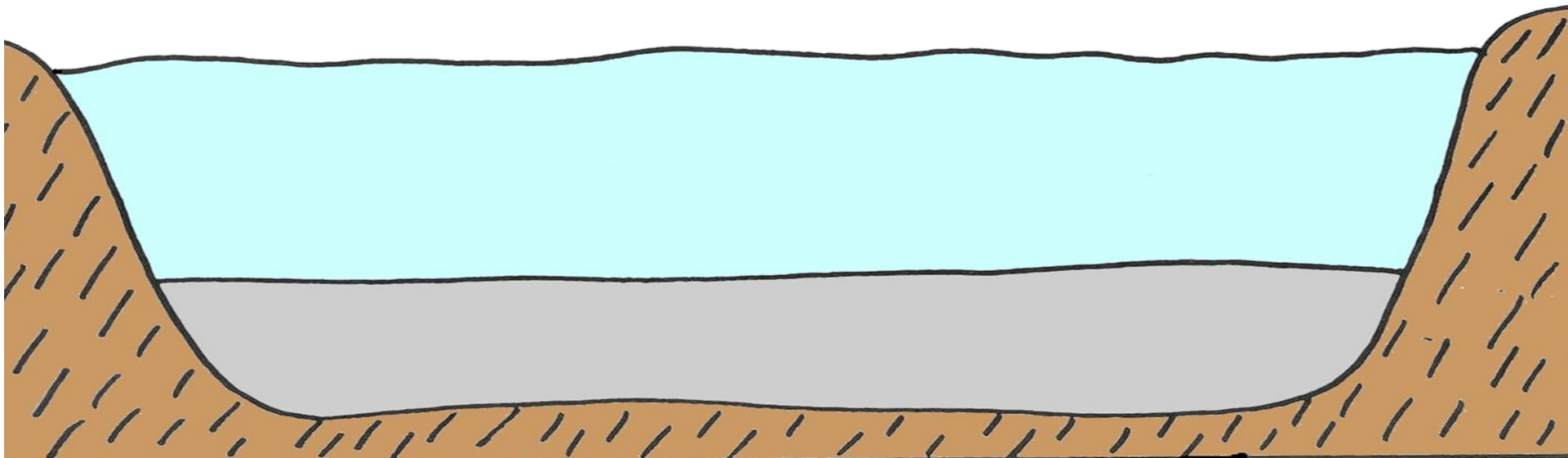
WASTEWATER STABILIZATION POND/ LAGOON SYSTEMS

Waste Stabilization Ponds/Lagoons

A structure constructed to contain and to facilitate the operation and control of a complex process of treating or stabilizing wastewater.



Waste Stabilization Ponds/ Lagoons

Physical Processes

Chemical Processes

Biological Processes

BACTERIA Types

Aerobic

Bacteria that can use only oxygen that is “free” or not chemically combined.

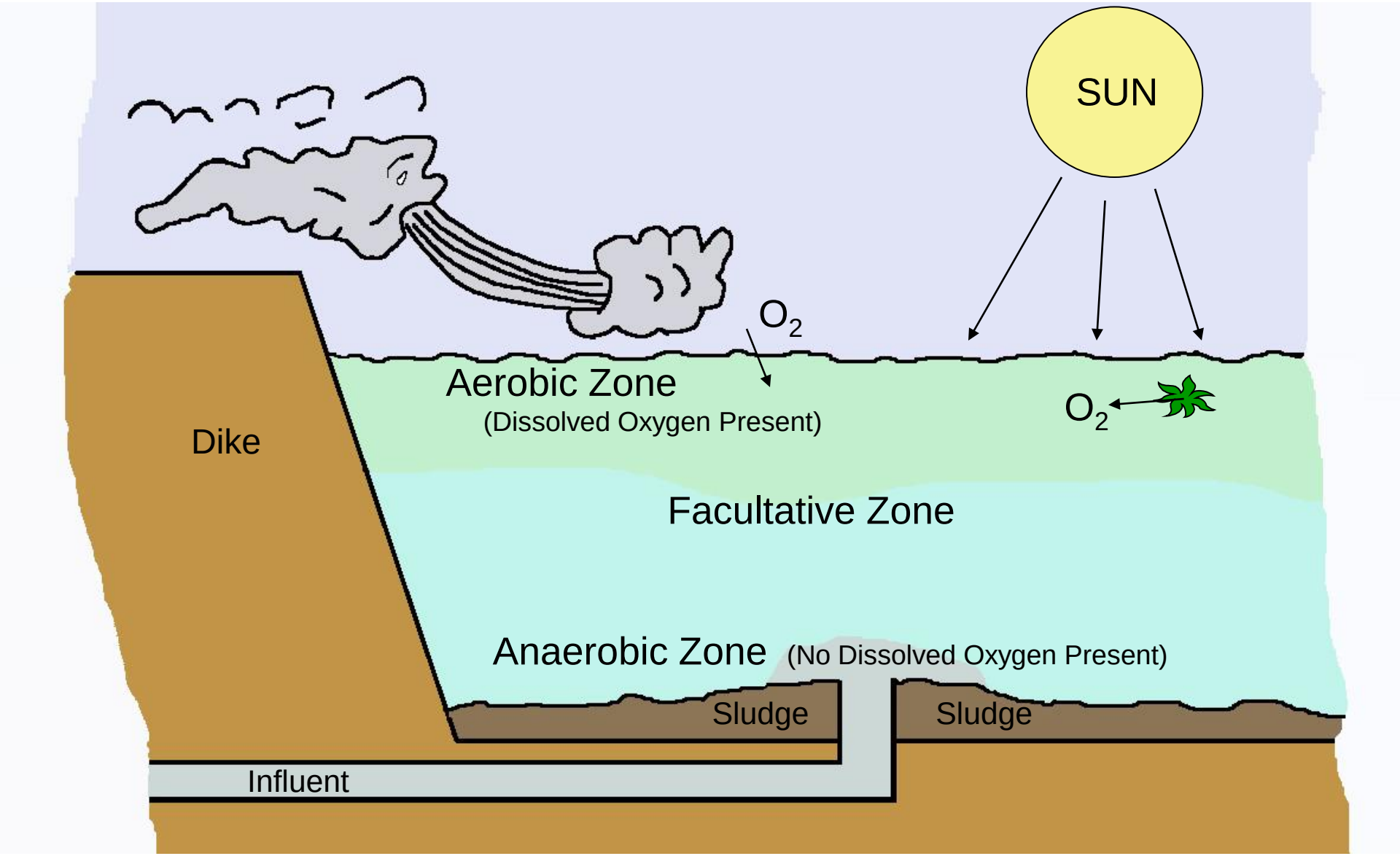
Anaerobic

Bacteria that can live in the absence of “free” oxygen.

Facultative

Bacteria that use either “free” or combined oxygen.

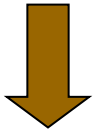
Zonal Relationships in a Lagoon



ANAEROBIC ZONE

Sedimentation

SOLIDS



Stabilization

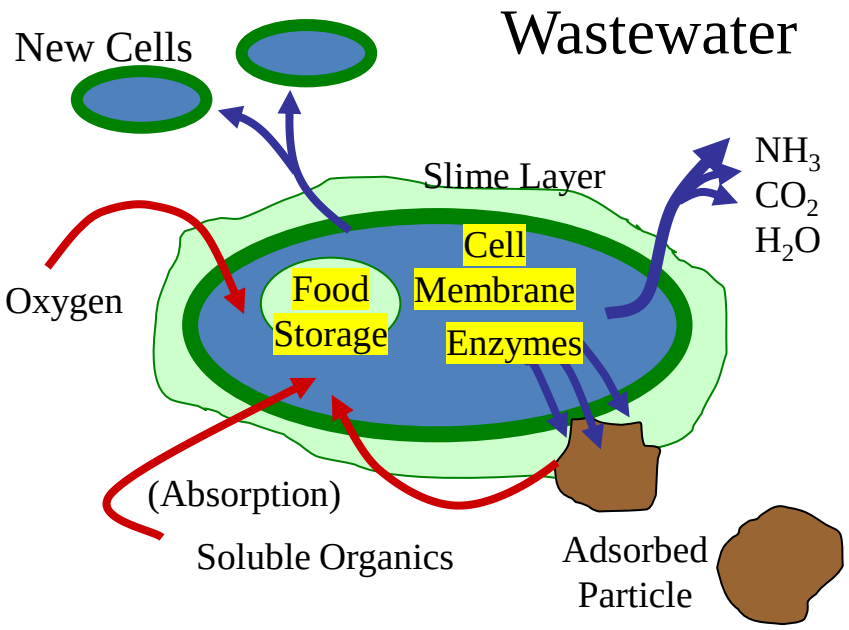
Organics → Bacteria → Organic Acids

Organic Acids → Bacteria → CO_2, NH_3, H_2S, CH_4

AEROBIC ZONE

Bacteria Use Soluble Organics

Organic Compounds + Oxygen → Carbon Dioxide + Water



FACULTATIVE ZONE

Organisms Utilize Dissolved Oxygen
or Combined Oxygen

Adapt to Changing Conditions

Continue Decomposition
during
Changing Conditions

DO

ABSORPTION from ATMOSHERE
PHOTOSYNTHESIS

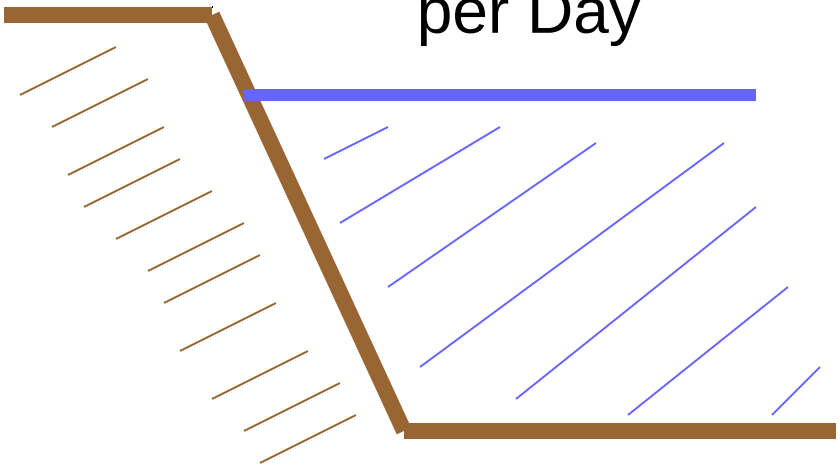
Efficient Treatment

Preventing Odors

OXYGEN SOURCES

Surface Aeration Provides

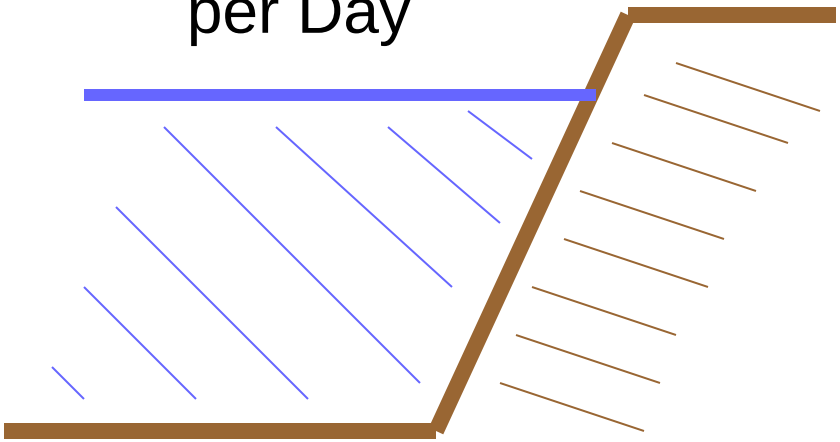
2.7 Kg
per Acre
per Day



At Lagoon D.O. of 2.0 mg/L
Temperature Permitting 8.0 mg/L

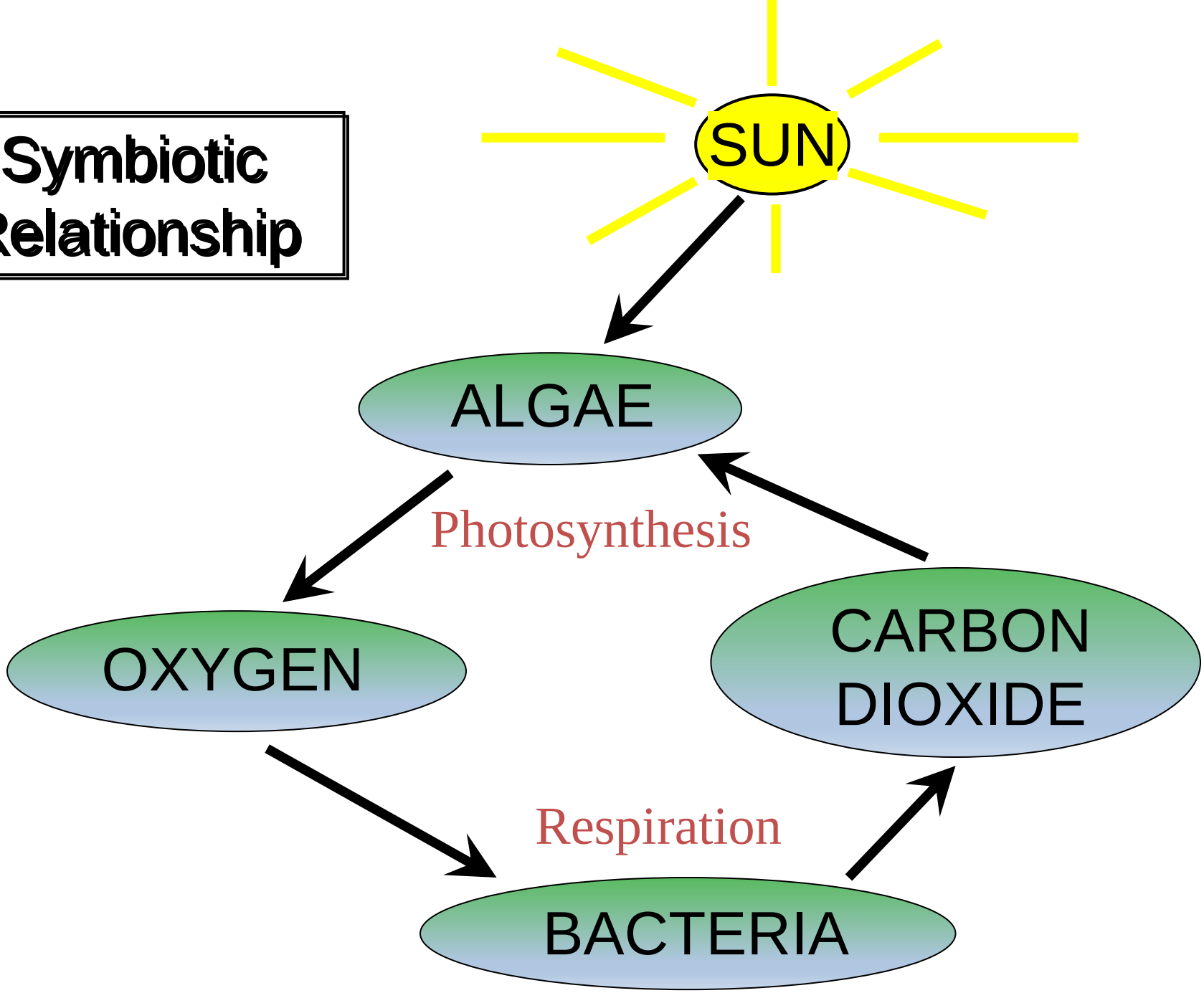
Algae (Photosynthesis) Provides

45 Kg
per Acre
per Day

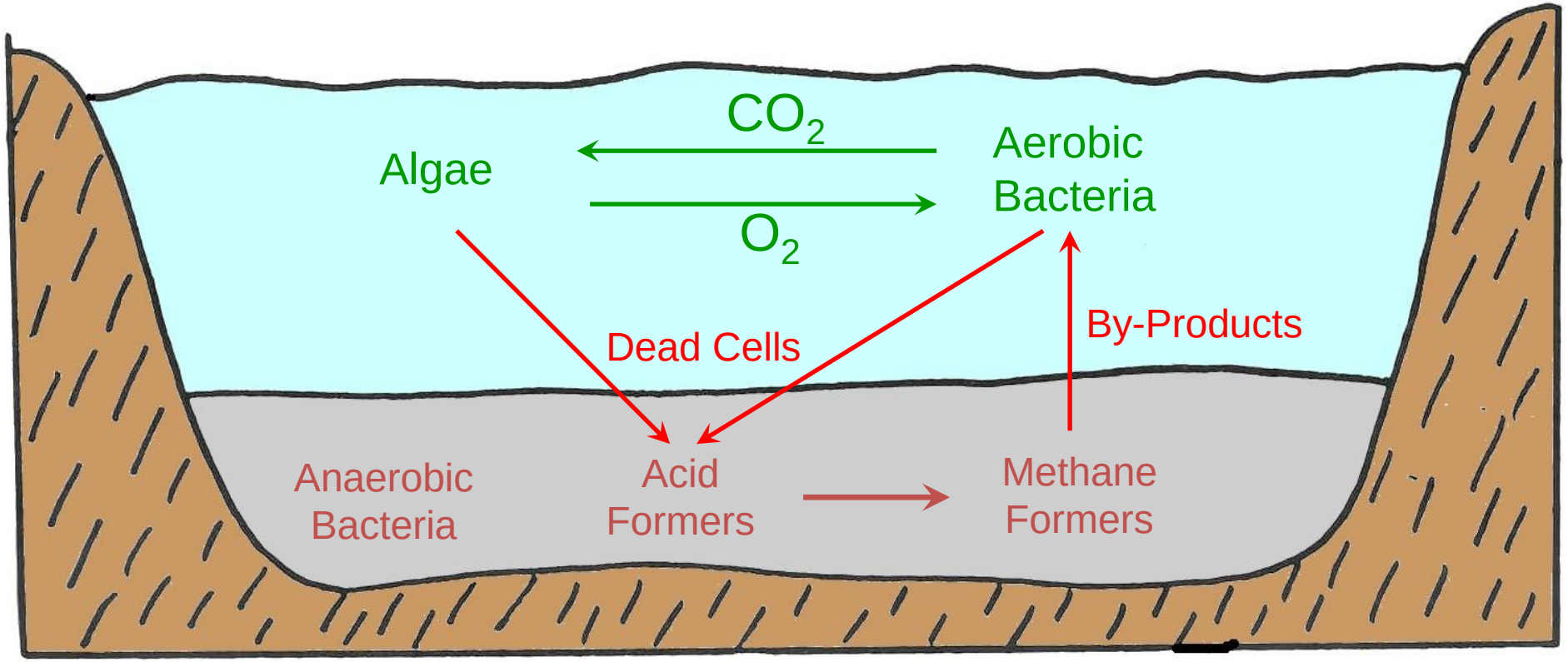


Each 27 Kg of Algae
Produce 45 pounds Oxygen

Symbiotic Relationship



ACTIVITY IN FACULTATIVE PONDS



Influence of Wind

Adds Oxygen

Increases Mixing

Influence of Light

Photosynthesis

Disinfection

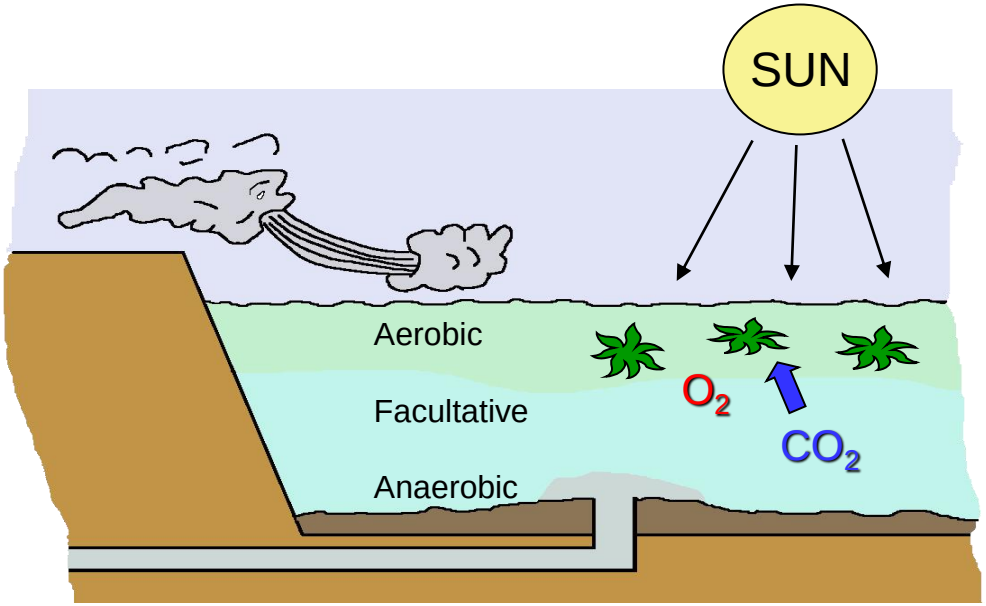
Influence of Temperature

Rate of Bacterial Activity

Growth of Algae

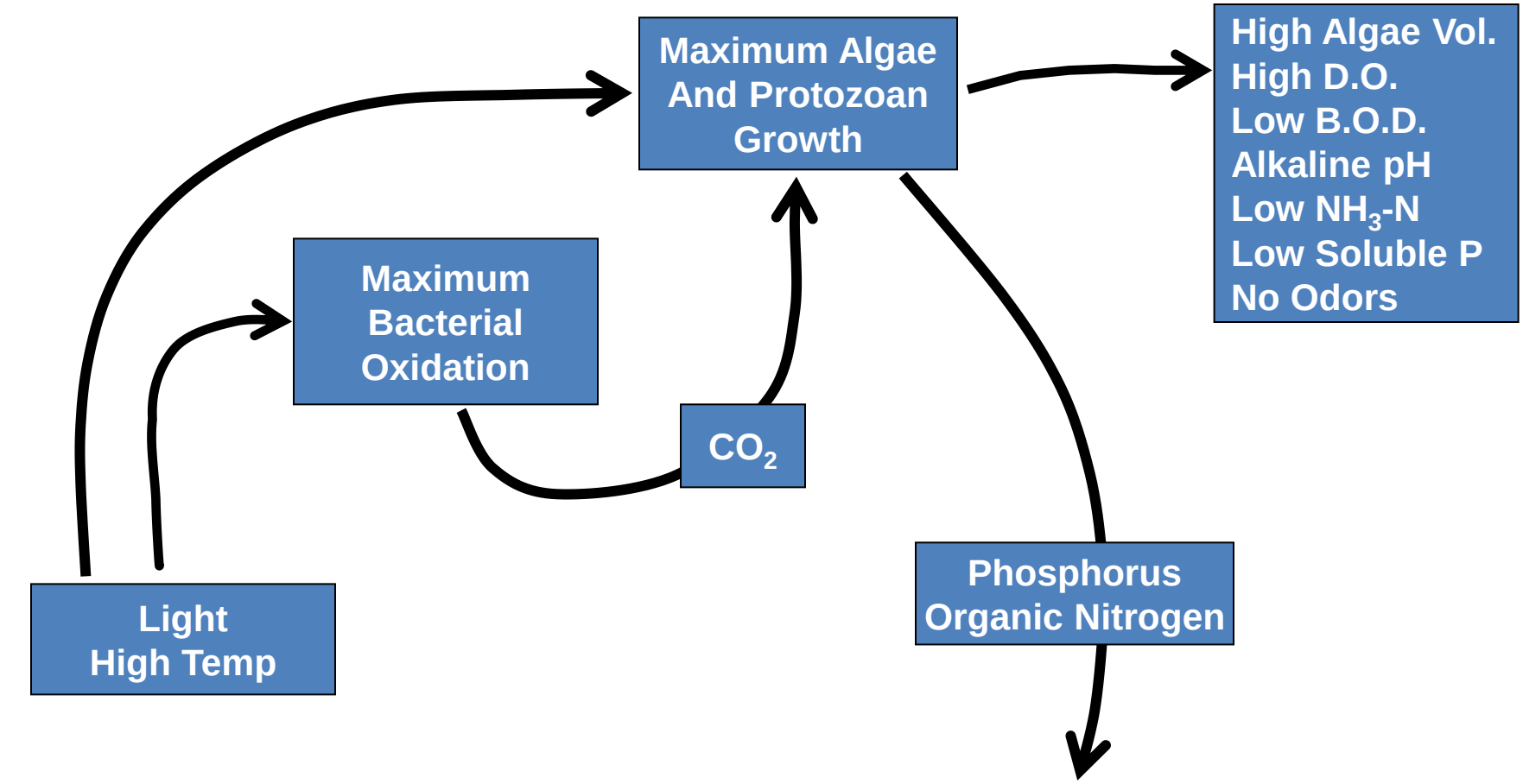
D.O. Saturation

Daily Fluctuations

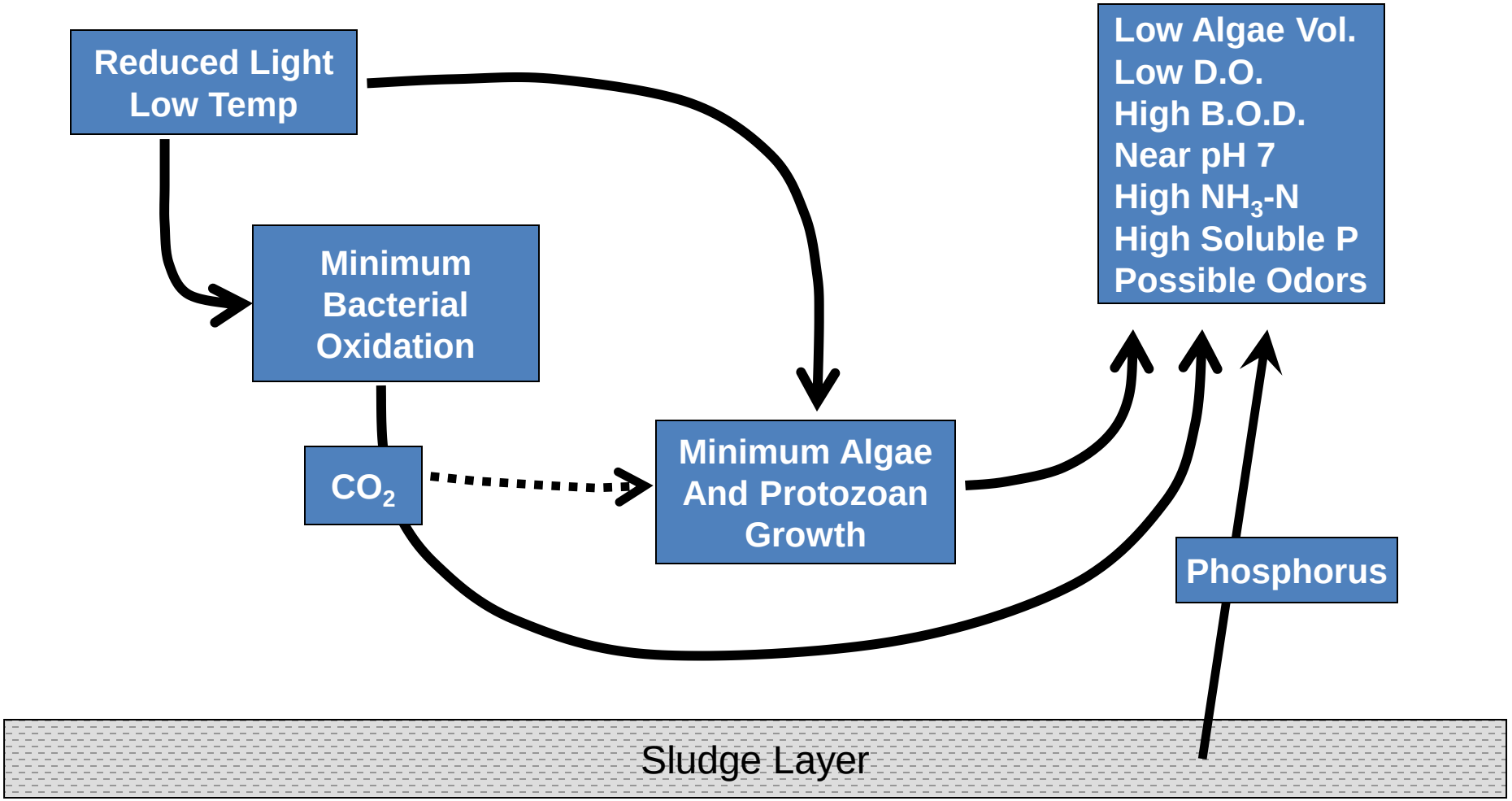


Temperature
DO
pH

Summer


Maximum Algae And Protozoan Growth
High Algae Vol.
High D.O.
Low B.O.D.
Alkaline pH
Low NH_3-N
Low Soluble P
No Odors
Maximum Bacterial Oxidation
CO_2
Light
High Temp
Phosphorus
Organic Nitrogen
Sludge Layer

Winter


Reduced Light
Low Temp
Minimum
Bacterial
Oxidation
CO_2
Minimum Algae
And Protozoan
Growth
Low Algae Vol.
Low D.O.
High B.O.D.
Near pH 7
High NH_3-N
High Soluble P
Possible Odors
Phosphorus
Sludge Layer

ADVANTAGES

1. Economical to Construct & Operate.
2. Low Monitoring & Control Requirements.
3. Rapid Recovery from “Shock” Loads.
4. Low Energy & Chemical Usage.
5. Low Mechanical Failure.
6. Minimal Sludge Disposal.
7. Long Life.

DISADVANTAGES

1. Large Land Usage.
2. Low Control Options.
3. Operations Dependant on Climate.
4. Often High Suspended Solids.
5. Seasonal Odors.
6. Possible Ground Water Contamination.
7. Not Good In High Loading Situations.

GOOD PRACTICES

- Process Is In Balance
- Properly Designed Facility
- Process Is Controlled
- System Is Maintained

Design of Ponds and Lagoons

$BOD_{in} = BOD_{out} + BOD_{consumed}$

$Q\ So = Q\ S + V\ (kS)$

$S/So = 1/(1+(k\ V/Q)) = 1/(1+k\ \theta)$

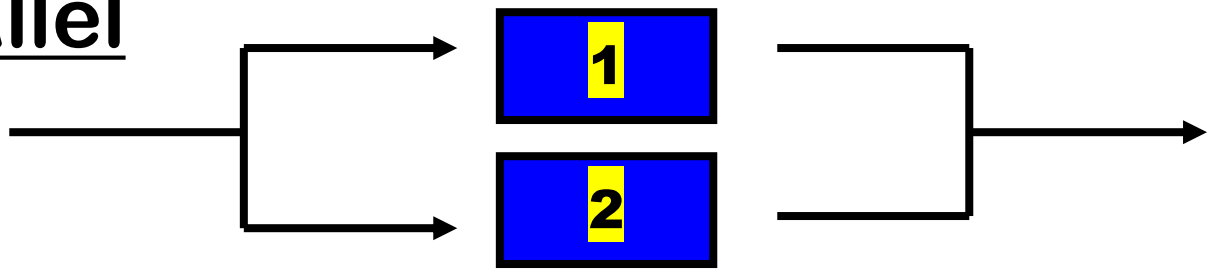
S = soluble BOD remaining, mg/L
So = initial Soluble BOD, mg/L

k = reaction rate coefficient, d^{-1}
θ = hydraulic retention time, d
V = reactor volume, m^3
Q = flow rate, m^3/d

Series

Placing Majority of Load on First Cell
Summer Operation

Parallel



Dividing Organic Load Between At Least Two Cells
Winter Operation

Thank you !