

Name: _____ Laboratory Section: _____
Date: _____ Score/Grade: _____

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Exercise 17
Pre-Lab Video



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LAB EXERCISE

Global Climate Systems

Lab Exercise and Activities

SECTION 1

Climatology and Climate Classification

1. Mark your present location with an **X** on Figure 17.1. Place the name of this location next to the **X**. Next, mark the location (approximately) that is most characteristic of your place of birth with an **O** and record the name of that place next to the **O**.

Personal answer

SECTION 2

Climographs for Five Stations

Station #2:

Montreal, Quebec

Total annual rainfall:

103.8 cm

Average annual temperature:

6.0°C

Annual temperature range:

32.1 C°

Distribution of temperature during the year:

Wide range between summer and winter

Distribution of precipitation during the year:

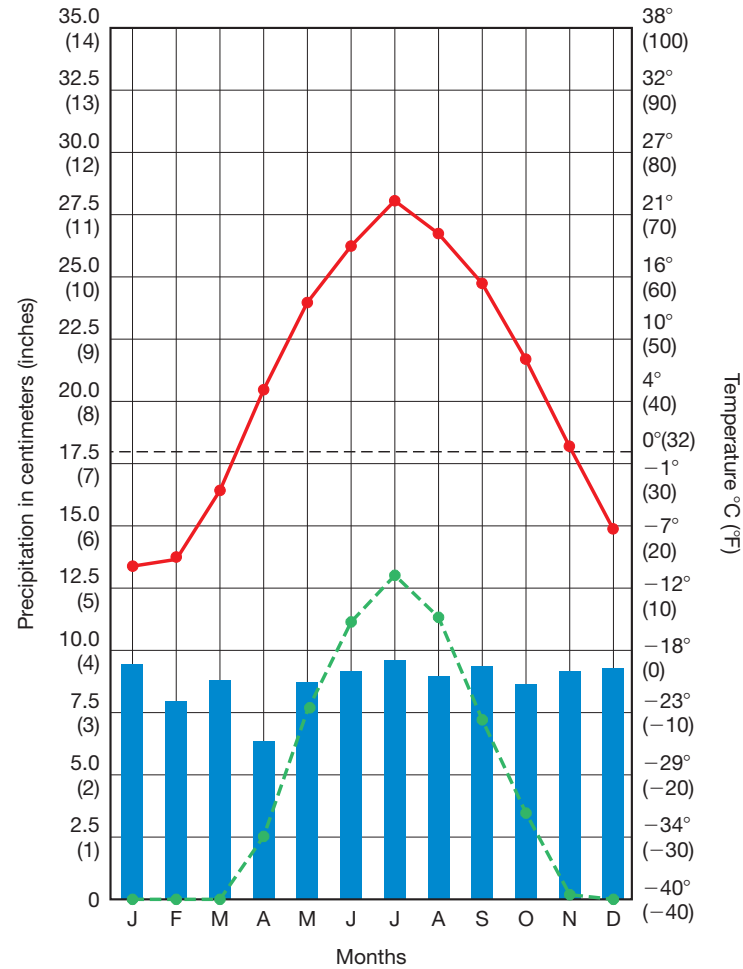
Even distribution of precipitation through year

Principal atmospheric lifting mechanism(s):

Frontal cyclonic storms in winter

Distribution of potential evapotranspiration during the year:

POTET exceeds PRECIP in summer, annual surplus.



▲ Figure 17.2a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature °C	-10.0	-9.4	-3.3	5.6	13.3	18.3	22.3	19.4	15.0	8.3	0.6	-6.7	6.0
(°F)	(14.0)	(15.1)	(26.1)	(42.1)	(55.9)	(64.9)	(72.1)	(66.9)	(59.0)	(46.9)	(33.1)	(19.9)	(42.8)
PRECIP cm	9.6	7.7	8.8	6.6	8.0	8.7	9.5	8.8	9.3	8.7	9.0	9.1	103.8
(in.)	(3.8)	(3.0)	(3.5)	(2.6)	(3.1)	(3.4)	(3.7)	(3.5)	(3.7)	(3.4)	(3.5)	(3.6)	(40.8)
POTET cm	0	0	0	2.7	8.1	11.9	13.9	12.1	7.7	3.7	0.2	0	60.3
(in.)	(0)	(0)	(0)	(1.1)	(3.2)	(4.7)	(5.5)	(4.8)	(3.0)	(1.5)	(0.1)	(0)	(23.7)

What are the main climatic influences for this station (air pressure, air mass sources, degree of continentality, temperature of ocean currents)?

Polar front, cP and mT, moderately continental, warm current

Köppen climate classification symbol: Dfb ; name: Humid continental ; explanation for this determination:

Warmest month above 10°C; coldest month below 0°C. Mild summer; warmest month below 22°C, year-round PRECIP.

Representative biome (terrestrial ecosystem) characteristic of region: NF/MF ; characteristic vegetation:

needleleaf forest

Station #3:

Oymyakon, Siberia, Russia

Total annual rainfall:

19.3 cm

Average annual temperature:

−16.3°C

Annual temperature range:

62 C°

Distribution of temperature during the year:

Extremely high range of temperatures, sub-zero winter, cool summer.

Distribution of precipitation during the year:

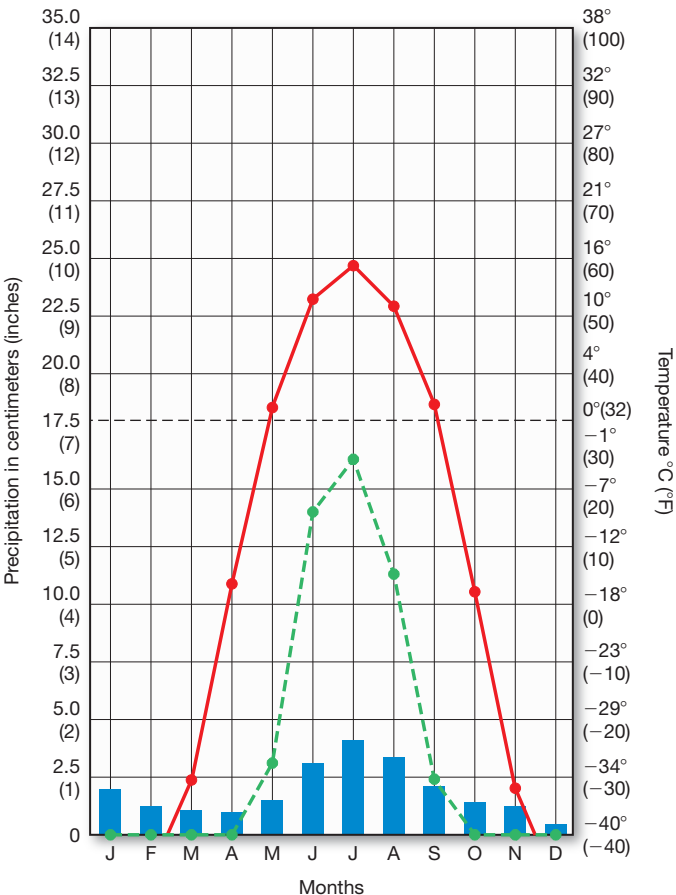
Dry winter, slightly less dry summer.

Principal atmospheric lifting mechanism(s):

Frontal cyclonic storms in winter, convection in summer.

Distribution of potential evapotranspiration during the year:

High POTET in summer, low in winter, annual deficit.



▲ Figure 17.2b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature °C	−47.2	−42.9	−34.2	−15.4	1.4	11.6	14.8	10.9	1.6	−16.2	−35.0	−44.0	−16.3
(°F)	(−53.0)	(−45.2)	(−29.6)	(4.3)	(34.5)	(52.9)	(58.6)	(51.6)	(34.9)	(2.8)	(−31.0)	(−47.2)	(2.7)
PRECIP cm	0.8	0.5	0.5	0.3	1.0	3.3	4.1	3.8	2.0	1.3	1.0	0.8	19.3
(in.)	(0.3)	(0.2)	(0.2)	(0.1)	(0.4)	(1.3)	(1.6)	(1.5)	(0.8)	(0.5)	(0.4)	(0.3)	(7.6)
POTET cm	0	0	0	0	3.0	13.5	15.7	10.9	2.3	0	0	0	45.5
(in.)	(0)	(0)	(0)	(0)	(1.2)	(5.3)	(6.2)	(4.3)	(0.9)	(0)	(0)	(0)	(17.9)

What are the main climatic influences for this station (air pressure, air mass sources, degree of continentality, temperature of ocean currents)?

Polar front, cP and cA air masses, extreme continentality.

Köppen climate classification symbol: *Dwd* ; name: *Subarctic* ; explanation for this determination:

Warmest month above 10°C; coldest month below 0°C. Winter drought; coldest month below −38°C.

Representative biome (terrestrial ecosystem) characteristic of region: *NF/MF* ; characteristic vegetation:

needleleaf forest and tundra transition

Station #4:

New Orleans, Louisiana

Total annual rainfall:

161.3 cm

Average annual temperature:

21.1°C

Annual temperature range:

15 C°

Distribution of temperature during the year:

Warm summers, cool winters

Distribution of precipitation during the year:

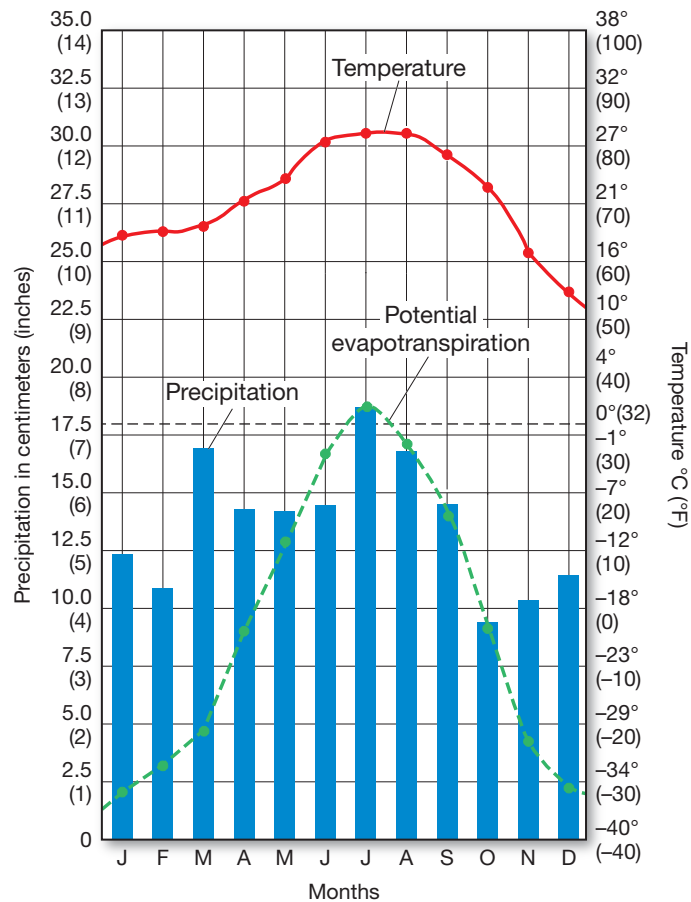
Wet year round

Principal atmospheric lifting mechanism(s):

Frontal cyclonic storms in winter, summer convection.

Distribution of potential evapotranspiration during the year:

High in summer, low in winter, annual surplus.



▲ Figure 17.2c

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature °C	13.3	14.4	17.2	21.1	24.4	27.8	28.3	28.3	26.7	22.8	16.7	13.9	21.1
(°F)	(56.0)	(58.0)	(63.0)	(70.0)	(76.0)	(82.0)	(83.0)	(83.0)	(80.0)	(73.0)	(62.0)	(57.0)	(70.0)
PRECIP cm	12.2	10.7	16.8	13.7	13.7	14.2	18.0	16.3	14.7	9.4	10.2	11.7	161.3
(in.)	(4.8)	(4.2)	(6.6)	(5.4)	(5.4)	(5.6)	(7.1)	(6.4)	(5.8)	(3.7)	(4.0)	(4.6)	(63.5)
POTET cm	2.2	2.6	4.9	8.4	12.7	16.8	18.0	17.1	13.9	8.8	4.0	2.4	111.8
(in.)	(0.9)	(1.0)	(1.9)	(3.3)	(5.0)	(6.6)	(7.1)	(6.7)	(5.5)	(3.5)	(1.6)	(0.9)	(44.0)

What are the main climatic influences for this station (air pressure, air mass sources, degree of continentality, temperature of ocean currents)?

ITCZ, mT air masses, coastal, warm current.

Köppen climate classification symbol: *Cfa* ; name: *Humid subtropical* ; explanation for this determination:

Warmest month above 10°C; coldest month above 0°C. Year-round PRECIP; hot summer, warmest month above 22°C.

Representative biome (terrestrial ecosystem) characteristic of region: *MBMF* ; characteristic vegetation:

midlatitude broadleaf and mixed forest

Station #5:***Edinburgh, Scotland***

Total annual rainfall:

65.8 cm

Average annual temperature:

8.7°C

Annual temperature range:

11.7°C

Distribution of temperature during the year:

Mild climate range, cool winters, cool summers.

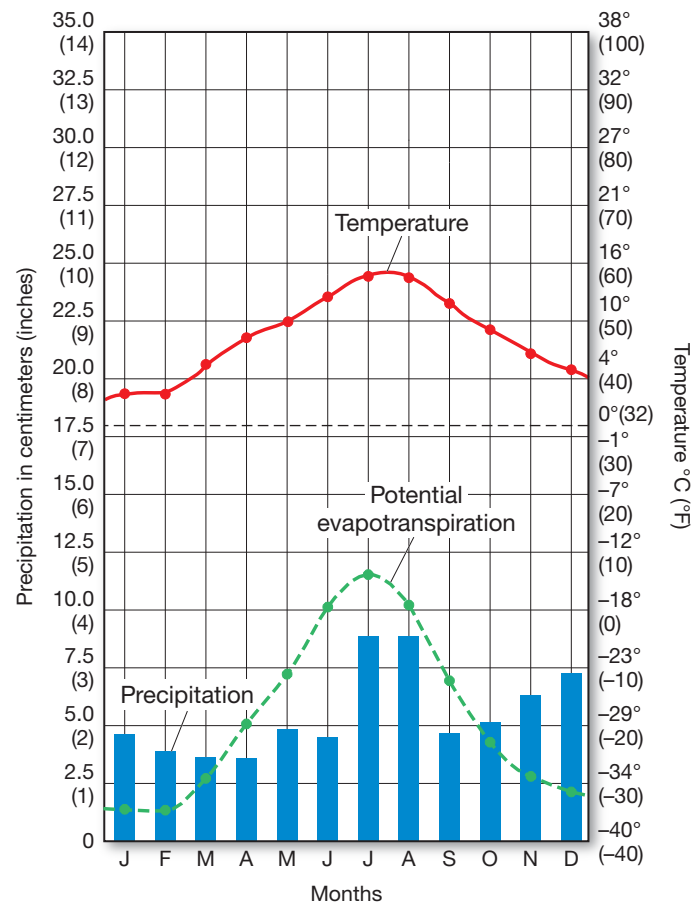
Distribution of precipitation during the year:

Wet year round.

Principal atmospheric lifting mechanism(s):

Frontal cyclonic storms.

Distribution of potential evapotranspiration during the year:

Low in winter, moderate in summer, very small annual surplus.**▲ Figure 17.2d**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature °C	3.0	3.0	5.0	7.6	10.1	12.7	14.7	14.3	12.5	9.7	6.5	4.8	8.7
(°F)	(37.4)	(37.4)	(41.0)	(45.7)	(50.2)	(54.9)	(58.5)	(57.7)	(54.5)	(49.5)	(43.7)	(40.6)	(47.7)
PRECIP cm	4.8	3.6	3.3	3.3	4.8	4.6	8.9	9.1	4.8	5.1	6.1	7.4	65.8
(in.)	(1.9)	(1.4)	(1.3)	(1.3)	(1.9)	(1.8)	(3.5)	(3.6)	(1.9)	(2.0)	(2.4)	(2.9)	(25.9)
POTET cm	1.3	1.3	2.8	4.8	7.6	10.2	11.7	10.2	7.4	4.8	2.8	1.8	64.8
(in.)	(0.5)	(0.5)	(1.1)	(1.9)	(3.0)	(4.0)	(4.6)	(4.0)	(2.9)	(1.9)	(1.1)	(0.7)	(25.5)

What are the main climatic influences for this station (air pressure, air mass sources, degree of continentality, temperature of ocean currents)?

Polar front, cP and mP air masses, coastal, warm Gulf Stream current.

Köppen climate classification symbol: ***Cfb*** ; name: ***Marine west coast*** ; explanation for this determination:

Warmest month above 10°C; coldest month above 0°C. Year-round PRECIP; mild summer, warmest month below 22°C.

Representative biome (terrestrial ecosystem) characteristic of region: ***MBMF*** ; characteristic vegetation:

midlatitude broadleaf and mixed forest

Station #6:

Sacramento, California

Total annual rainfall:

45.5 cm

Average annual temperature:

16.8°C

Annual temperature range:

16.4 C°

Distribution of temperature during the year:

Hot summers, mild winters

Distribution of precipitation during the year:

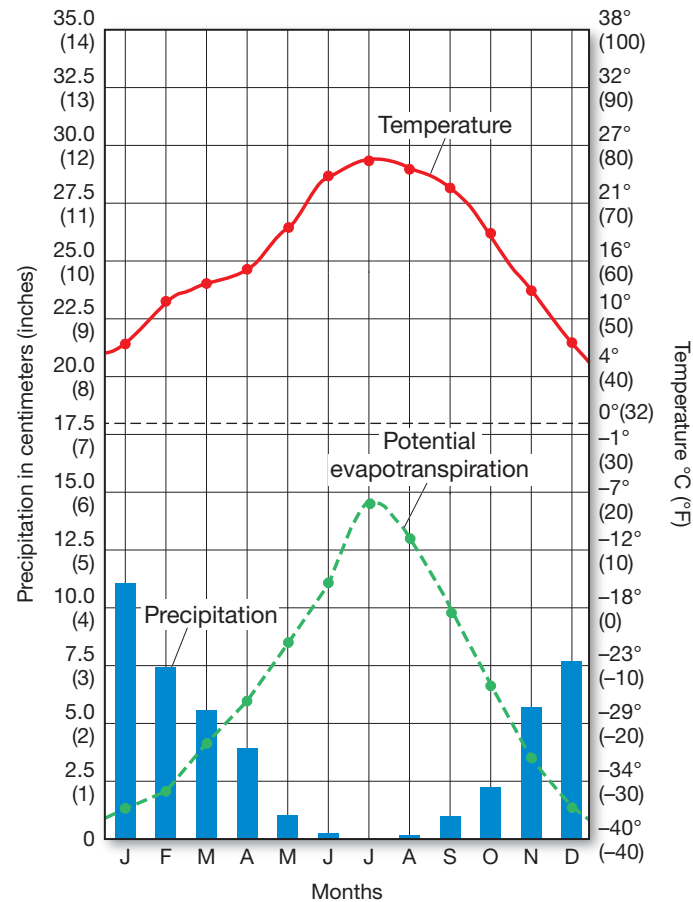
Moderately wet winter, very dry rest of year.

Principal atmospheric lifting mechanism(s):

Frontal cyclonic storms in winter

Distribution of potential evapotranspiration during the year:

High POTET summer, annual deficit.



▲ Figure 17.2e

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature °C	8.4	11.2	12.9	15.6	19.1	22.3	24.8	24.2	22.7	18.5	12.6	8.6	16.8
(°F)	(47.1)	(52.2)	(55.3)	(60.1)	(66.3)	(72.2)	(76.6)	(75.6)	(72.9)	(65.3)	(54.7)	(47.5)	(62.2)
PRECIP cm	10.7	7.4	5.6	3.6	1.0	0.3	0.0	0.3	0.8	2.3	5.8	7.6	45.5
(in.)	(4.2)	(2.9)	(2.2)	(1.4)	(0.4)	(0.1)	(0.0)	(0.1)	(0.3)	(0.9)	(2.3)	(3.0)	(17.9)
POTET cm	1.5	2.3	4.0	6.0	8.5	11.5	14.0	12.7	9.9	6.6	3.0	1.5	81.5
(in.)	(0.6)	(0.9)	(1.6)	(2.4)	(3.3)	(4.5)	(5.5)	(5.0)	(3.9)	(2.6)	(1.2)	(0.6)	(32.1)

What are the main climatic influences for this station (air pressure, air mass sources, degree of continentality, temperature of ocean currents)?

Polar front and subtropical high, cP and mT air masses, moderately coastal, cold current.

Köppen climate classification symbol: *Csa* ; name: *Mediterranean summer dry* ; explanation for this determination:

Warmest month above 10°C; coldest month above 0°C. Pronounced summer drought with 70% of PRECIP in winter; hot summer, warmest month above 22°C.

Representative biome (terrestrial ecosystem) characteristic of region: *MSH* ; characteristic vegetation:

Mediterranean shrubland

SECTION 3

Climate Analysis

Temperature, precipitation, and potential evapotranspiration patterns are the elements used in determining climate classification. Factors influencing these patterns help to more fully understand the distribution of climate regions.

Use *Geosystems* to find background information for some of your responses. Answer the following questions about the completed climographs in Figures 17.2a through 17.2e.

New Orleans—Station # 4

1. What effects do latitudinal position, air mass interactions, and ocean currents have in producing the climate of New Orleans? For instance, why is the winter precipitation of New Orleans higher than in more northerly cities?

Storm tracks bring frontal and cyclonic activity in the winter months when Miami is experiencing a lower precipitation period. Miami is 5° farther south in latitude.

2. In examining POTET (potential evapotranspiration) values throughout the year for New Orleans and comparing them to PRECIP (precipitation) received, is there an annual moisture surplus or deficit?

PRECIP exceeds POTET during all months except two, so water surpluses dominate the water balance.

Edinburgh—Station # 5

3. Where are the several places in North America that you find this same climatic regime?

Marine west coast is along northwest coast of North America, and small areas in the Appalachian Mountains due to cooler summer temperatures at elevation.

4. What controlling factors contribute to the cool summers in Edinburgh?

Cool ocean currents and high midlatitude location.

Sacramento—Station # 6

5. What factors produce the natural summer drought (high POTET and low PRECIP) experienced in Sacramento? (Consider air masses, pressure systems, and ocean currents.)

Shifting subtropical high-pressure anticyclone—Pacific or Hawaiian high pressure. Cool offshore currents and stable air masses.

6. What challenges would natural vegetation face growing in this climate, as opposed to the climate in Montreal or New Orleans?

Extensive irrigation and redistribution of regional water supplies through extensive diversion schemes is necessary for agriculture and landscaping.

Montreal—Station # 2

7. Compare the annual range of temperature (between January and July) in Montreal with your analysis of New Orleans. Why the greater range value for Montreal?

Montreal experiences a 32.1 C° annual range of temperature, New Orleans a 15 C° range. Montreal has four months that average below freezing, New Orleans none. A greater continental effect and increased distance from moderating winds and water temperatures help explain this difference.

8. What contributing factors (mechanisms and conditions) produce the even distribution of precipitation throughout the year in Montreal?

Winter cyclonic and frontal activity and summer convectional showers and occasional effects from migrating depressions.

Oymyakon—Station # 3

9. Explain why this station experiences this climate. What are the contributing factors? Why is the summer so hot? Why is the winter so cold? What are two factors that reduce summer and winter PRECIP?

The combination of high latitude and extreme continentality produce the highest temperature range on Earth. Long summer days without much moisture to absorb heat are followed by long bitterly cold winter nights. The extreme continentality and extreme cold both act to reduce moisture for precipitation.

SECTION 4

The Desert Climates

Station #7:

Walgett, N.S.W.

Total annual rainfall:

45 cm

Average annual temperature:

20.0°C

Annual temperature range:

17.3 C°

Distribution of temperature during the year:

Warm summer and cool winter—distribution of temperature indicates a southern hemisphere location.

Which PRECIP regime from Figure 17.3 is this? Which diagram should you use to evaluate this climate?

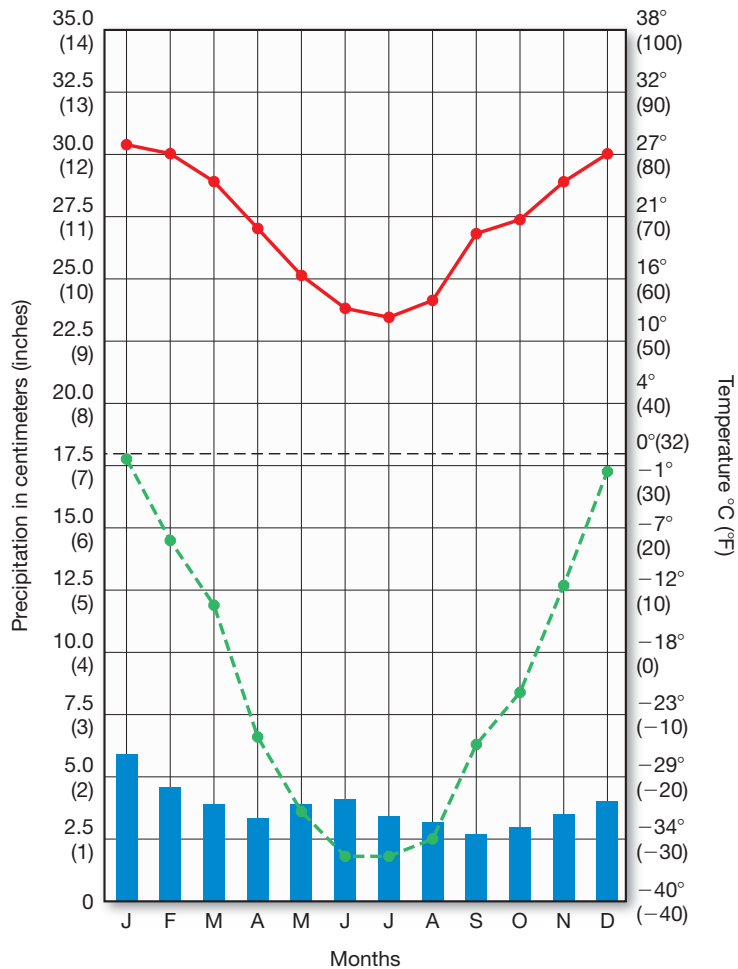
PRECIP evenly distributed.

Principal atmospheric lifting mechanism(s):

Frontal and convection.

Distribution of potential evapotranspiration during the year:

Very high in high sun season, low in winter, annual deficit.



▲ Figure 17.4a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature °C	28.1	27.2	24.4	19.7	15.0	11.7	10.8	12.5	19.2	20.6	24.4	27.2	20.0
(°F)	(82.5)	(81.0)	(76.0)	(67.5)	(59.0)	(53.0)	(51.5)	(54.5)	(66.5)	(69.0)	(76.0)	(81.0)	(68.0)
PRECIP cm	5.3	4.8	4.1	3.0	3.8	4.1	3.3	2.8	2.5	3.0	3.8	4.3	45.0
(in.)	(2.1)	(1.9)	(1.6)	(1.2)	(1.5)	(1.6)	(1.3)	(1.1)	(1.0)	(1.2)	(1.5)	(1.7)	(17.7)
POTET cm	17.8	14.5	11.9	6.6	3.6	1.8	1.8	2.5	6.3	8.4	12.7	17.3	104.6
(in.)	(7.0)	(5.7)	(4.7)	(2.6)	(1.4)	(0.7)	(0.7)	(1.0)	(2.5)	(3.3)	(5.0)	(6.8)	(41.2)

What are the main climatic influences for this station (air pressure, air mass sources, degree of continentality, temperature of ocean currents)?

Polar front and subtropical high, cT and mP, moderately coastal, warm current.

Köppen climate classification symbol: **BSh** ; name: **Hot low-latitude steppe** ; explanation for this determination:

PRECIP more than 1/2 potet, but not equal to it. Mean annual temp > 18°C.

Representative biome (terrestrial ecosystem) characteristic of region: **DBC** ; characteristic vegetation:

short grass and dry shrubs

Station #8:

Reno, NV

Total annual rainfall:

17.8 cm

Average annual temperature:

10.0°C

Annual temperature range:

20.5 C°

Distribution of temperature during the year:

Warm summers, mild winters.

Which PRECIP regime from Figure 17.3 is this? Which diagram should you use to evaluate this climate?

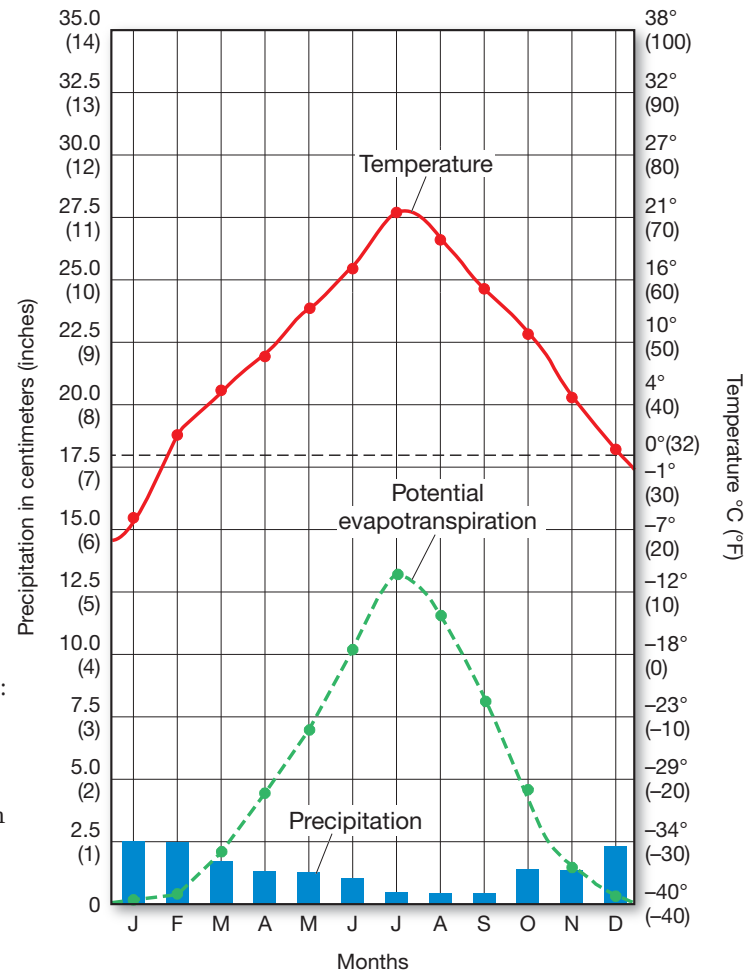
PRECIP concentrated in winter.

Principal atmospheric lifting mechanism(s):

Frontal cyclonic storms in winter, convection in summer.

Distribution of potential evapotranspiration during the year:

Very high in summer, high annual deficit.



▲ Figure 17.4b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature °C	-0.6	2.2	5.0	8.9	12.8	16.7	21.1	19.4	15.6	10.6	4.4	0.6	10.0
(°F)	(31.0)	(36.0)	(41.0)	(48.0)	(55.0)	(62.0)	(71.7)	(67.0)	(60.0)	(51.0)	(40.0)	(33.0)	(50.0)
PRECIP cm	2.5	2.5	1.8	1.3	1.3	1.0	0.5	0.5	0.5	1.5	1.5	2.3	17.8
(in.)	(1.0)	(1.0)	(0.7)	(0.5)	(0.5)	(0.4)	(0.2)	(0.2)	(0.2)	(0.6)	(0.6)	(0.9)	(7.0)
POTET cm	0	0.7	2.2	4.0	7.1	10.1	13.0	11.7	7.8	4.3	1.7	0.2	62.8
(in.)	(0)	(0.3)	(0.9)	(1.6)	(2.8)	(4.0)	(5.1)	(4.6)	(3.1)	(1.7)	(0.7)	(0.1)	(24.7)

What are the main climatic influences for this station (air pressure, air mass sources, degree of continentality, temperature of ocean currents)?

Polar front and subtropical high, cP and mT, continental, warm ocean to south.

Köppen climate classification symbol: *BWk* ; name: *Cold midlatitude desert* ; explanation for this determination:

PRECIP less than 1/2 potet. Mean annual temp < 18°C.

Representative biome (terrestrial ecosystem) characteristic of region: *DBW* characteristic vegetation:

warm desert and semidesert scrubland

1. Characterize water balance conditions in **Reno, Nevada**, during June, July, and August. (Compare precipitation and potential evapotranspiration for these months.)

Reno has prolonged extensive DEFIC due to 9 months of POTET exceeding PRECIP.

2. What air mass lifting mechanism produces most of the precipitation received in Reno?

In winter, frontal cyclonic storms, in summer convective showers, cumulonimbus cloud development.

3. What air masses produce most of the precipitation received in January and February?

mP air masses

4. What is the annual range of temperature (between January and July) for Reno?

20.5°C

What factors contribute to this value for Reno?

Continental, rainshadow reducing available moisture for latent heat.

5. Walgett, N.S.W., within a temperate short-grass plain region, is in the Southern Hemisphere (Station # 7). What indications of this global location can you determine from its temperature, PRECIP, and POTET data? Explain.

The pattern of temperature and rainfall is six months out of phase with northern hemisphere patterns.

6. What climate is suggested by just evaluating PRECIP and POTET? What climate did you determine using Figure 17.3?

Walgett is a hot desert, based upon just PRECIP, POTET, and temperature. Using Figure 17.3, Walgett is a hot steppe climate.

SECTION 5

Your Climate Region (optional station exercise)

Answers will vary based on location of students.