

# Introduction to Biology. Lecture 10

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- 1 Where we are?
  - How to be a cell
- 2 How to make proteins
  - More details



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# Where we are?

## How to be a cell



# Main duties

- Making energy: fermentation/respiration or photosynthesis
- Making proteins
- Digesting food
- Constructing body
- Multiplying
- Making sex



# How to make proteins

To build factory, we need energy (see before) and also need *machines*. These are *proteins*. To build machines from scratch, we need *instruction* books. This is *DNA*. To work with instructions, it is better to keep them in library but copy only some *pages* for immediate use. These are *RNAs*.

- DNA and RNA contain four types of nucleotides
- The sequence of nucleotides is a cypher
- Each tree nucleotides will encode amino acid (“genetic code”)
- Ribosomes translate triplets into amino acids and make proteins



# How to take food

- Digestive proteins are transported outside membrane
- They destroy polymers into monomers
- Monomers then are pumping through membrane into the cell
- If cell is photosynthetic, it produce monomers itself



# How to make body

- Monomers could be spend:
  - in destructive reactions to obtain ATP, **or**
  - in synthetic reactions to make new polymers. These reactions are using ATP





# How to multiply

- DNA is a double helix which may copy itself
- Two copies of DNA untangled and separated, then cytoplasm and membrane divide
- Of course, these processes spend lots of ATP



# How to make proteins

## More details



# How to make proteins I

- Proteins are chemical machines of cell
- Each machine is described in gene
- The only way to make them is DNA → RNA → proteins
- DNA is a folded double spiral; it has two chains
- Every chain consists of four “letters”—nucleotides (A, T, G, C)
- Two chains are complimentary, and only A–T and G–C pairs are possible



# How to make proteins II

- DNA may duplicate, then new DNAs will build complimentary chains and become exact copies
- DNA may also “produce” RNA: one of chains serves as matrix for new RNA
- RNA also has four letters (A, U, G, C)
- When RNA is building on DNA, RNA’s “U” will be complimentary with DNA’s “A”; all other rules are the same



# How to make proteins III

- New RNA is a messenger RNA (mRNA)
- It will come into ribosome, and ribosome will translate every three letters (triplet) into amino acid
- mRNA moves within ribosome, and new amino acids are joining into growing protein
- Translation rules are known as “genetic code”
- There are 64 possible triplets and only 20 amino acids—genetic code is redundant



# Translation rules: “genetic code”

	U		C		A		G		
U	UUU	Phe	UCU	Ser	UAU	Tyr	UGU	Cys	U
	UUC	Phe	UCC	Ser	UAC	Tyr	UGC	Cys	C
	UUA	Leu	UCA	Ser	UAA	<i>STOP</i>	UGA	<i>STOP</i>	A
	UUG	Leu	UCG	Ser	UAG	<i>STOP</i>	UGG	Trp	G
C	CUU	Leu	CCU	Pro	CAU	His	CGU	Arg	U
	CUC	Leu	CCC	Pro	CAC	His	CGC	Arg	C
	CUA	Leu	CCA	Pro	CAA	Gln	CGA	Arg	A
	CUG	Leu	CCG	Pro	CAG	Gln	CGG	Arg	G
A	AUU	Ile	ACU	Thr	AAU	Asn	AGU	Ser	U
	AUC	Ile	ACC	Thr	AAC	Asn	AGC	Ser	C
	AUA	Ile	ACA	Thr	AAA	Lys	AGA	Arg	A
	AUG	Met	ACG	Thr	AAG	Lys	AGG	Arg	G
G	GUU	Val	GCU	Ala	GAU	Asp	GGU	Gly	U
	GUC	Val	GCC	Ala	GAC	Asp	GGC	Gly	C
	GUA	Val	GCA	Ala	GAA	Glu	GGA	Gly	A
	GUG	Val	GCG	Ala	GAG	Glu	GGG	Gly	G



# Translation rules: “genetic code” (another variant)

		Second letter				
		U	C	A	G	
First letter	U	UUU } Phe	UCU } Ser	UAU } Tyr	UGU } Cys	U
		UUC } Phe	UCC } Ser	UAC } Tyr	UGC } Cys	C
		UUA } Leu	UCA } Ser	UAA Stop	UGA Stop	A
		UUG } Leu	UCG } Ser	UAG Stop	UGG Trp	G
	C	CUU } Leu	CCU } Pro	CAU } His	CGU } Arg	U
		CUC } Leu	CCC } Pro	CAC } His	CGC } Arg	C
		CUA } Leu	CCA } Pro	CAA } Gln	CGA } Arg	A
		CUG } Leu	CCG } Pro	CAG } Gln	CGG } Arg	G
	A	AUU } Ile	ACU } Thr	AAU } Asn	AGU } Ser	U
		AUC } Ile	ACC } Thr	AAC } Asn	AGC } Ser	C
		AUA } Met	ACA } Thr	AAA } Lys	AGA } Arg	A
		AUG } Met	ACG } Thr	AAG } Lys	AGG } Arg	G
	G	GUU } Val	GCU } Ala	GAU } Asp	GGU } Gly	U
		GUC } Val	GCC } Ala	GAC } Asp	GGC } Gly	C
		GUA } Val	GCA } Ala	GAA } Glu	GGA } Gly	A
		GUG } Val	GCG } Ala	GAG } Glu	GGG } Gly	G
						Third letter



# Summary

- Prokaryotic cells are simplest cells. They produce energy, obtain monomers, synthesize polymers, e.g. proteins from DNA and RNA, and sometimes also make monomers themselves (with photosynthesis), divide and even perform a sexual process (recombine DNA between cells)





# For Further Reading



## Genetic code.

[http://en.wikipedia.org/wiki/Genetic\\_code](http://en.wikipedia.org/wiki/Genetic_code)



## Protein biosynthesis.

[http://en.wikipedia.org/wiki/Protein\\_biosynthesis](http://en.wikipedia.org/wiki/Protein_biosynthesis)

