Molecular Biology 1

- iClicker 22A
- Introduction to Molecular Biology
- Genes and DNA
- iClicker 22B

- Due in Lab next week
  - Nothing!!
  - No lab next week!!
  -
- Register your iClicker
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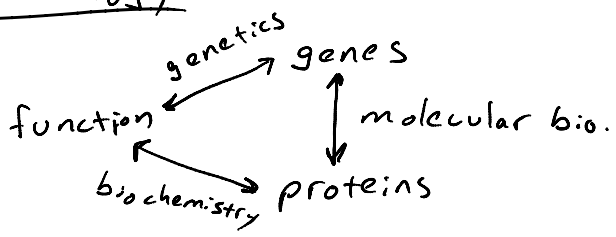
Molecular Biology



– how can chemical reaction result in so many different outcomes?

Major Issues ~100 yrs. ago

1. what are genes made of?
2. how do they encode protein?
3. how did genes replicate so reproducibly?

~1900 → there was one major question

are genes made of DNA or proteins?

1910 - 1920 - genes are on chromosomes

Chromosomes are made of 40% DNA & 60% protein

DNA -> "boring"
- not a catalyst
- simple shape -> long chain

Protein -> catalysts
- complex shapes

2 research approaches

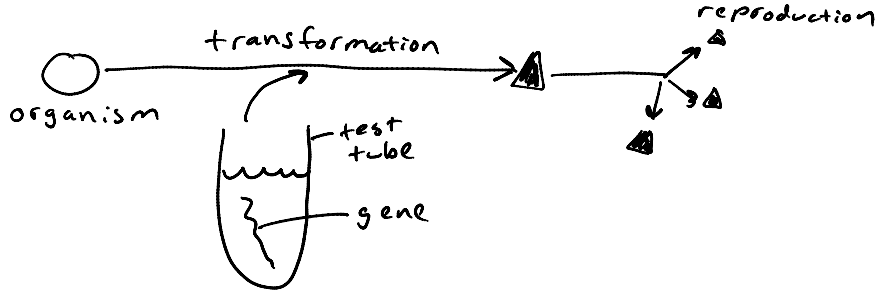
(A) purify a gene and see what it is made of

(B) look at DNA & protein structure and look for clues as to their function

(A) gene = a substance that causes reproducible and inheritable changes in phenotype

reproducible -> always the same effect

inheritable -> all offspring are changed



Experiments

Griffiths (1928)
- bacterium Streptococcus pneumonae
- no antibiotics at the time
- studied in mice

Bio 111 Handout for Molecular Biology 1

This handout contains:
1. Today's iClicker Questions
2. Handout for today's lecture.
3. Take-home problem for next wednesday.

iClicker Question #24A - before lecture

Which of the following is/are not feature(s) of a gene?

(A) Genes can be copied.
(B) Genes encode proteins.
(C) Genes give rise to many of the physical traits of organisms.
(D) Genes cannot be altered.
(E) None of the above.

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iClicker Question #24B - after lecture

Given our understanding of DNA structure, which of the following sets of DNA base compositions is impossible *for double-stranded DNA*?

	%A	%G	%C	%T
(A)	30	20	20	30
(B)	10	10	40	40
(C)	10	10	10	10

(D) More than one is impossible.
(E) I don't know.

Beaming in your answers

1. Figure out your answer and select the appropriate letter (A-E).
2. Turn on your iClicker by pressing the "ON/OFF" button; the blue "POWER" light should come on. If the red "LOW BATTERY" light comes on, you should replace your batteries soon.
3. Transmit your answer as follows:
   a. Press the button corresponding to the answer you've selected (A thru E).
   b. The "STATUS" light will flash green to indicate that your answer has been received. If the "STATUS" light flashed red, your answer was not received; you should re-send it until you get a green "STATUS" light.

Bio 111 DNA Experiments

Griffiths & *Streptococcus pneumonae*

- *S. pneumonae* - bacterium that causes pneumonia (potentially deadly infection)
- Grows in colonies on petri plates (like yeast) - 2 forms:
  - R - rough colonies - harmless (inject into mice & has no effect)
  - S - smooth & shiny colonies - virulent (inject into mice & they die)

    23 types of S: S_1 through S_{23} (can be distinguished by tests)

What was known before:

- loss of virulence: if you isolate S_3 from patients & grow it for a long time on petri plates, you find some rough colonies. They called them $R_{(3)}$.
- reversion: very rarely, $R_{(3)}$ will have some S_3 offspring (but never S_2 or S_{22} etc).
- heat killing: you can boil any S strain & this kills the bacteria. They burst open & you can get the "extract". This extract is harmless when injected in to mice.

Griffith's Experiments: Wanted to understand this type switching

(1) mouse  inject live $R_{(3)}$ → mouse lives → R is harmless

(2)  inject live S_2 → mouse dies → S is deadly

- isolate bacteria from dead mouse's blood & it is type S_2

(3)  inject extract of heat-killed S_2 → mouse lives

- never find S_2 in the mouse's blood.

(4)  mix:
- live $R_{(3)}$
- extract of heat-killed S_2

⇒ inject → mouse dies

– isolate bacteria from blood of dead mouse: if reversion, you'd expect S_3.
⇒ find S_2 - UNEXPECTED RESULT

Conclusion: Transformation — genes from S_2: live R_3 → ○ all S_2

Transformation Something in extract of S_2 causes an inheritable change in R_3 → converted in S_2

∴ extract of S_2 contains a gene

1944 Avery & other labs showed that DNA was a gene

(B)

A C T G A C → bases
| | | | | |
backbone

Chargaff & DNA Base Ratios

What was known before:
- DNA contained 4 bases: A, G, C, T
- DNA was a linear polymer
- it was believed (on very limited evidence) that DNA was just a repetating "tetranucleotide":
  AGCTAGCTAGCTACGT.....
  therefore: 25% A 25% G 25% C 25% T

Chargaff (1950 & 1951)
- Purified DNA from different organisms & measured the "base composition" %A %G %C %T

→ digested DNA into individual nucleotides

Some of his data:

Organism	%A	%G	%C	%T	total
sea urchin*	32.8	17.7	16.3	32.1	98.9
human*	30.4	19.6	19.9	30.1	100.
bacterium*	15.1	34.9	35.4	14.6	100

*Base composition was the same in all cells of the same organism.

Conclusions:

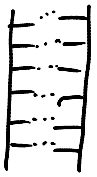
(1) was DNA a tetranucleotide?
- No
thought the seq. might be interesting

(2) are all organisms the same?
maybe different DNA = different genes

(3) patterns in nucleotide composition
% A ≅ % T
% C ≅ % G
is this a coincidence?

1953 Watson & Crick

(a) structure of DNA
- 2 parallel backbone strands



(b) base-pairing

A – T G – C

nucleotides bond through H-bonds