

Biology 318
Prokaryotic Genetics

Review Vocabulary

Phenotype: physical traits

Genotype: genetic make-up

Mutations: replication errors, single base pairs

Recombination: rearranging or acquiring genes

*Since prokaryotes haploid (no meiosis/crossing over),
how do they evolve? Five ways...*

Mutations

Naturally occur - replication, DNA Pol errors

Rate - about 1 mistake per million base pairs

Mutagens (chemicals, UV...) enhance error rate

Mutations can be silent, harmful, or beneficial

*BOTH eukaryotes and prokaryotes show similar
mutation rates, respond similarly to mutagens.*

Application - Ames Testing, 1960

Mutagenicity is correlated with carcinogenicity

Ames exposed Salmonella to various chemicals

Counted # mutants - higher than normal?

One of several safety tests used by FDA

Transformation - Griffith, 1928

Used 2 strains of Streptococcus pneumoniae

Rough (capsule -) vs. virulent Smooth (+)

Showed heat-lysing killed S, releasing DNA

Which was taken up by live R, transforming to S

*This experiment = part of the evidence that showed DNA
was the genetic material.*

Conjugation - Lederberg, 1946

Requires bacteria have F plasmid, sex pilus

F(+) donor sex pilus attaches to F(-) recipient

Copy of F plasmid moves through pilus

*Recall: plasmids - including F - frequently carry
emergency genes like antibiotic resistant.*

Bacterial Viruses

And how they contribute to bacterial evolution...

Bacteriophage/Phage

Unenveloped capsid with DNA only

Bind Gram (-) host cell wall, inject DNA

Borrow host DNA and RNA Pol, ribosomes

Some virulent/lytic; others temperate/lysogenic

Ubiquitous... including on you and in your gut!

SO - Lysogenic Conversion

Bacteria acquire traits from lysogenic phage

Acquired trait is viral - contrast with transduction

Many diseases depend on phage gene factors...

Corynebacterium diphtheriae - Diphtheria

Lysogen toxin halts eukaryotic ribosomes

2-5 days, gray pseudomembrane over throat

Difficulty breathing, fatal heart problems
Vaccinated for in US; still top 10 world killer

*30-60% humans naturally carry phage-less bacteria in
their nose/throats... protective???*

Streptococcus pyogenes - Scarlet Fever

Lysogen toxin - hyper-inflammation, rash, fever

Typically follows pharyngitis, strawberry tongue

Anti-bacterial drugs typically resolve in 1 week

*10-30% humans naturally carry phage-less strains in
their throats... protective???*

Vibrio cholerae - Cholera

Lysogen toxin - extreme salt/H₂O loss, diarrhea

50% untreated victims die - "rice water stools"

Food/water - marine, estuaries, shellfish, fish

Water/salt replacement most effective treatment

*Not typically found in people, regular pandemics - many
spread by shipping industry, bilges.*

AND... Transduction

During lysis, bacterial genome shredded

Some fragments accidentally wind up in capsids

Recombinant phage carry genes to next host

*In transduction, trait acquired FROM previous host
BACTERIUM. Virus acts as CARRIER.*

Retroviruses & Transduction

During integration - pick up host cancer genes

Carry to next host - transmit infectious cancer

Rous Sarcoma Virus (1911) - chicken tumors

HTLV - blood-transmitted form of leukemia

*Highest HTLV in Japan; many US studies searching for
viral causes of other cancers.*

***Don't forget individual lab assignment - Genetic
Engineering/Gene Therapy (also Ch. 7)***