reserves	About US$ 6 billion in 1990-91	About US$ 413 billion in 2018-19 (later figures: Topic 114)

Services contributed most strongly to the growth described here. Over the periods shown, agriculture grew by 3.6 per cent a year in 1980-91 and by 2.3 per cent in 2002-07.



Sources: Day 16 Source Index | Topic 155 | Section 2.7

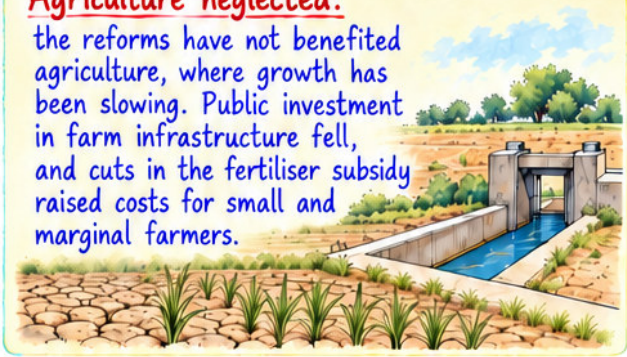
Criticisms and the later steps

Debate about the reform period:

the following criticisms concern the distribution of gains, sectoral performance and employment. They should not be read as undated claims about every later year.

Agriculture neglected:

the reforms have not benefited agriculture, where growth has been slowing. Public investment in farm infrastructure fell, and cuts in the fertiliser subsidy raised costs for small and marginal farmers.



Industry slowed:

cheaper imports and low investment in infrastructure reduced the demand for domestic goods.



Employment:

output growth did not generate sufficient employment opportunities. The key question is whether rising production also creates enough productive jobs.



Social spending:

the reforms placed limits on the growth of public expenditure, especially in the social sectors.



Later policy responses and initiatives:

National Manufacturing Policy:

announced on 4 November 2011. Its goals were to raise the share of manufacturing in GDP to 25 per cent and to create 100 million additional jobs by 2022.



Make in India:

launched by Prime Minister Narendra Modi on 25 September 2014 (Topic 293).



Production Linked Incentive (PLI) schemes:

on 11 November 2020 the Union Cabinet approved PLI schemes for 10 key sectors, with an outlay of Rs 1,45,980 crore over five years. These came on top of the PLI schemes already notified for mobile and electronic components, pharmaceutical ingredients and medical devices.
By 2023 the schemes covered 14 key sectors, with an outlay of Rs 1.97 lakh crore.





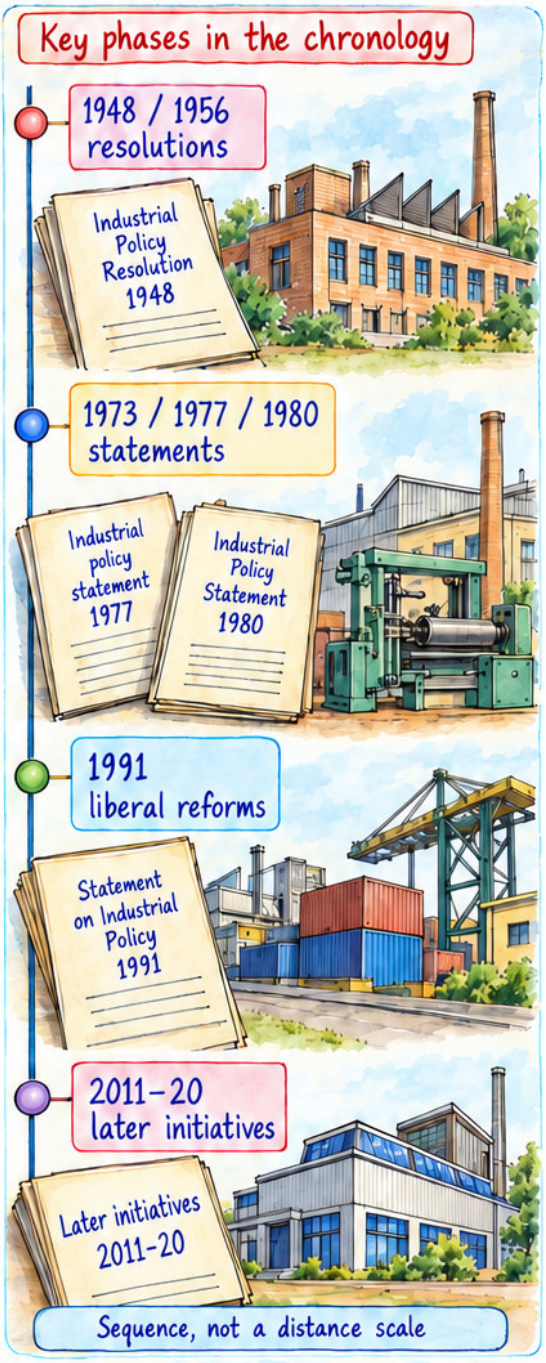
Disinvestment in detail (Topic 784), reforms after 1991 (Topic 624) and privatisation and globalisation (Topic 993) come on other days.

Sources: Day 16 Source Index | Topic 155 | Section 2.8

Extra section: a chronology of industrial policy, 1948 to 2020 (1/2)

Date	Event
6 April 1948	Industrial Policy Resolution
30 April 1956	Industrial Policy Resolution with Schedules A and B
2 February 1973	Government decisions on industrial policy (high-priority industries)
23 December 1977	Industrial policy statement (small-scale, tiny and cottage industries; District Industries Centres)
23 July 1980	Industrial Policy Statement (competition; nucleus plants)
1 and 3 July 1991	Exchange rate adjustments of the rupee
24 July 1991	Statement on Industrial Policy, and the Budget speech for 1991-92
6 August 1991	Policy measures for small, tiny and village enterprises
2002	Competition Act; MRTP repeal took effect on 1 September 2009

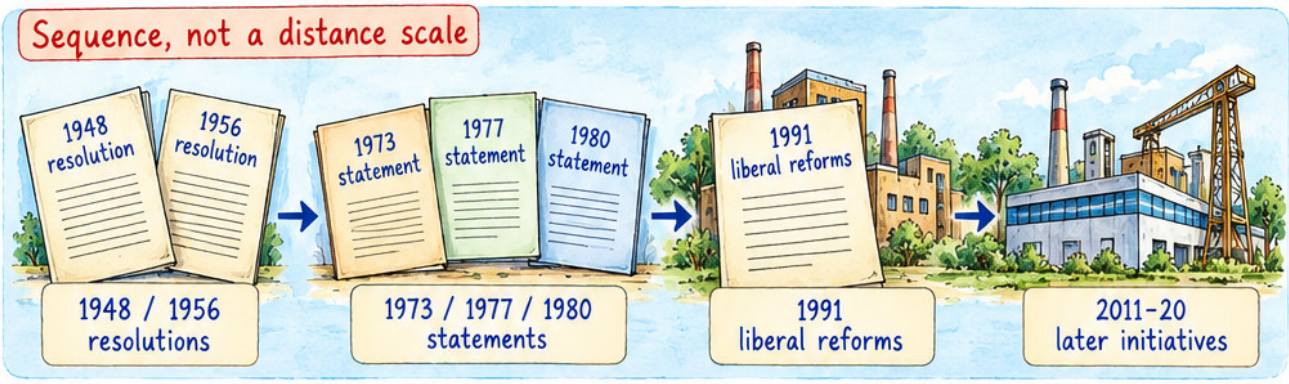
Key phases in the chronology





Sources: Day 16 Source Index | Topic 155 | Section 3

Extra section: a chronology of industrial policy, 1948 to 2020 (2/2)



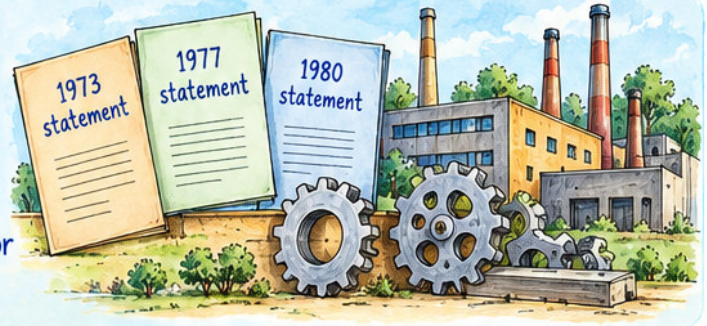
Date	Event
4 November 2011	National Manufacturing Policy announced
25 September 2014	Make in India launched
10 April 2015	The last 20 items reserved for small-scale units de-reserved
1 February 2017	Budget speech decides to abolish the FIPB in 2017-18
11 November 2020	Cabinet approves PLI schemes for 10 key sectors

What the chronology shows:

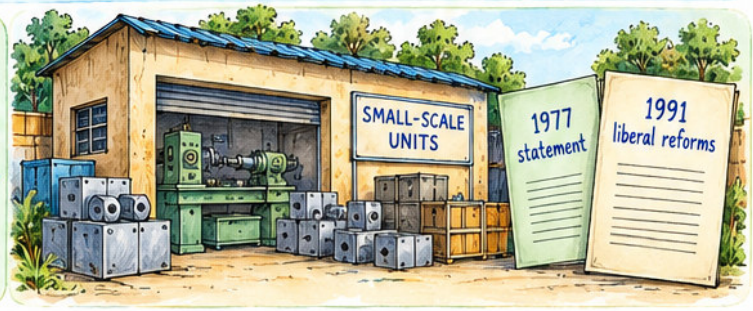
- The devaluation came first, in the first week of July 1991. The industrial policy and the Budget followed three weeks later, on the same day.



- Controls were loosened in stages before 1991 too: the 1973 statement opened some industries to large houses and foreign companies, and the 1980 statement spoke of competition. The 1991 statement made the open door the rule and controls the exception.



- Small-scale reservation, which the 1977 statement had widened, outlived the 1991 reforms by almost 24 years.



Sources: Day 16 Source Index | Topic 155 | Section 3

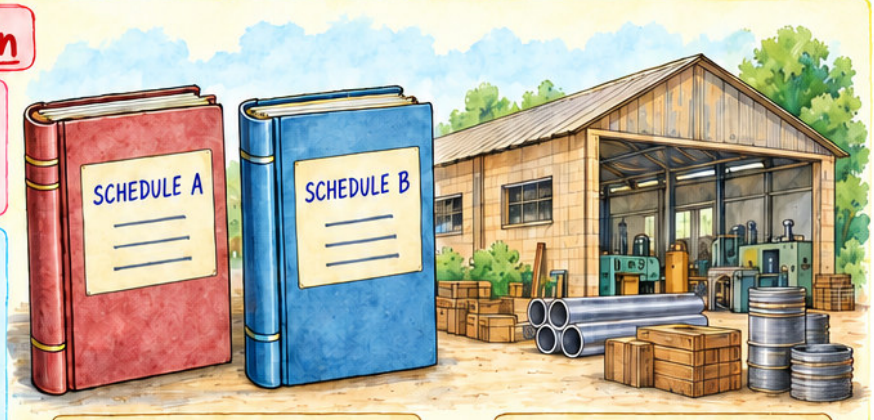
Three common exam traps

1. The 1956 Resolution

✗ "The 1956 Resolution had three schedules, A, B and C."

It printed two schedules, A and B. The third category was not a schedule: it was simply all the remaining industries, left ordinarily to private initiative.

Thus, three categories should not be confused with three printed schedules.



1956 Schedules A and B

Third category remaining industries

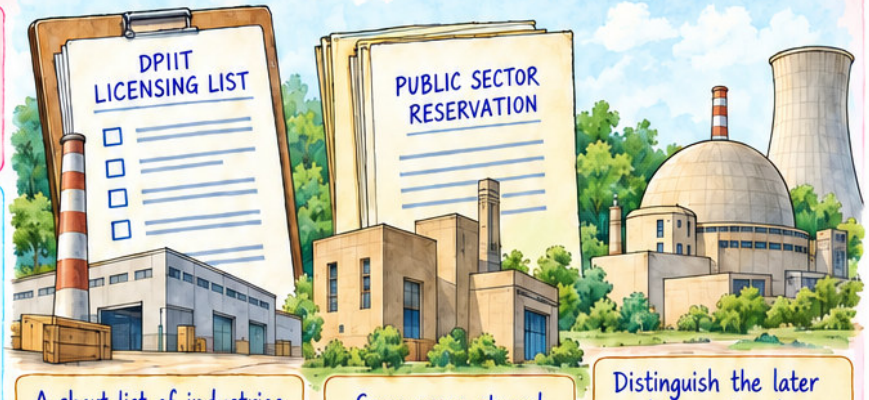
"Schedule C" is not the Resolution's printed heading

2. The 1991 policy

✗ "The 1991 policy abolished industrial licensing and public sector reservation altogether."

Both were cut down, not ended. A short list of industries still needed a compulsory licence, and some areas stayed reserved for the public sector.

Use the dated DPIIT licensing list and distinguish the later nuclear-sector changes from the original 1991 reservations.



A short list of industries still needed a compulsory licence

Some areas stayed reserved for the public sector

Distinguish the later nuclear-sector changes from the original 1991 reservations.

3. The 1991 policy

✗ "The 1991 policy capped all foreign investment at 51 per cent."

Automatic approval up to 51 per cent foreign equity applied to the high-priority industries of Annex III; it was not a ceiling for all FDI.

Major investments by large international firms could also be negotiated through a special Empowered Board.

These are different routes: automatic approval for the specified industries, and negotiation for major projects.

Later sector-specific limits are separate from the original 1991 rule, including the later 100 per cent limit for insurance companies.



Automatic approval up to 51 per cent foreign equity applied to the high-priority industries of Annex III; it was not a ceiling for all FDI.

Major investments by large international firms could also be negotiated through a special Empowered Board.

Later sector-specific limits are separate from the original 1991 rule, including the later 100 per cent limit for insurance companies.

Sources: Day 16 Source Index | Topic 155 | Section 4

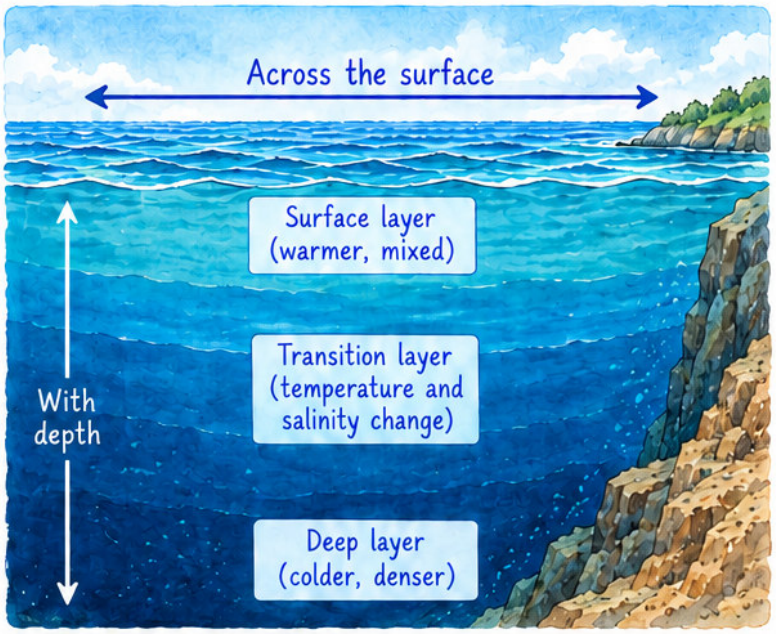
Ocean water: heat, salt and density

Temperature tells us how hot or cold seawater is. Salinity tells us how much dissolved salt it contains. These are different properties: warm water is not automatically saltier.

Follow two balances

- Heat gained and lost changes temperature.
- Freshwater gained and lost changes salt concentration.





Why they matter

Temperature and salinity help determine density: mass per unit volume. Density differences affect layering and ocean circulation; pressure also affects density.

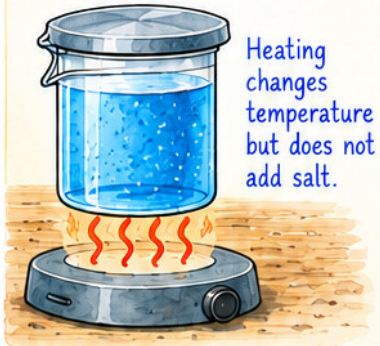
Two directions to study

- Across the surface: compare latitudes, coasts and ocean basins.
- Down the water column: compare surface, transition and deep layers.

Think it through

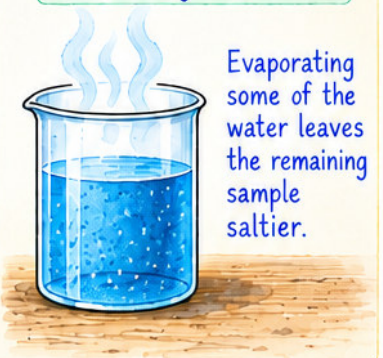
Heating a covered seawater sample does not add salt. Evaporating some of its water leaves the remaining sample saltier.

Temperature changes



Heating changes temperature but does not add salt.

Salinity rises



Evaporating some of the water leaves the remaining sample saltier.

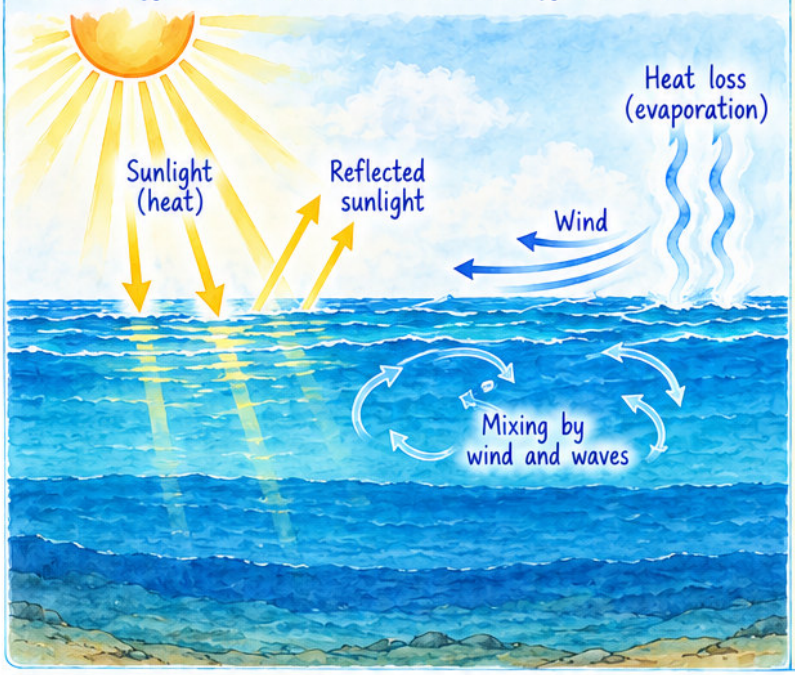
From properties to ocean behaviour



Source reference: NOAA | Concept-first teaching edition

Why does the ocean warm slowly?

Sunlight supplies most of the heat to the upper ocean. Some energy is reflected, while absorbed energy warms the water.



Three reasons for a slow response

1. High heat capacity



Water needs much energy for a small temperature rise.

2. Mixing



Wind and waves spread heat through a layer, rather than heating only a thin surface.

3. Evaporation



Escaping water carries heat away from the surface.

The heat budget

Temperature rises when heat gain exceeds heat loss. It falls when heat loss exceeds heat gain.

Gain greater than loss: warming



Loss greater than gain: cooling

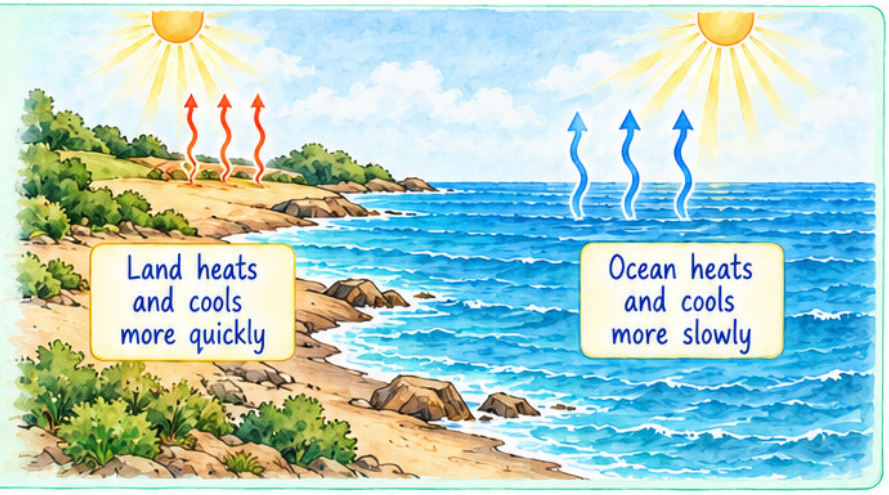


The ocean exchanges heat with the atmosphere through radiation, evaporation and direct contact. Currents also carry heat from one region to another.

Application

Coastal climates are often moderated because the nearby ocean stores heat and releases it gradually.

Ocean water generally heats and cools more slowly than land.

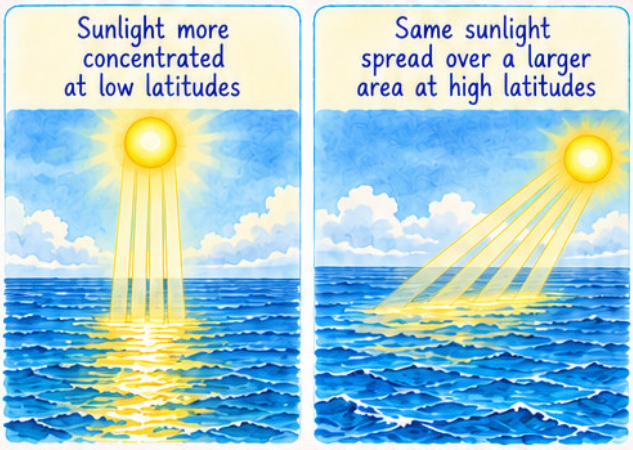


References: Day 16 Source Index | Topic 156

Why surface temperatures differ

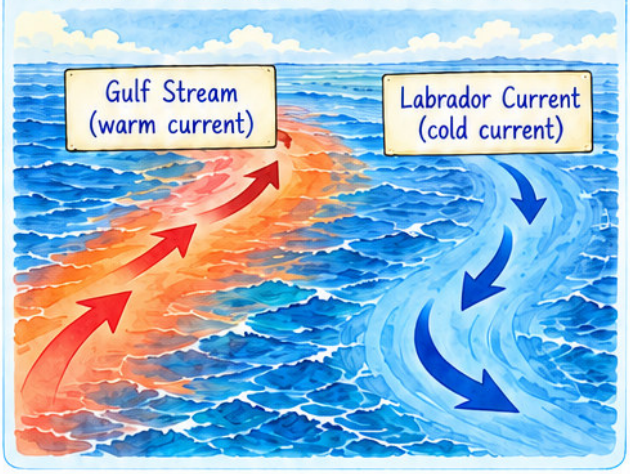
1. Latitude sets the broad pattern

Low latitudes receive more concentrated sunlight over the year. Poleward, the same incoming rays spread over a larger area, so the ocean surface is generally cooler.



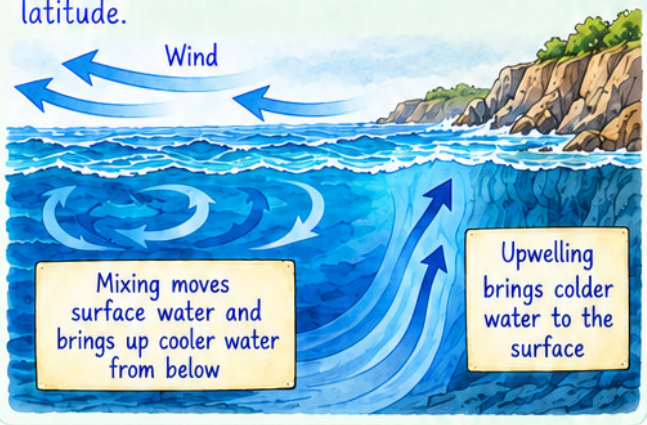
2. Currents modify the pattern

Warm currents carry heat towards cooler regions. Cold currents bring cooler water into warmer regions. The Gulf Stream is a warm current; the Labrador Current is cold.



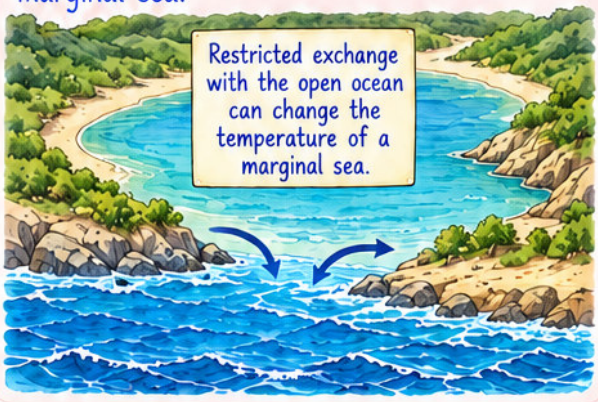
3. Winds and mixing matter

Winds move surface water and mix it with water below. Upwelling can bring colder water to the surface, cooling a coast even at low latitude.



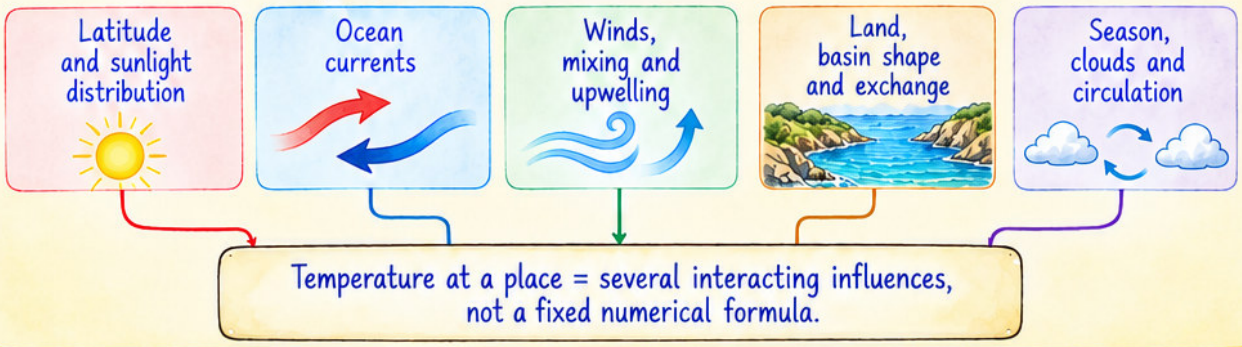
4. Land and basin shape matter

Land heats and cools faster than water. Nearby land, seasonal winds and restricted exchange can change the temperature of a marginal sea.



5. Read the pattern, not a fixed formula

Surface temperature also varies with season, clouds and circulation. It does not fall by one identical amount at every degree of latitude.



References: Day 16 Source Index | Topic 156

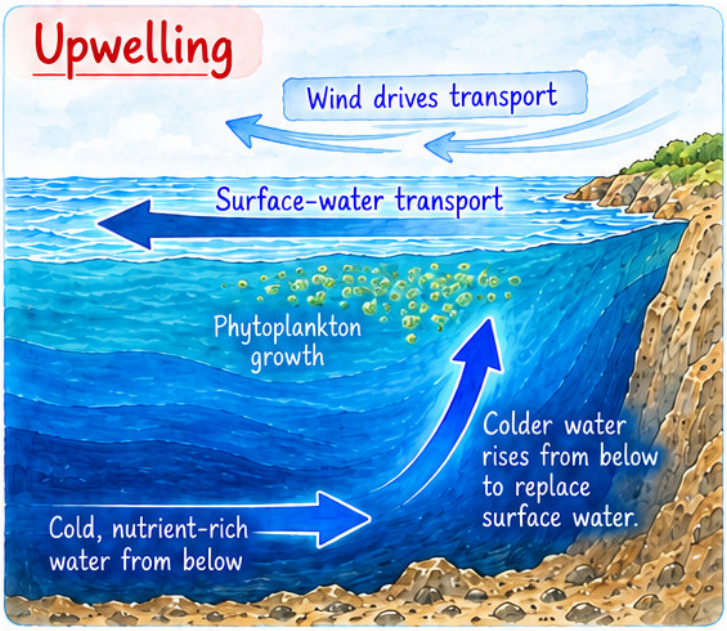
How winds bring cold water upward

Upwelling is the rise of deeper water to replace surface water that has moved away.

Read the mechanism

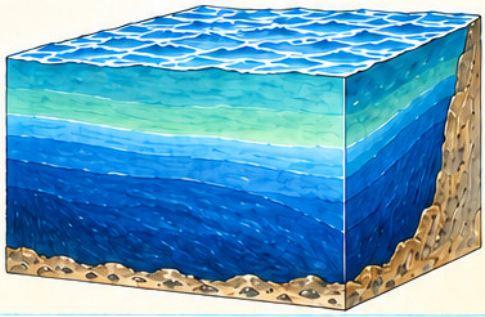
1. Wind drives surface-water transport.
2. When that transport moves water away from a coast, a gap develops near the surface.
3. Colder water rises from below to replace it.

Upwelling

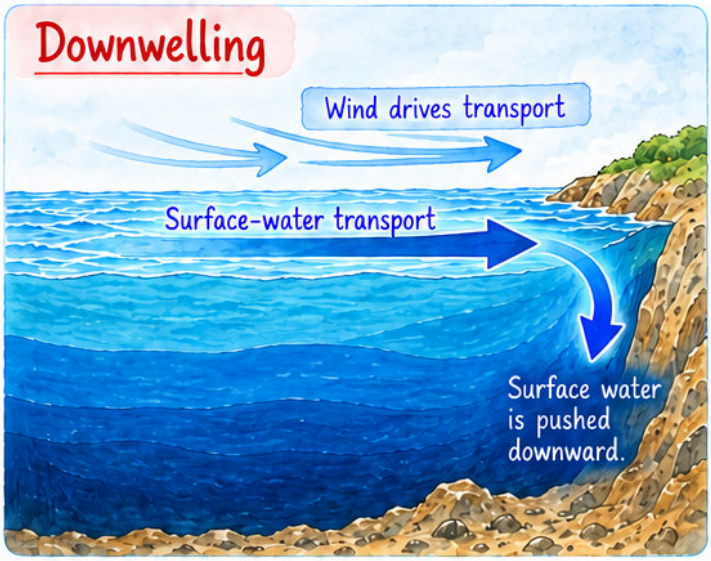


Why the coast becomes cooler

The replacement water has been below the strongly sun-heated surface. It is usually colder and often nutrient-rich.

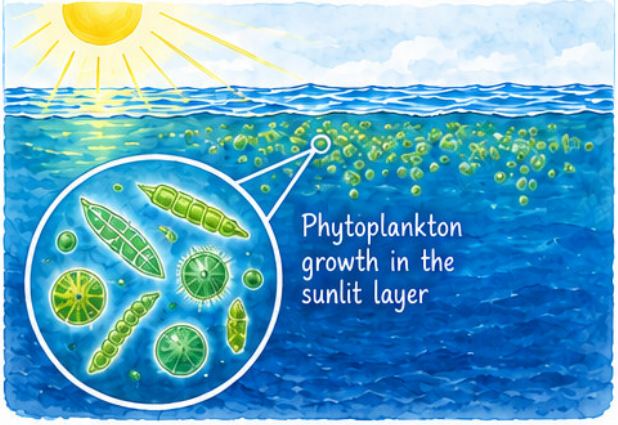


Downwelling



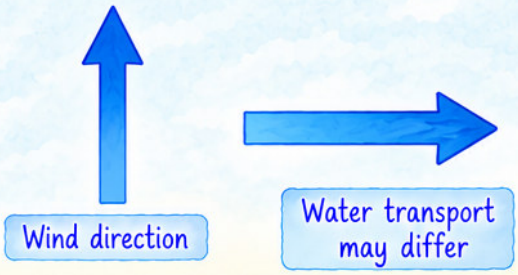
The biological link

Nutrients reaching the sunlit layer support phytoplankton growth and can sustain productive fishing grounds.



Important distinction

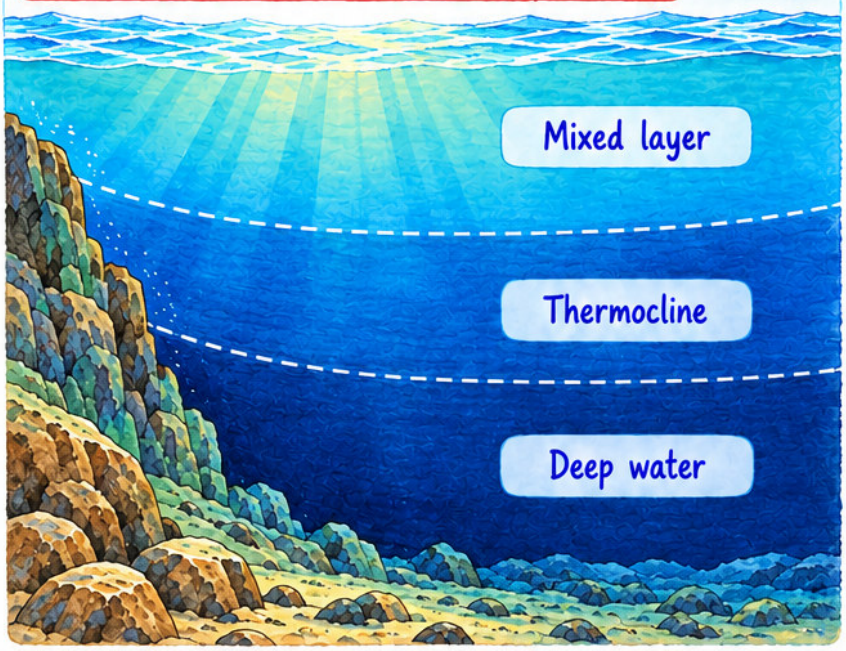
Wind direction and water-transport direction are not always the same. Earth's rotation helps determine the transport; alongshore winds can cause coastal upwelling.



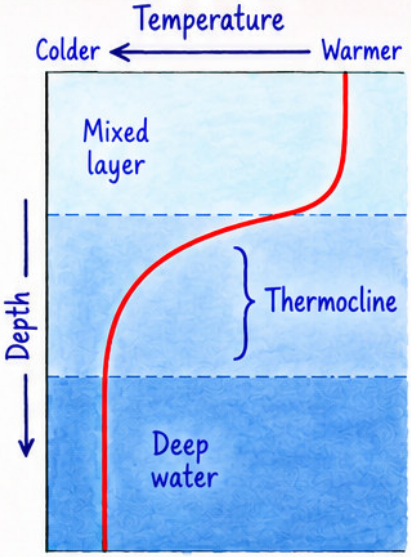
Source reference: NOAA | Concept-first teaching edition

Temperature with depth: three zones

A common low-latitude profile



Typical temperature profile



Not to scale; boundaries vary.

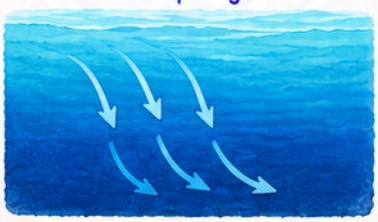
1. Mixed layer

Sunlight warms the upper ocean. Wind and waves mix this water, so temperature changes relatively little within the layer.



2. Thermocline

Below the mixed layer, temperature falls rapidly with increasing depth. This is a transition zone, not the deep layer itself.



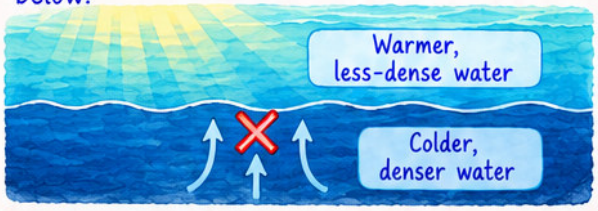
3. Deep water

Below the main thermocline, the water is cold and temperature usually changes Much more slowly with depth.



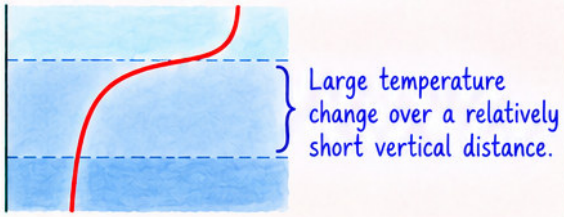
Why the contrast develops

Sunlight is absorbed mainly in the upper ocean. A warm, less-dense surface layer resists mixing with colder, denser water below.



Read a temperature profile

Moving downward through the thermocline means a large temperature change over a relatively short vertical distance.



Remember

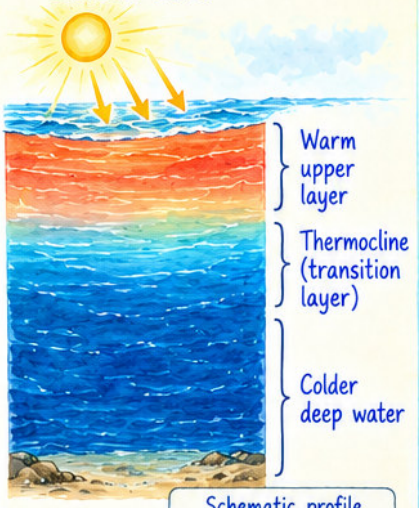
Layer depths vary by place and season. This is a schematic pattern, not three fixed-depth compartments for every ocean.

Source reference: NOAA | Concept-first teaching edition

Layers change with latitude and season

Tropics

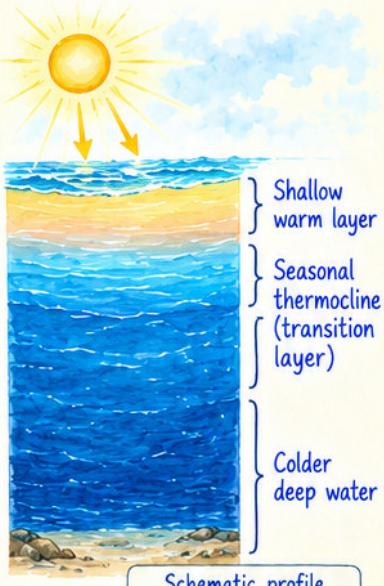
- Strong year-round surface heating commonly maintains a warm upper layer above colder deep water, with a persistent thermocline between them.



Schematic profile (not to scale)

Temperate seas – summer

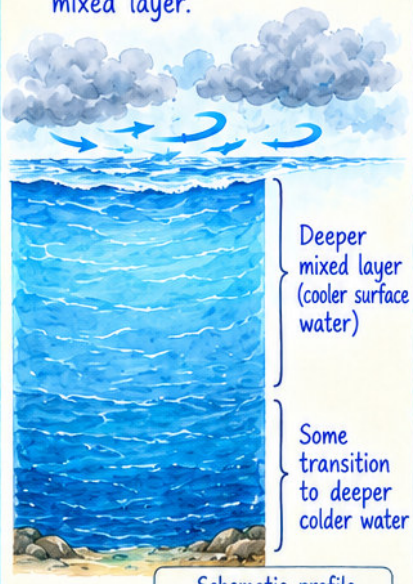
- Summer heating creates a shallow warm layer and a seasonal thermocline.



Schematic profile (not to scale)

Temperate seas – winter

- Winter cooling and stronger mixing can weaken this seasonal contrast and deepen the mixed layer.



Schematic profile (not to scale)

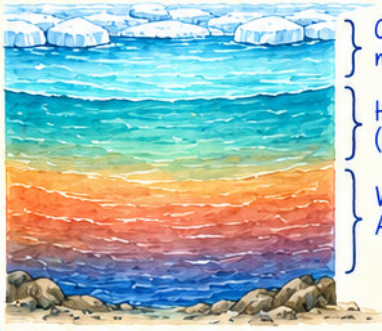
Polar seas

- A warm-surface thermocline may be weak or absent.
- But cold water does not mean that the entire water column is uniform.



An Arctic example (not all polar oceans)

- Relatively fresh, near-freezing surface water can lie above saltier water and a warmer Atlantic-origin layer.
- A strong salinity gradient can limit vertical mixing.



Schematic profile (not to scale)

The key idea

- Temperature layering and salinity layering are related but different. A weak thermocline does not prove that there is no stratification.

Temperature layering
Controls density through temperature differences.



Salinity layering
Controls density through salinity differences.



Always ask

- Which region, which season and which property does this profile describe?

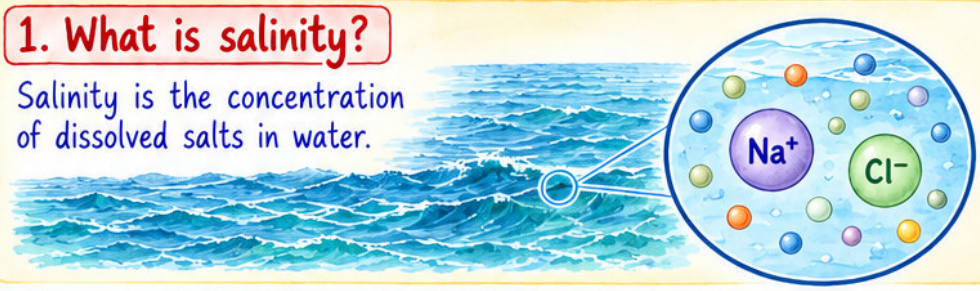


Source reference: NOAA | Concept-first teaching edition

Salinity: salt in a seawater sample

1. What is salinity?

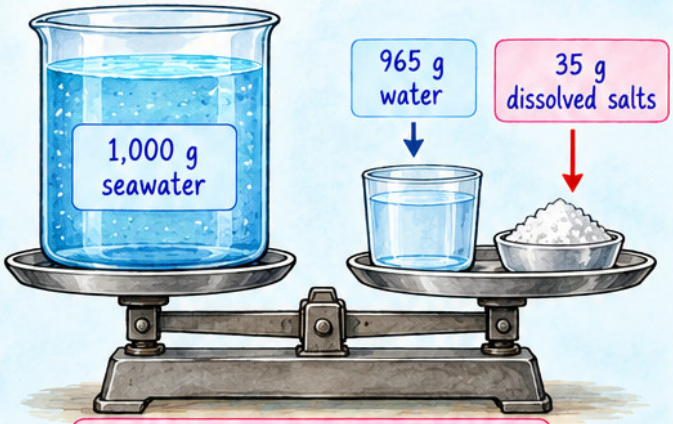
Salinity is the concentration of dissolved salts in water.



Sodium and chloride are the dominant ions. Seawater contains many salts, not only sodium chloride.

2. Understand 35 parts per thousand

A 1,000 g sample of seawater at about 35 ‰. contains about 35 g of dissolved salts and 965 g of water. This is about 3.5% by mass.



965 g water + 35 g dissolved salts = 1,000 g seawater (about 3.5% by mass)

3. The denominator matters

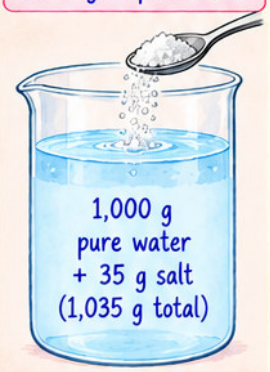
It is 35 g of salt in 1,000 g of seawater, not 35 g added to 1,000 g of pure water.

35 g in 1,000 g of seawater



✓

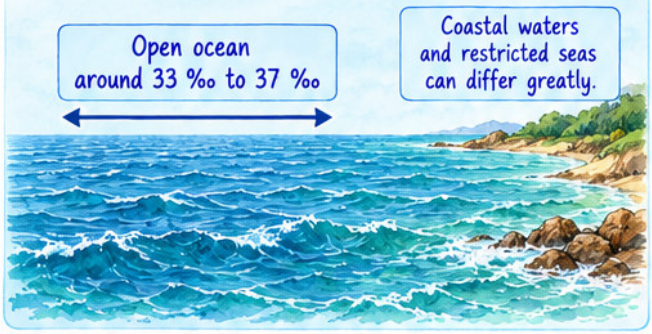
35 g added to 1,000 g of pure water



✗

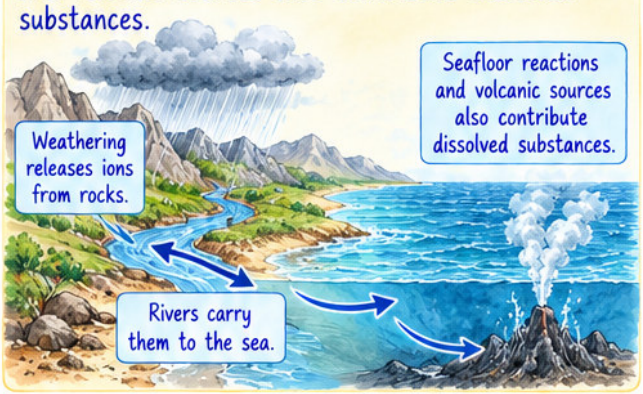
4. A useful scale

Average ocean salinity is about 35 ‰. Much open-ocean water lies around 33–37 ‰, but coastal waters and restricted seas can differ greatly.



5. Where do the salts come from?

Weathering releases ions from rocks on land; rivers carry them to the sea. Seafloor reactions and volcanic sources also contribute dissolved substances.



6. What is dissolved?

Sodium and chloride are the dominant ions. Seawater contains many salts, not only sodium chloride.



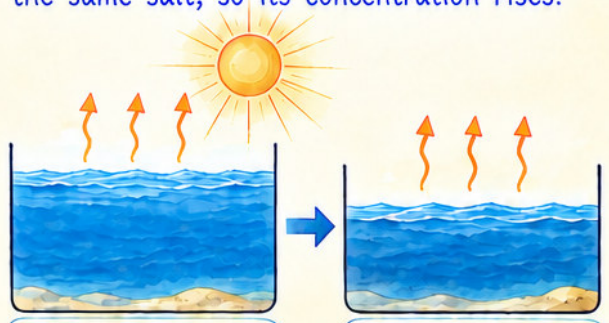
Source reference: NOAA | Concept-first teaching edition

What makes seawater saltier or fresher?

Follow the water, then the salt.

Evaporation → salinity rises

Water leaves as vapour; most dissolved salts remain. Less water holds nearly the same salt, so its concentration rises.

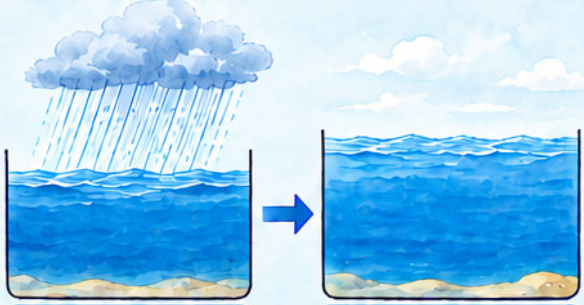


Before evaporation (lower salinity)

After evaporation (higher salinity)

Rain and rivers → salinity falls

Freshwater is added. The existing salts are spread through more water, so the surface is diluted.

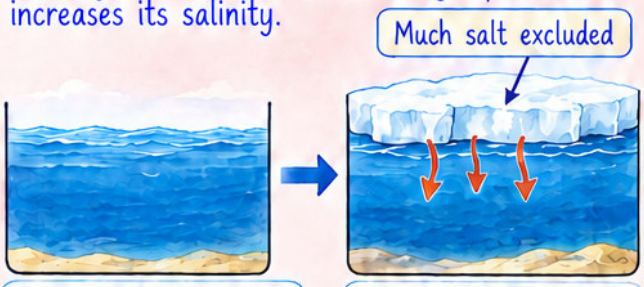


Before input (higher salinity)

After rain/river input (lower salinity)

Sea-ice formation → remaining water becomes saltier

Growing sea ice excludes much of the salt. Salt rejected into the surrounding liquid water increases its salinity.

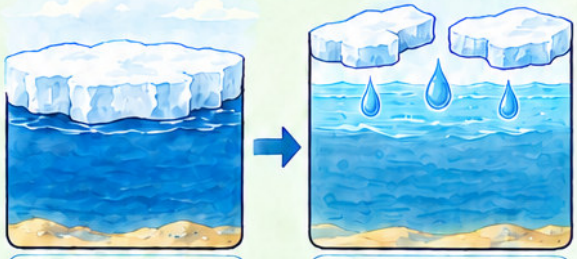


Before sea-ice formation (lower salinity)

After sea-ice formation (higher salinity)

Ice melting → surface water becomes fresher

Meltwater adds freshwater and dilutes seawater.

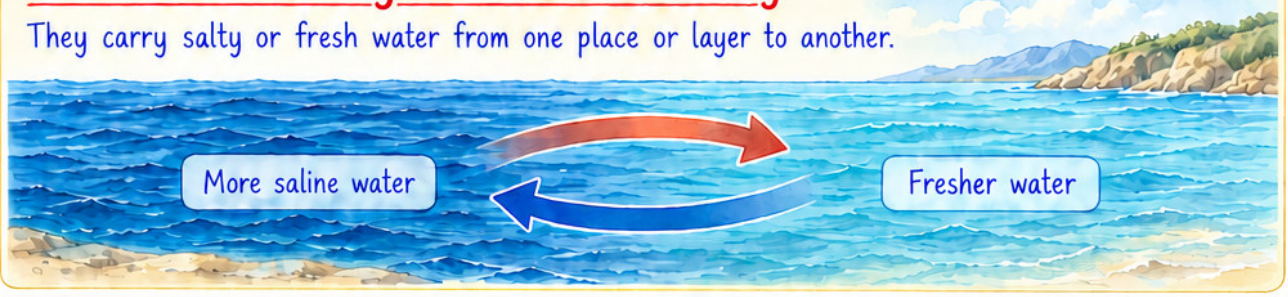


Before melting (higher salinity)

After ice melting (lower salinity)

Currents and mixing redistribute salinity

They carry salty or fresh water from one place or layer to another.



Memory rule

Remove freshwater: concentrate the salts.
Add freshwater: dilute the salts.

Qualification

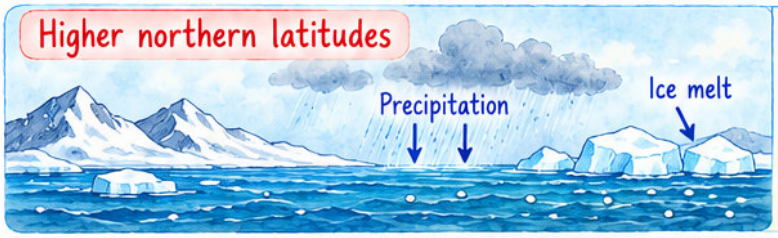
These processes can act together; the observed salinity reflects their combined balance and water movement.

References: Day 16 Source Index | Topic 156

Why the saltiest belt is not the equator

The surface pattern follows the freshwater balance, not temperature alone.

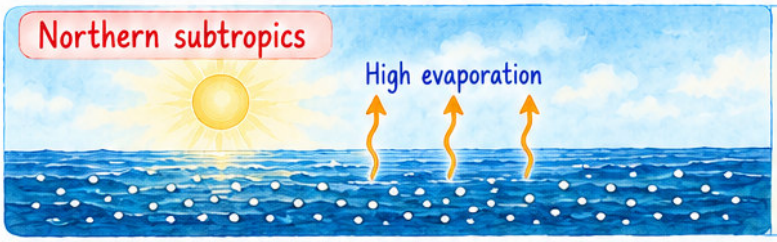
Higher northern latitudes



Higher latitudes: often fresher surfaces

Lower evaporation, precipitation and seasonal ice melt can reduce salinity. Sea-ice formation locally raises the salinity of the remaining liquid water.

Northern subtropics



Subtropical belts: evaporation wins

Around 20°–30° north and south, descending dry air often brings little rain. Strong evaporation with limited freshwater input favours high surface salinity.

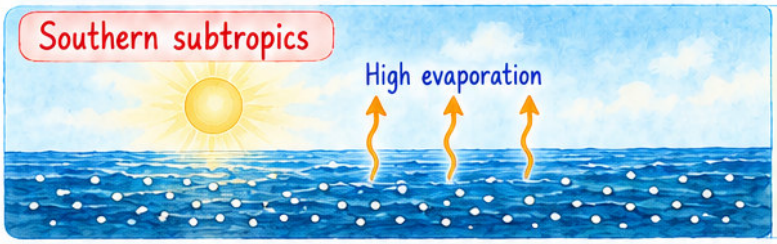
Equatorial belt



Equatorial belt: warm but rainy

Strong heating encourages evaporation, but frequent heavy rain supplies much freshwater. Dilution keeps surface salinity lower than in the dry subtropics.

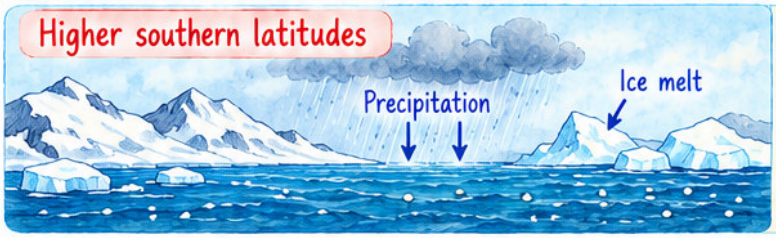
Southern subtropics



Subtropical belts: evaporation wins

Around 20°–30° north and south, descending dry air often brings little rain. Strong evaporation with limited freshwater input favours high surface salinity.

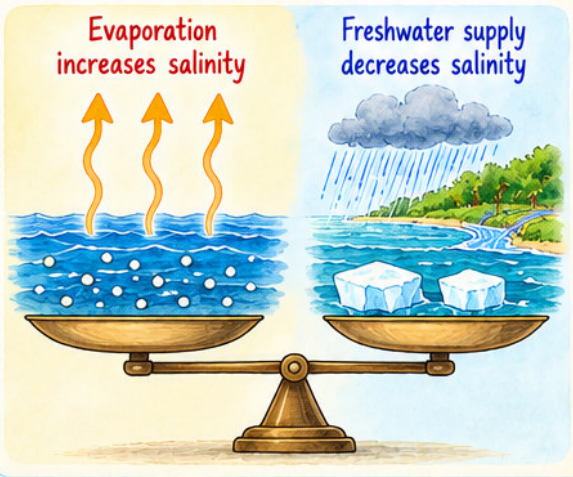
Higher southern latitudes



Higher latitudes: often fresher surfaces

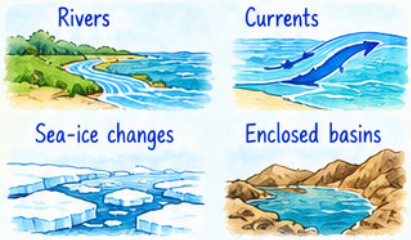
Lower evaporation, precipitation and seasonal ice melt can reduce salinity. Sea-ice formation locally raises the salinity of the remaining liquid water.

Surface salinity depends on the balance



Surface salinity is higher where evaporation exceeds the supply of freshwater from rainfall, river runoff and ice melt, and lower where freshwater input is large enough to dilute the surface water.

Local conditions modify every belt



Rivers, currents, sea-ice changes and enclosed basins can interrupt the broad latitudinal pattern.

Exam reasoning

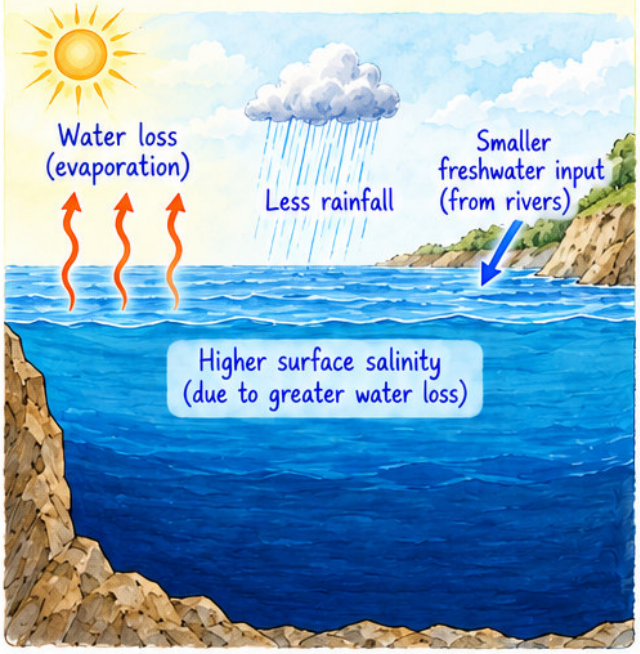
"Hottest water must be saltiest" is false. Compare evaporation with rainfall, runoff and ice processes before predicting salinity.

Source reference: NOAA | Concept-first teaching edition

Arabian Sea and Bay of Bengal: explain it

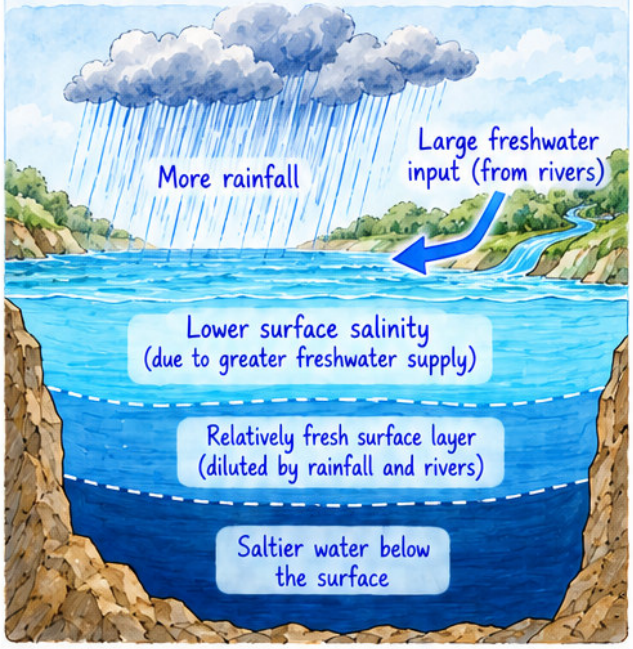
Arabian Sea

Evaporation removes a large amount of water. Freshwater input is smaller relative to this loss, so dissolved salts become more concentrated.



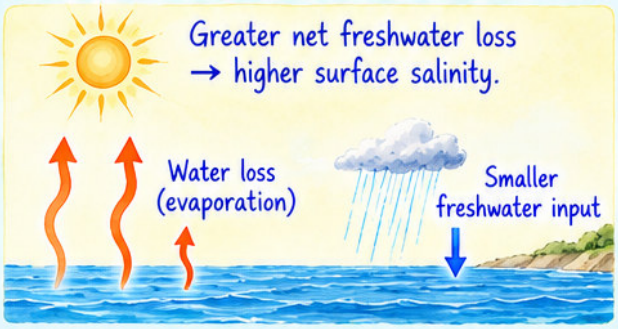
Bay of Bengal

Heavy rainfall and major rivers add large amounts of freshwater. This dilutes the surface and forms a relatively fresh upper layer.

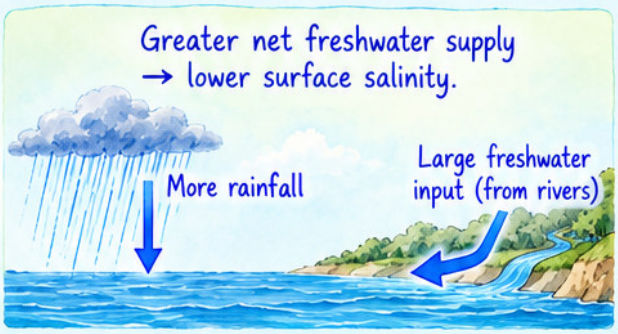


Trace the cause and effect

Greater net freshwater loss → higher surface salinity.

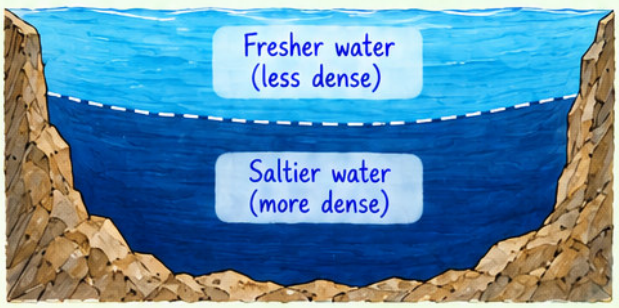


Greater net freshwater supply → lower surface salinity.



Why the fresh layer matters

Fresher water is less dense than saltier water at the same temperature and pressure. It can help maintain stable layering and reduce mixing with water below.



Below the surface

Saltier water can occur beneath the Bay's fresh surface layer; the surface comparison does not describe every depth.



Qualification

Monsoons, river discharge and circulation change the pattern through the year.

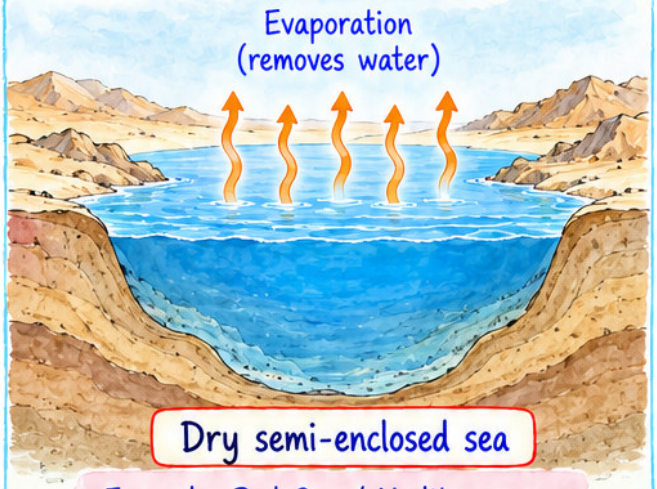
Source reference: Oceanography | Concept-first teaching edition

Why nearby seas can have different salinity

Think of a sea as a water-and-salt budget.

Dry climate + evaporation

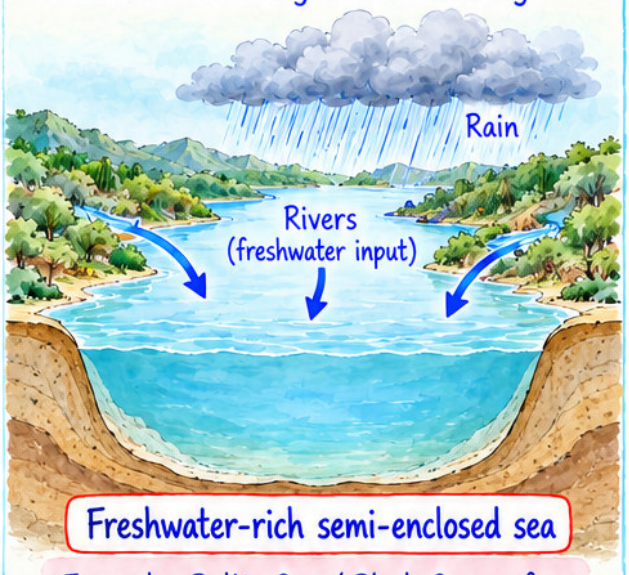
The Red Sea and Mediterranean Sea lose much water by evaporation. Limited freshwater supply helps make them saltier than many open-ocean waters.



Example: Red Sea / Mediterranean

Wet drainage basin + river inflow

Large freshwater inputs help keep the Baltic Sea and the surface of the Black Sea relatively low in salinity.



Example: Baltic Sea / Black Sea surface

Restricted exchange amplifies local effects

A narrow connection limits how quickly a sea exchanges water with the open ocean. It does not automatically make the sea salty: the freshwater balance still matters.



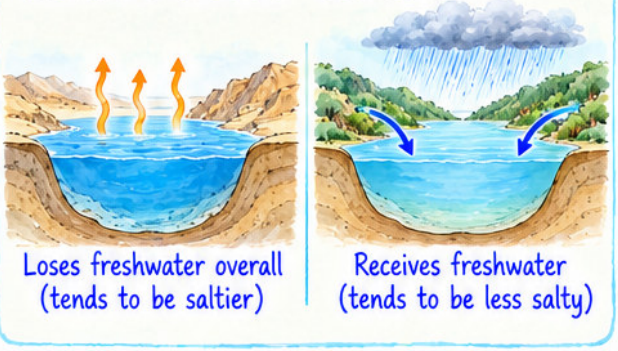
Connected is not landlocked

The Red Sea exchanges water with the Gulf of Aden through Bab el-Mandeb. Its high salinity does not mean that it has no outlet.



Application

Two semi-enclosed seas can have opposite salinity patterns if one loses freshwater overall and the other receives it.



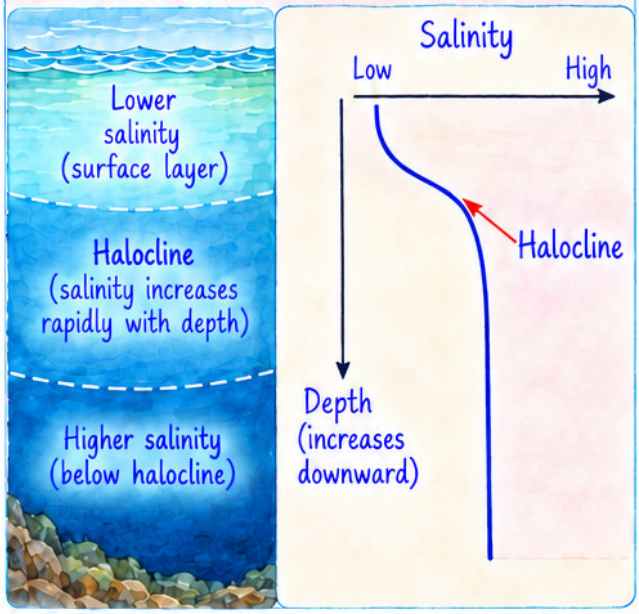
References: Day 16 Source Index | Topic 156

Halocline: a sharp salinity change with depth

A halocline is a layer where salinity changes rapidly with depth. The change can be upward or downward in value as you descend.

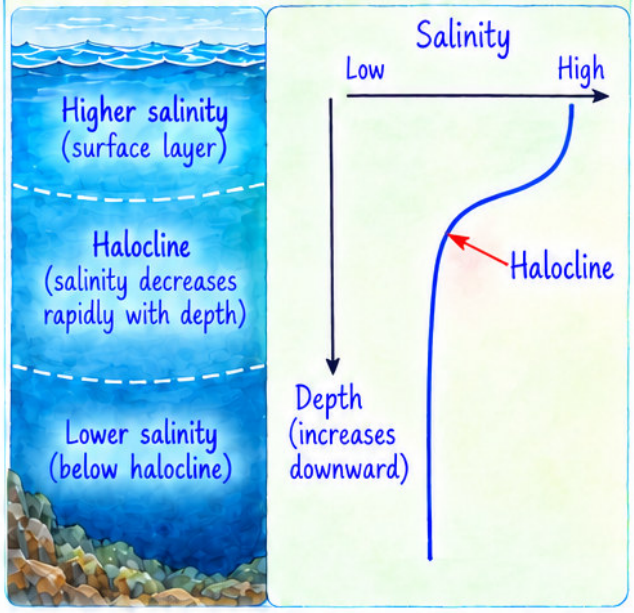
Case A: a fresh surface layer

Rain, river water or ice melt can freshen the top. Salinity then increases sharply below this cap.



Case B: a salty surface layer

Strong evaporation can leave the surface saltier than the water beneath. Salinity may decrease sharply with depth through the transition.



Do not confuse the variables

Thermocline
Rapid temperature change with depth.



Halocline
Rapid salinity change with depth.

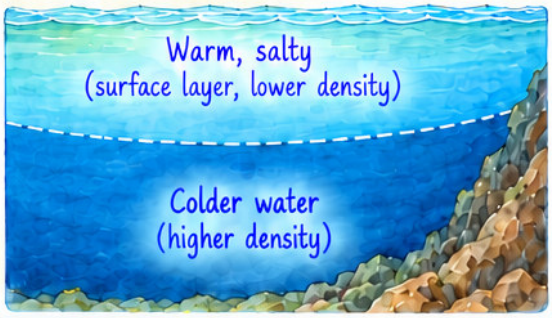


Pycnocline
Rapid density change with depth.



A salinity profile alone is not a density profile

Both temperature and salinity affect density, A warm, salty surface layer can remain above colder water if the combined density structure is stable.



Read the axes first

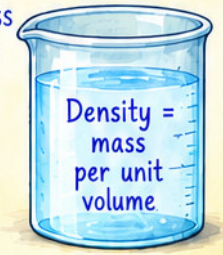
Depth increases downward; salinity increases towards the right.
These are schematic examples, not universal ocean profiles.

Source reference: NOAA | Concept-first teaching edition

Density connects heat, salt and circulation

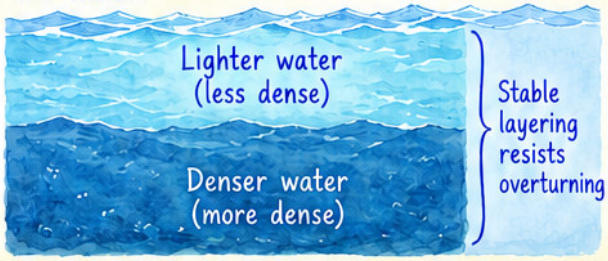
Density means mass per unit volume

Density tells us how much mass is contained in a given volume of water.



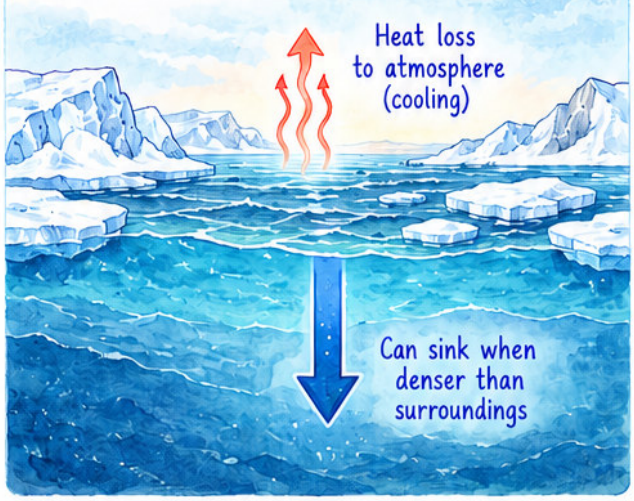
Stable layering

Lighter water lies above denser water. This arrangement resists overturning, although winds and tides can still mix water.



How sinking begins

Surface water that becomes sufficiently dense through cooling and salinity changes can sink beneath surrounding water. This helps form deep water in some high-latitude regions.



Change one factor at a time

Same salinity and pressure (cooling and warming)



At the same salinity and pressure, cooling ordinary seawater usually makes it denser; warming makes it less dense.

Same temperature and pressure (adding or removing salt)



At the same temperature and pressure, adding dissolved salt increases density; adding freshwater lowers it.

Two factors can increase density

Cooling



Lower temperature increases density (at the same salinity and pressure).

Increasing salinity

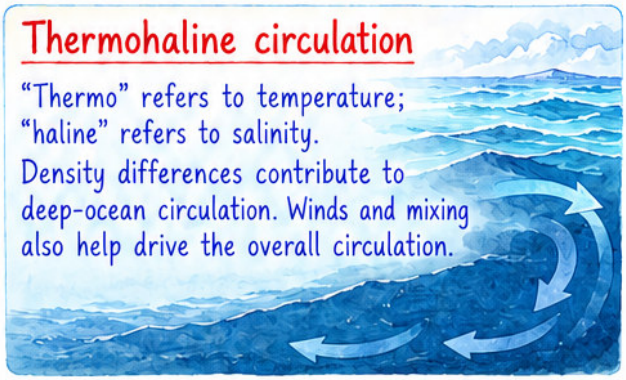


More dissolved salt increases density (at the same temperature and pressure).

Both factors make water denser.

Thermohaline circulation

"Thermo" refers to temperature; "haline" refers to salinity. Density differences contribute to deep-ocean circulation. Winds and mixing also help drive the overall circulation.



Avoid a shortcut



"Saltier always sinks" is incomplete.

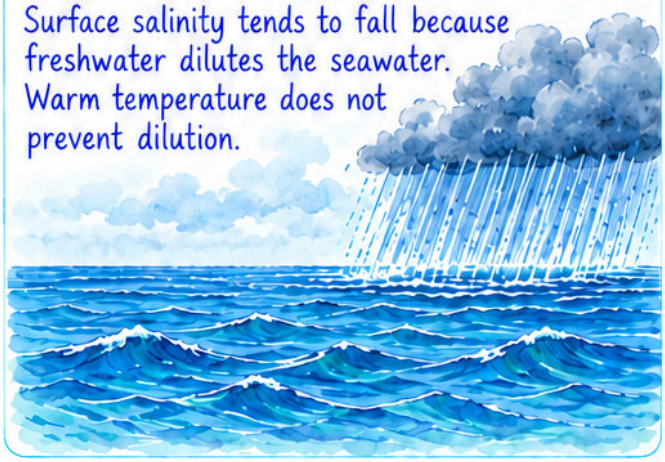
Compare temperature, salinity and pressure together before deciding which water is denser.

Source reference: NOAA | Concept-first teaching edition

Apply the concepts: predict and explain

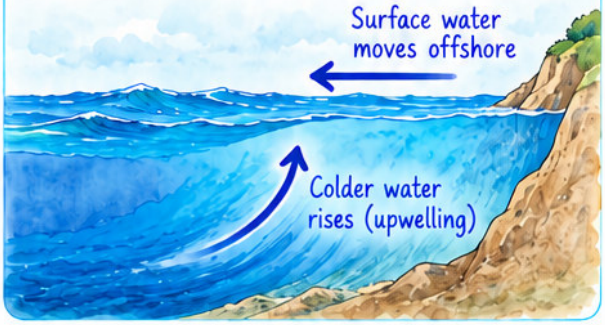
1. Heavy rain falls over a warm ocean surface. What happens first?

Surface salinity tends to fall because freshwater dilutes the seawater. Warm temperature does not prevent dilution.



2. Wind moves coastal surface water offshore. What can follow?

Colder water can rise to replace it. This upwelling may lower coastal surface temperature and bring nutrients upward.



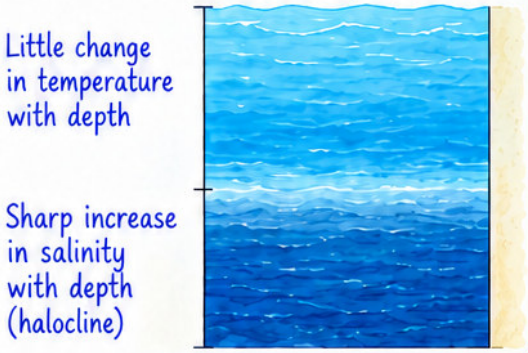
3. A sample loses water by evaporation, with no salt removed. What changes?

Salt concentration rises. The amount of salt need not increase for salinity to increase.



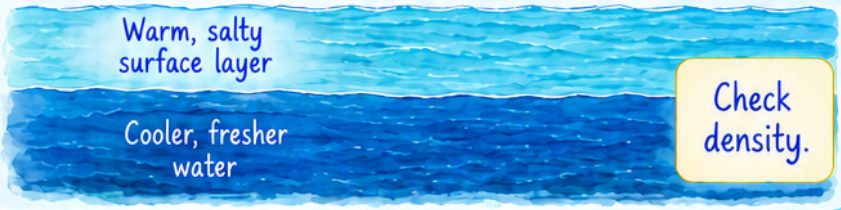
4. A profile shows little temperature change but a sharp salinity increase with depth. Is it unlayered?

No. It has a halocline; temperature alone cannot reveal the full density structure.



5. A salty surface layer lies above fresher water. Must the diagram be impossible?

No. Temperature also matters. Check the combined density before judging stability.



One reasoning route

Identify the process. → Track heat or freshwater. → Predict temperature or salinity. → Consider density and mixing.

Source reference: NOAA | Concept-first teaching edition