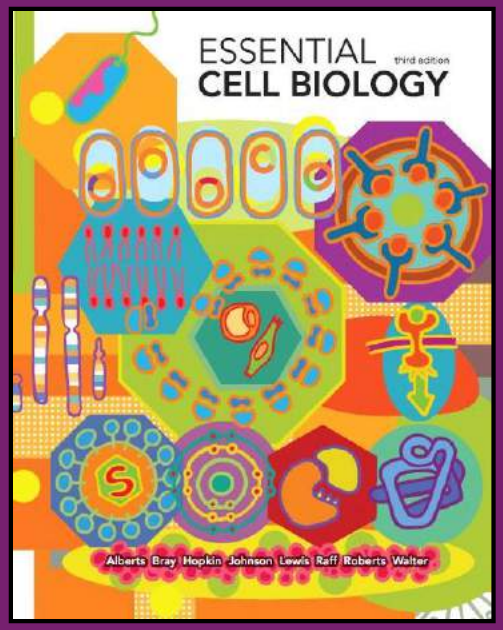


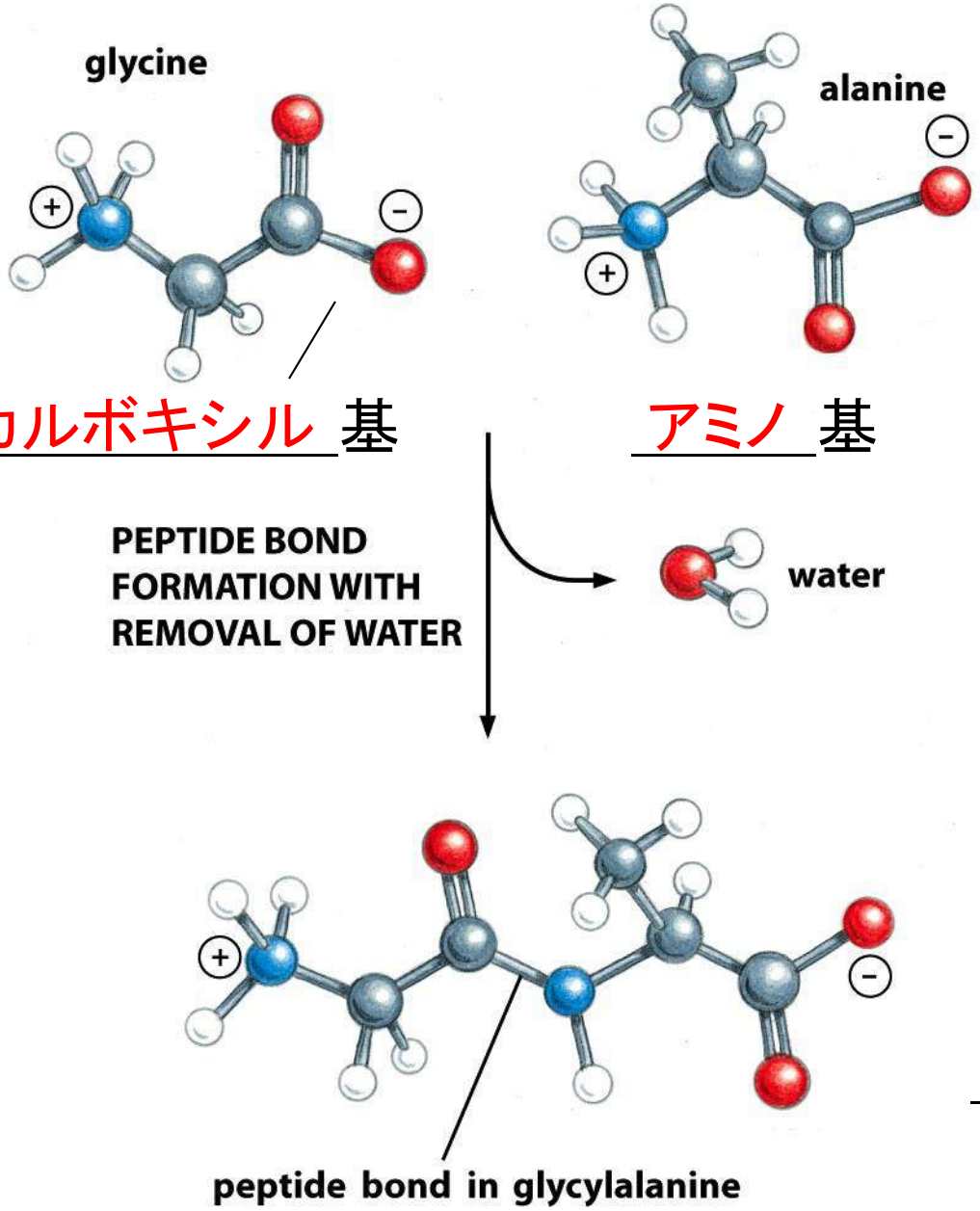
Essential Cell Biology

Third Edition

Chapter 4

Protein Structure and Function

2生化　岡島　H30. 05. 14



ペプチド 結合

Figure 4-1 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 121p.

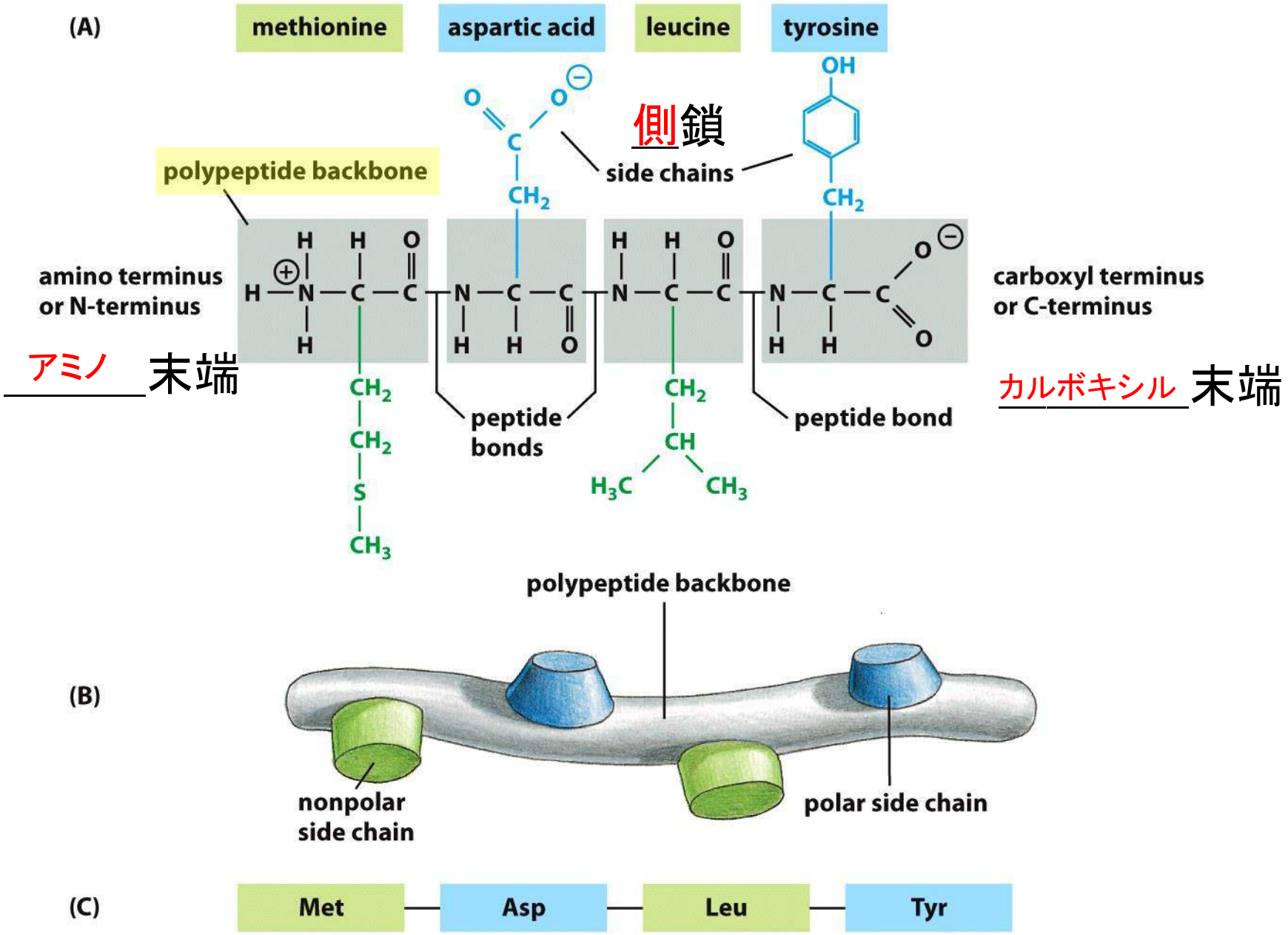


Figure 4-2 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 122p.

側鎖の化学的性質によるアミノ酸の分類

AMINO ACID			SIDE CHAIN
Aspartic acid	Asp	D	negative
Glutamic acid	Glu	E	negative
Arginine	Arg	R	positive
Lysine	Lys	K	positive
Histidine	His	H	positive
Asparagine	Asn	N	uncharged polar
Glutamine	Gln	Q	uncharged polar
Serine	Ser	S	uncharged polar
Threonine	Thr	T	uncharged polar
Tyrosine	Tyr	Y	uncharged polar

POLAR AMINO ACIDS
(hydrophilic)

親水性（極性）アミノ酸

AMINO ACID			SIDE CHAIN
Alanine	Ala	A	nonpolar
Glycine	Gly	G	nonpolar
Valine	Val	V	nonpolar
Leucine	Leu	L	nonpolar
Isoleucine	Ile	I	nonpolar
Proline	Pro	P	nonpolar
Phenylalanine	Phe	F	nonpolar
Methionine	Met	M	nonpolar
Tryptophan	Trp	W	nonpolar
Cysteine	Cys	C	nonpolar

NONPOLAR AMINO ACIDS
(hydrophobic)

疎水性（非極性）アミノ酸

Figure 4-3 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 122p.

Proteins fold into a conformation of lowest energy

(水分子と水素結合)

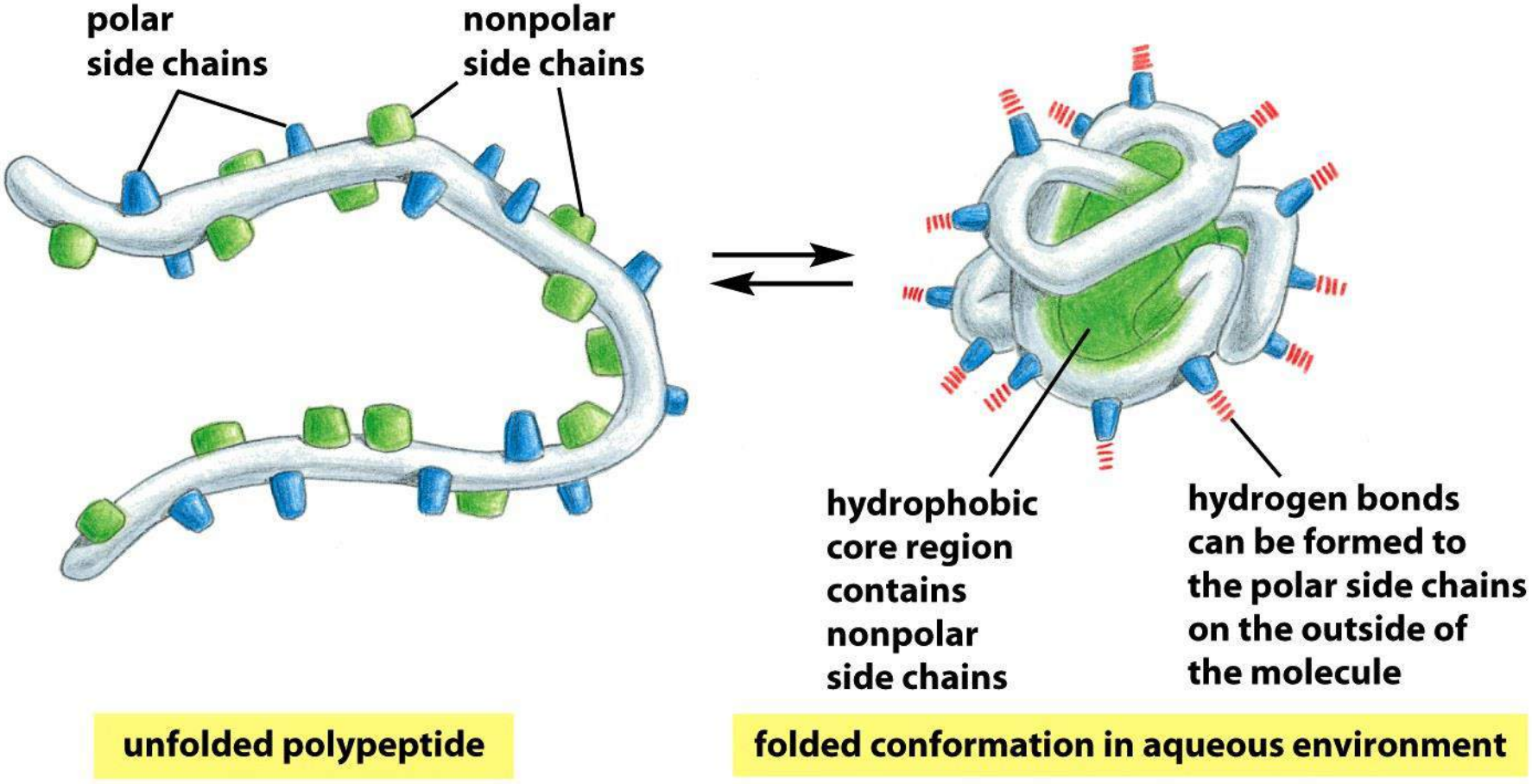
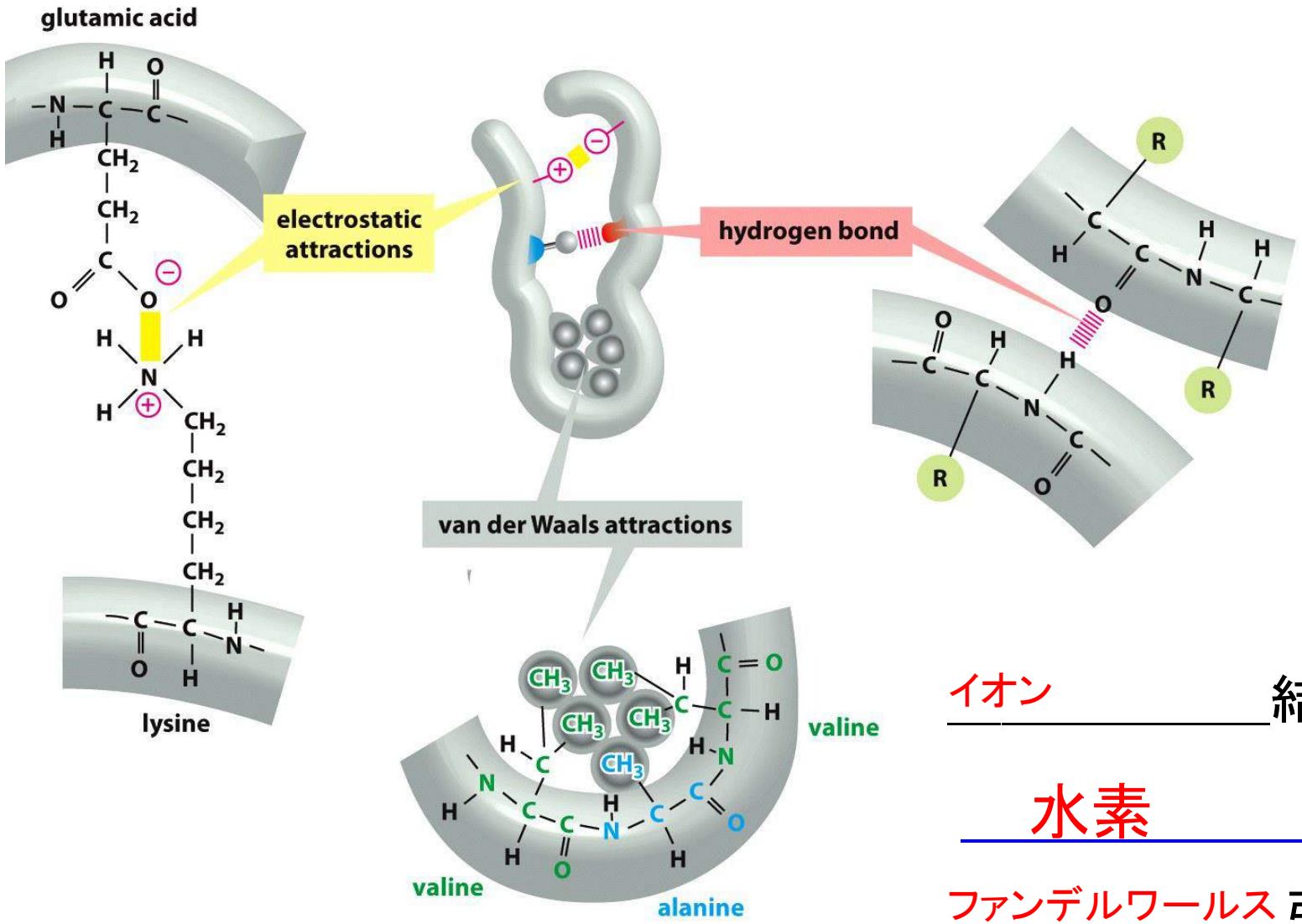


Figure 4-5 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 124p.

Three types of noncovalent bonds help proteins fold



イオン 結合

水素 結合

ファンデルワールス 引力

Figure 4-4 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010)123p.

Hydrogen bonds within a protein molecule help stabilize its folded shape

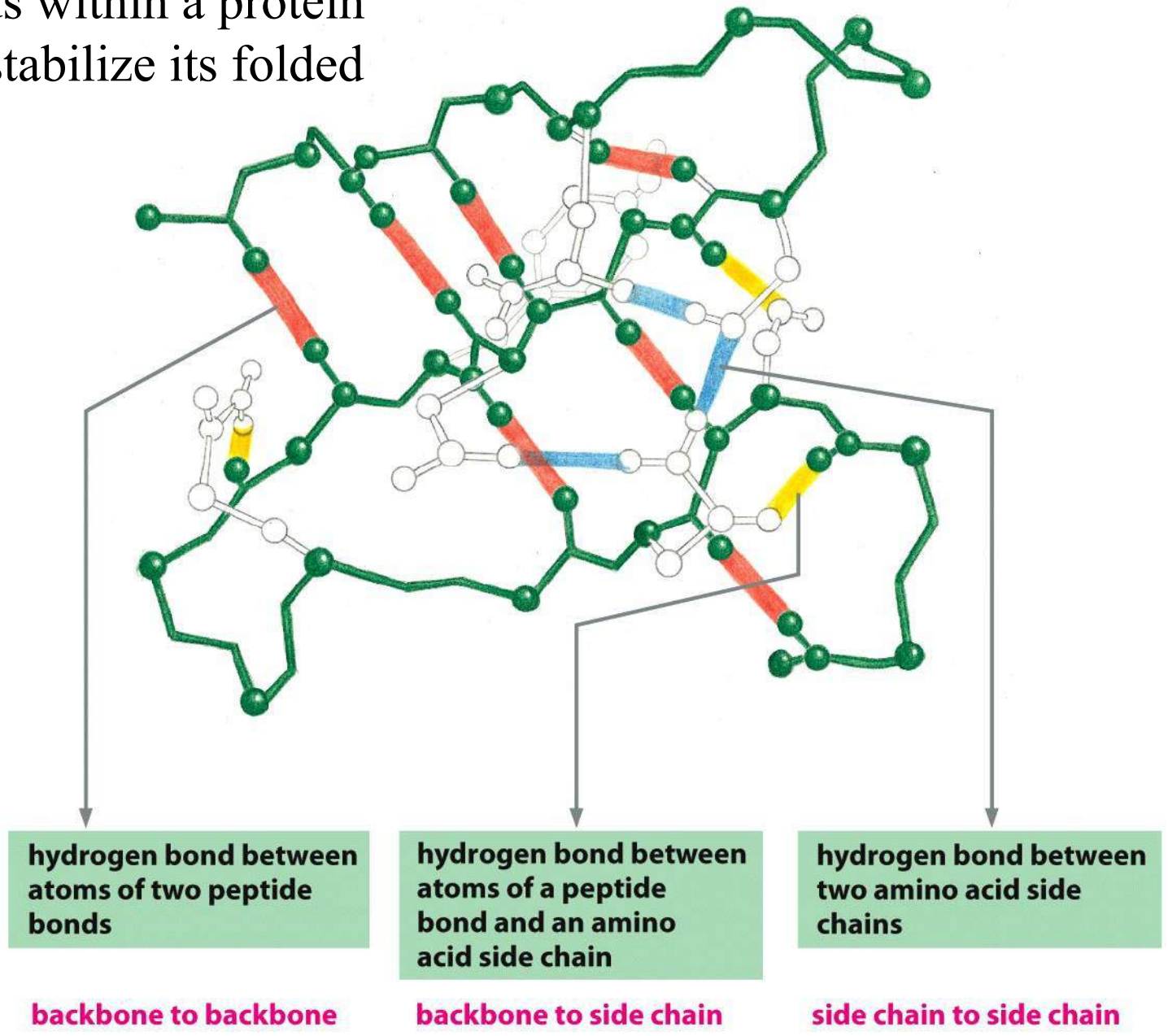


Figure 4-6 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 124p.

Aggregated Proteins

Neurodegenerative disorders
- Alzheimer's disease
- Huntiongton's disease
- Prion disease
  - scrapie---sheep
  - Bovine spongiform encephalopathy (BSE)
  - Creutzfeldt-Jacob disease (CJD)

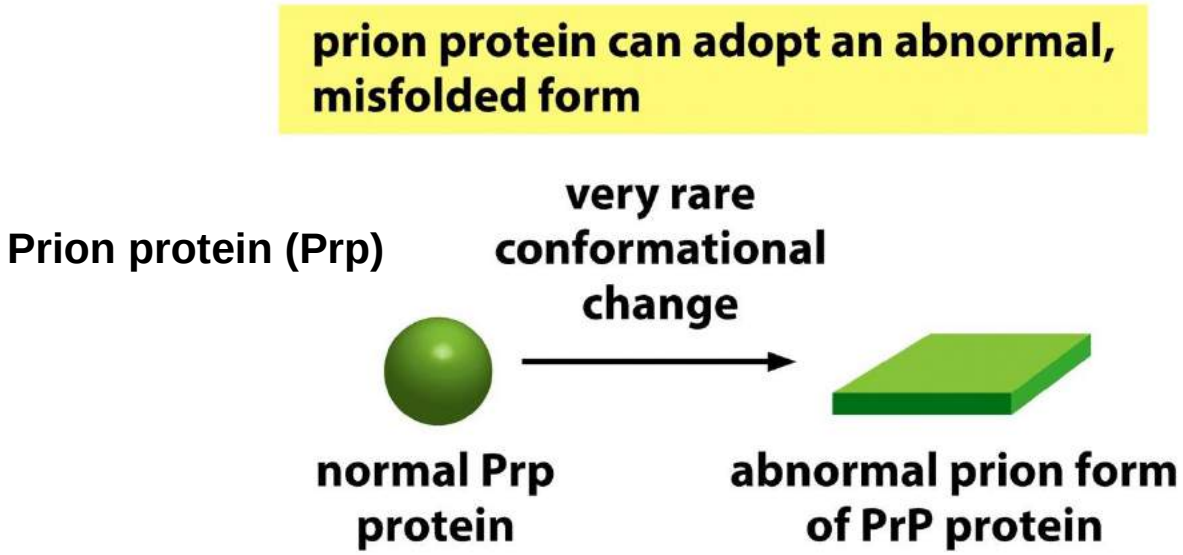


Figure 4-8(A) *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 125p.

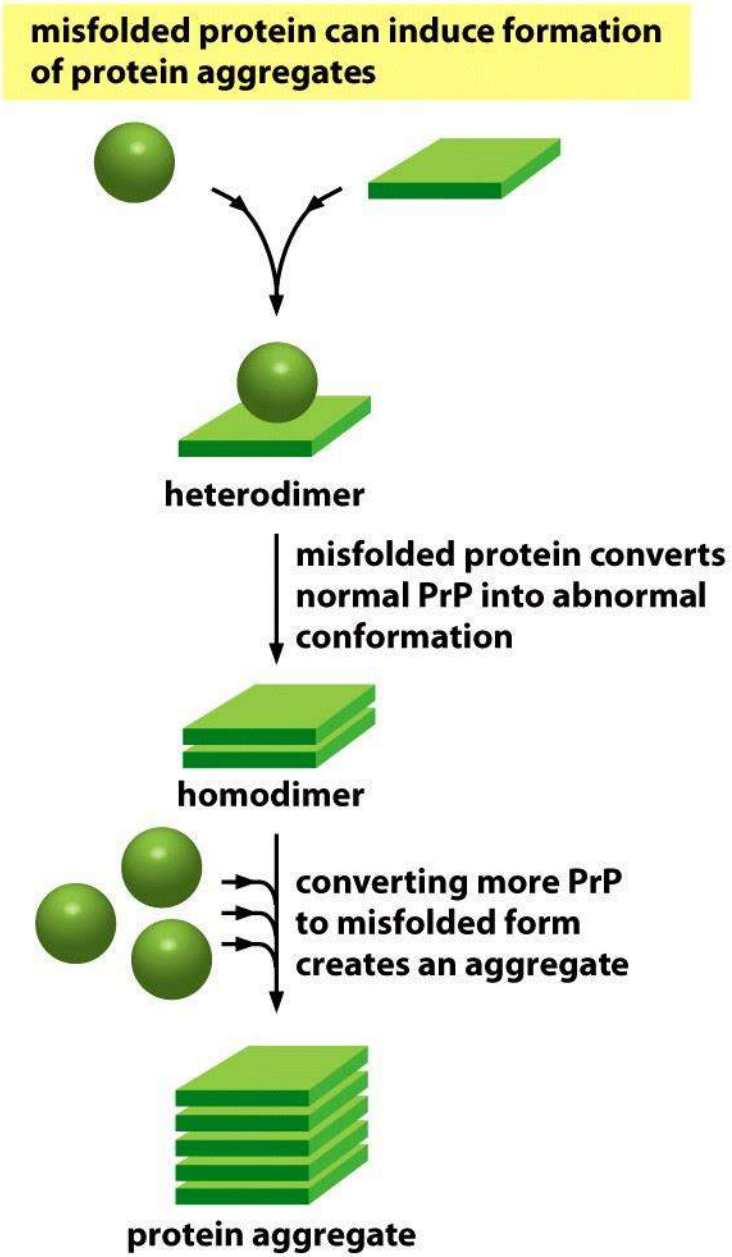


Figure 4-8(B) *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 125p.

Proteins come in a wide variety of complicated shape

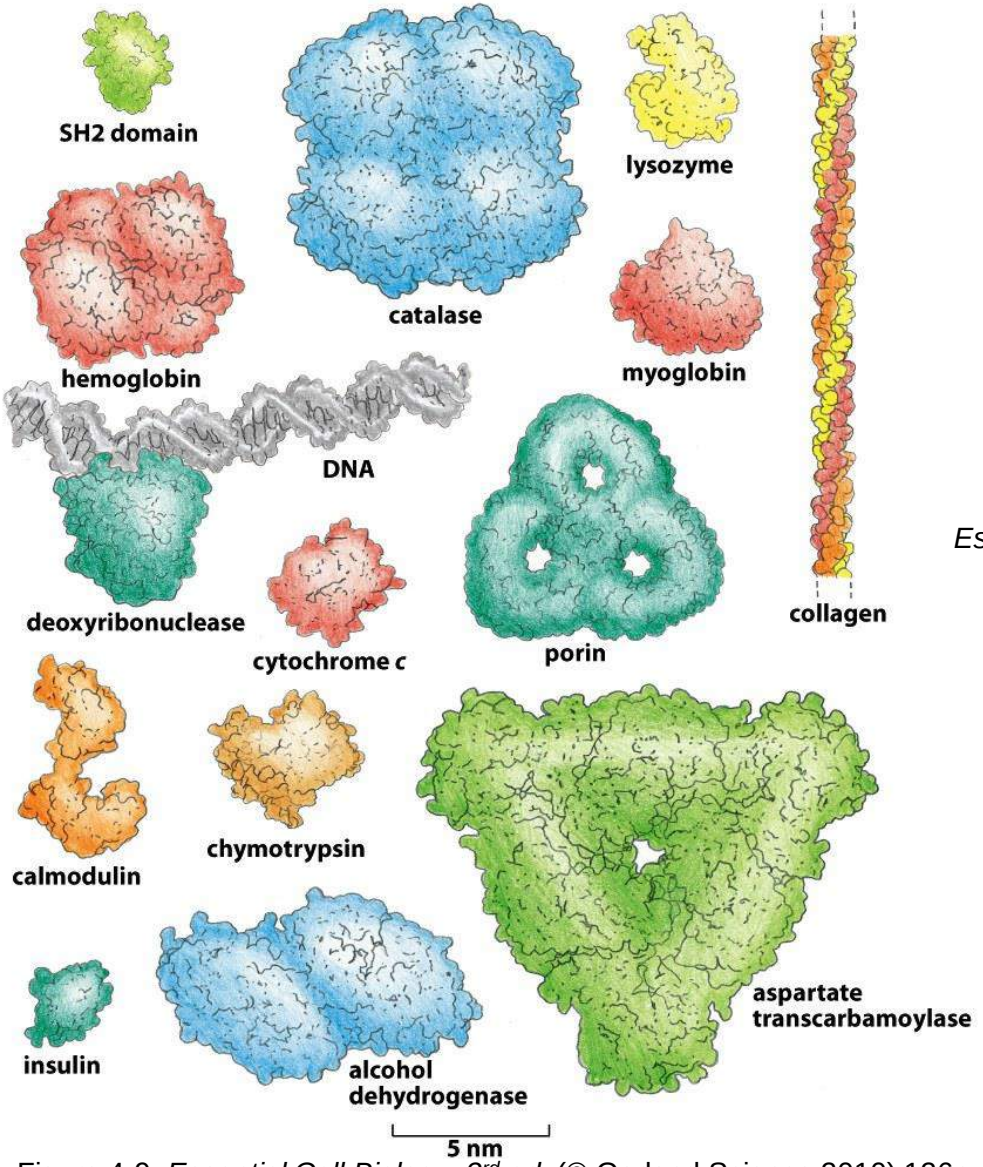
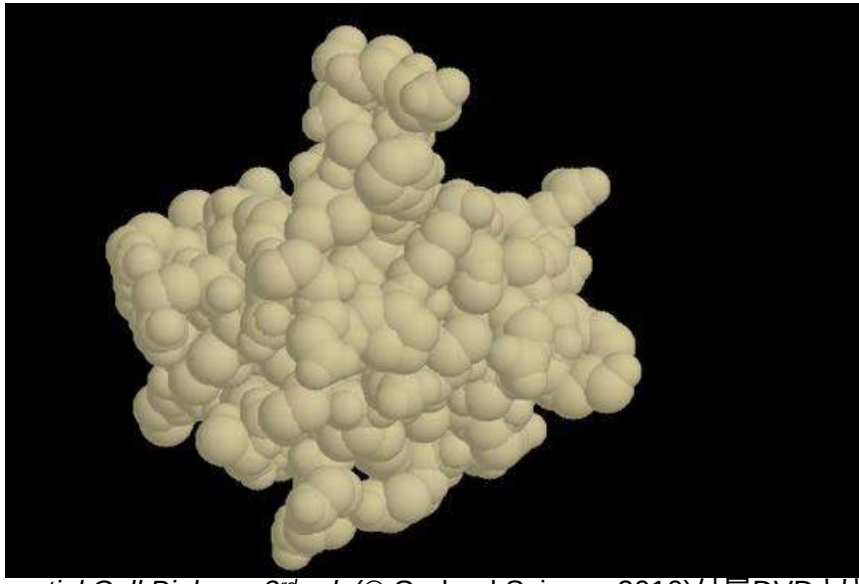


Figure 4-9 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 126p.



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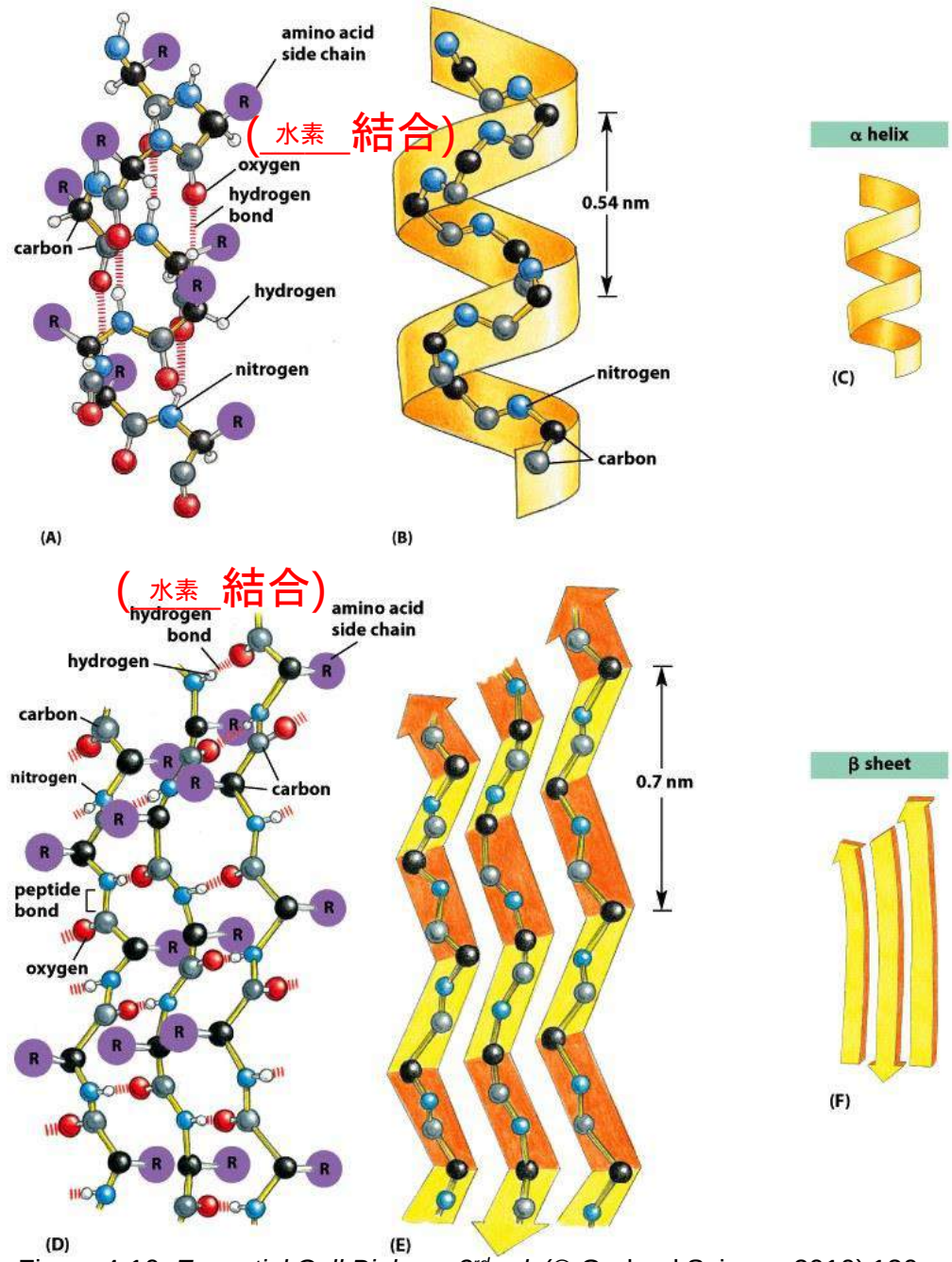
SH2 domain

（リン酸化されたチロシンに結合）

polypeptide backbone model
ribbon model

Wire model
Space-filling model] side chain

Tertiary structure （三次　　構造）

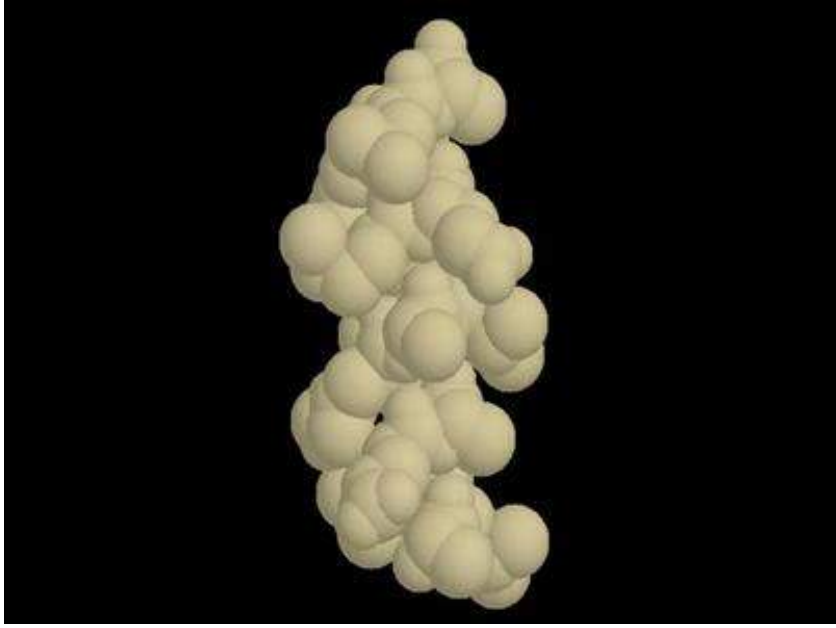


(水素結合)

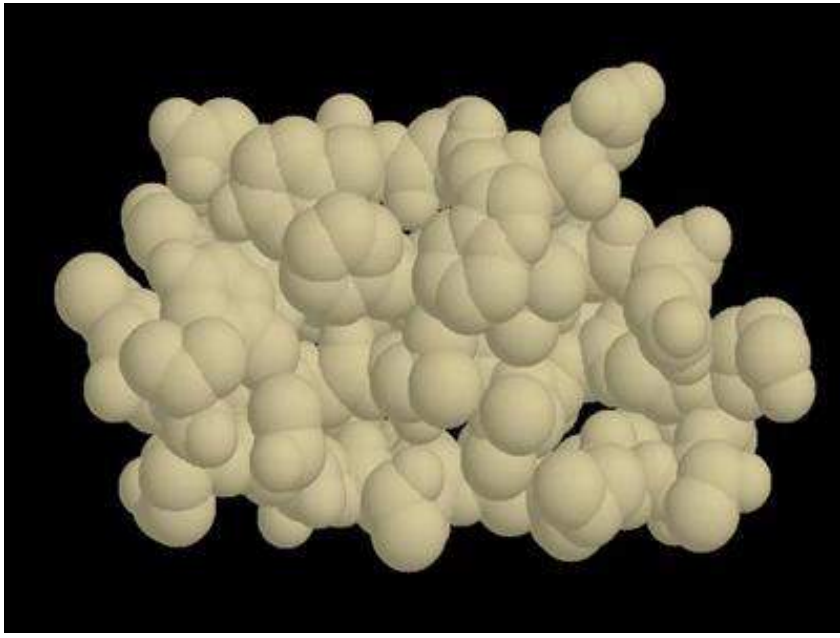
(水素結合)

Figure 4-10 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 130p.

two-dimensional structure (2次構造)



水素結合の位置は?
側鎖の位置は?



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A segment of α–helix can cross a lipid bilayer

20程度の(疎水性アミノ酸)

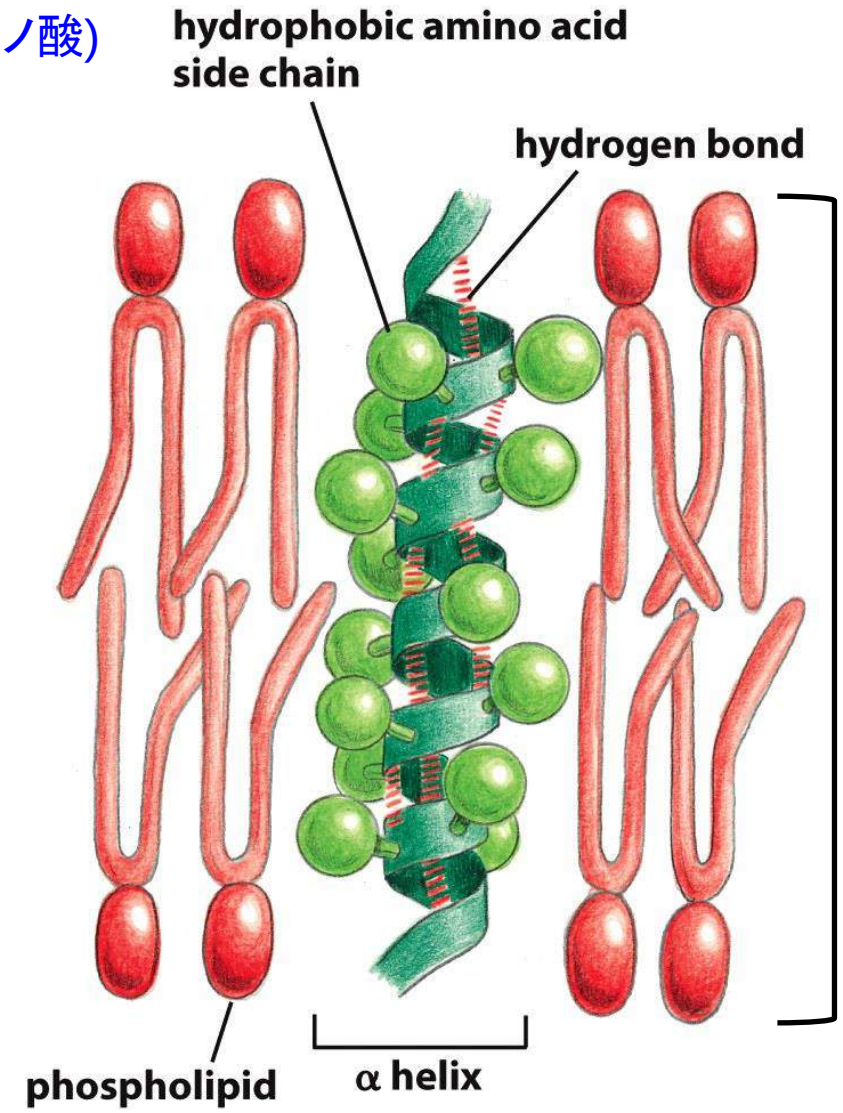

Figure 4-12 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 131p.

Two or three α–helices form coiled-coil

αケラチン、ミオシンの２重ラセン構造
フィブリノーゲンの３重ラセン構造

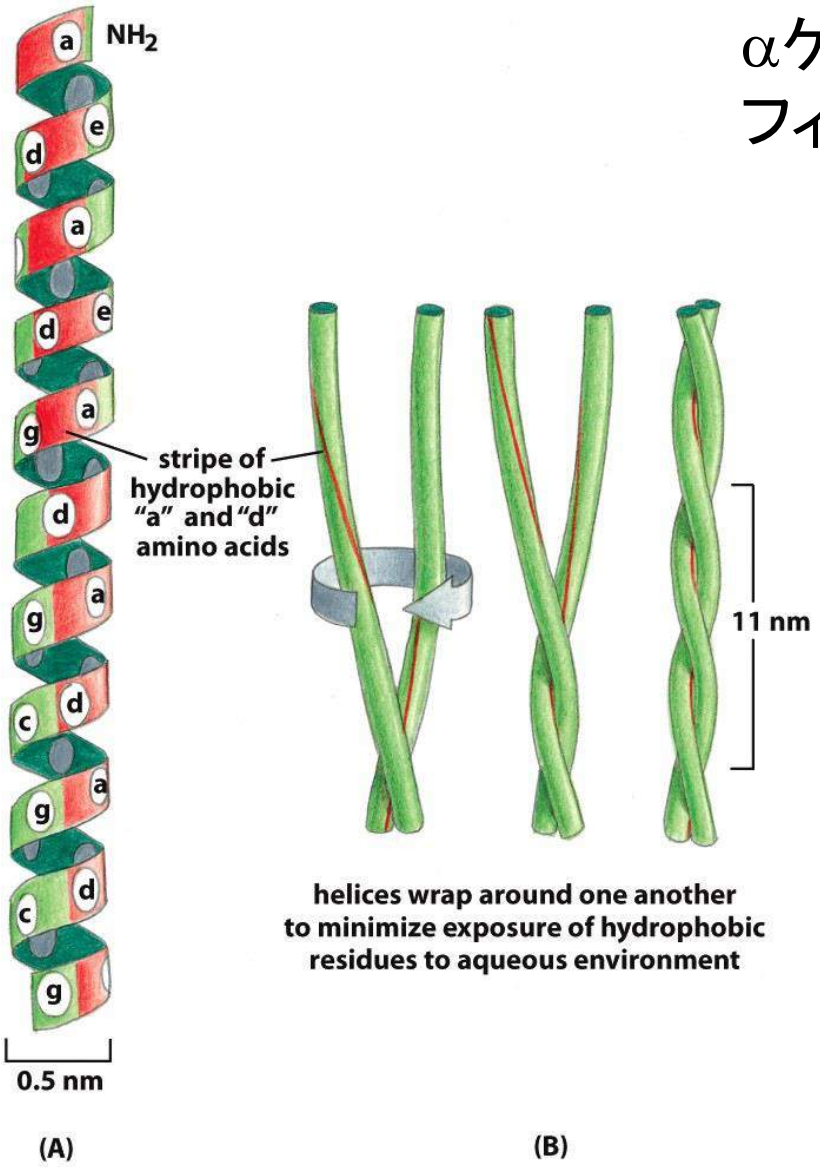

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Figure 4-13 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 132p.

Many proteins are composed of separate functional domains (ドメイン)

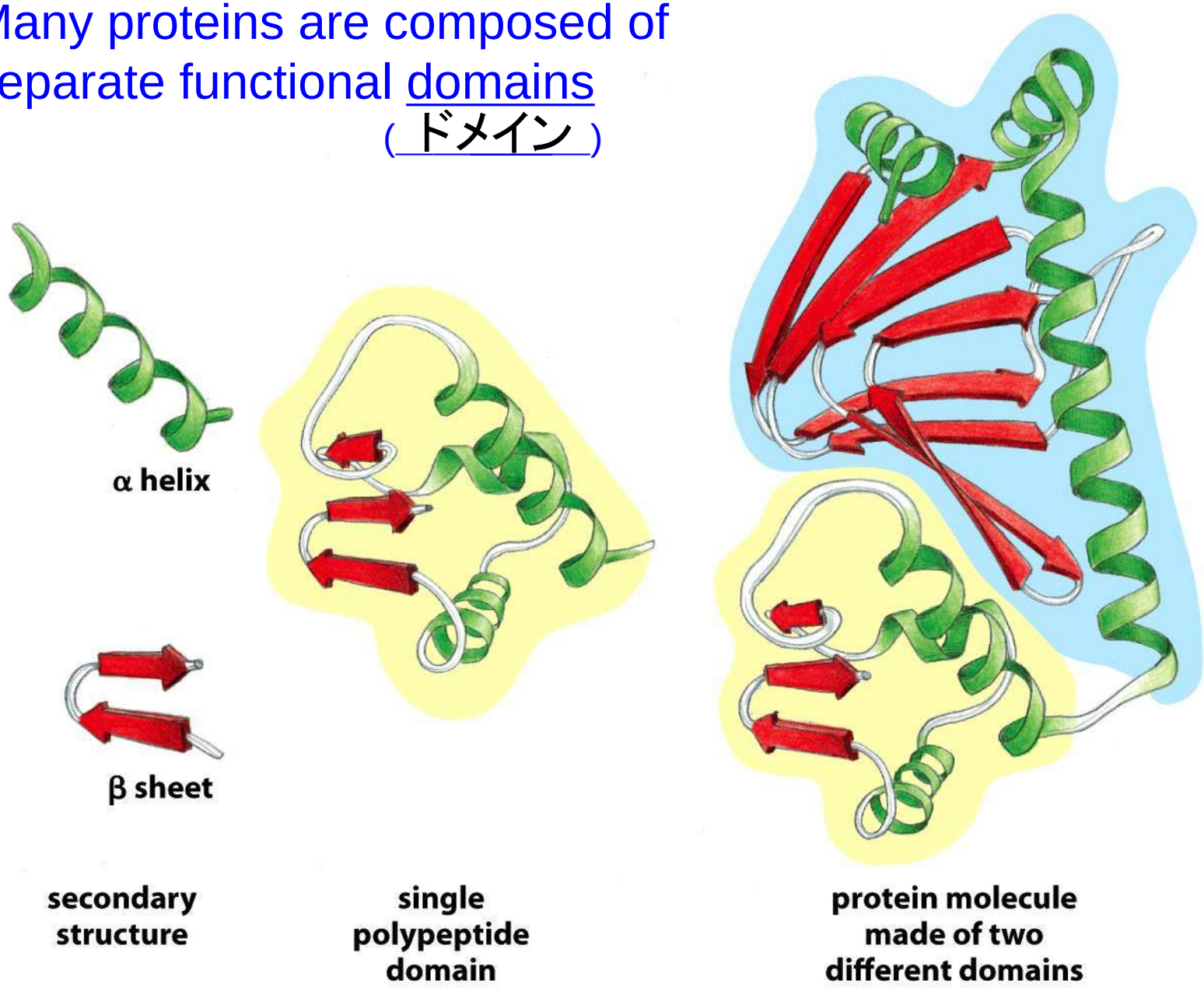
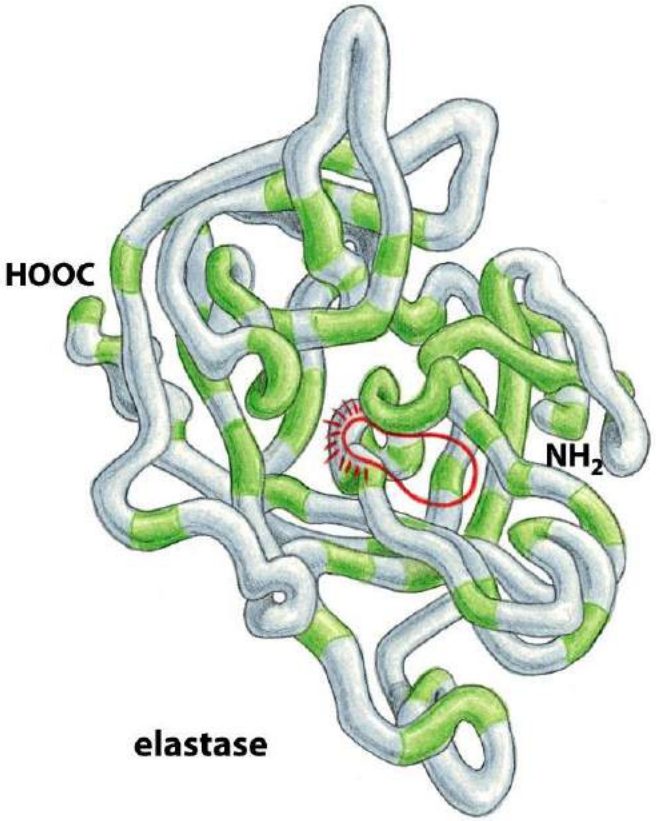
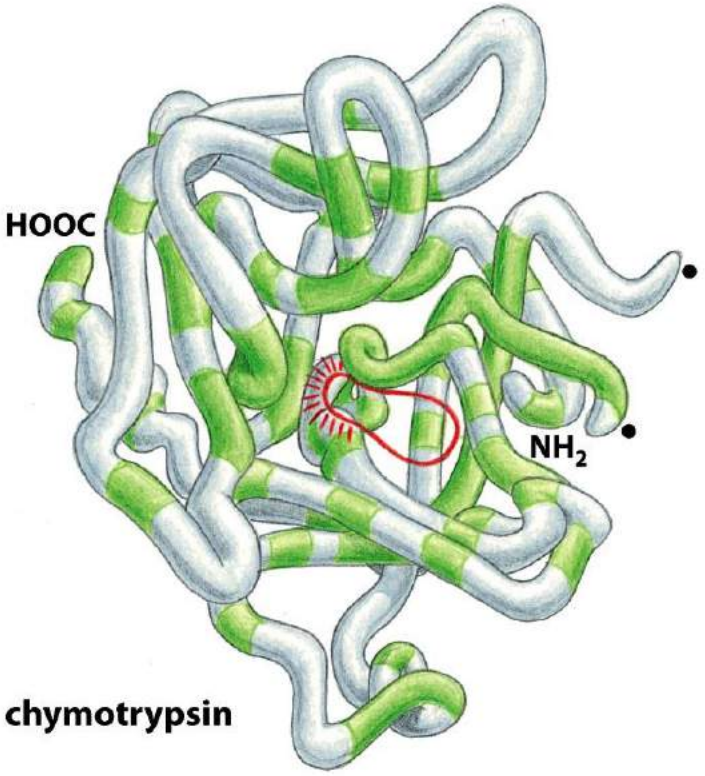


Figure 4-16 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 133p.

Serine proteases comprise a family of proteolytic enzymes



エラスチンを分解



芳香族アミノ酸の
カルボキシル基側を加水分解

タンパク質ファミリー
アミノ酸配列の類似性
構造の類似性

Figure 4-18 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 135p.

Many proteins molecules contain multiple copies of a single protein subunit

(サブユニット)

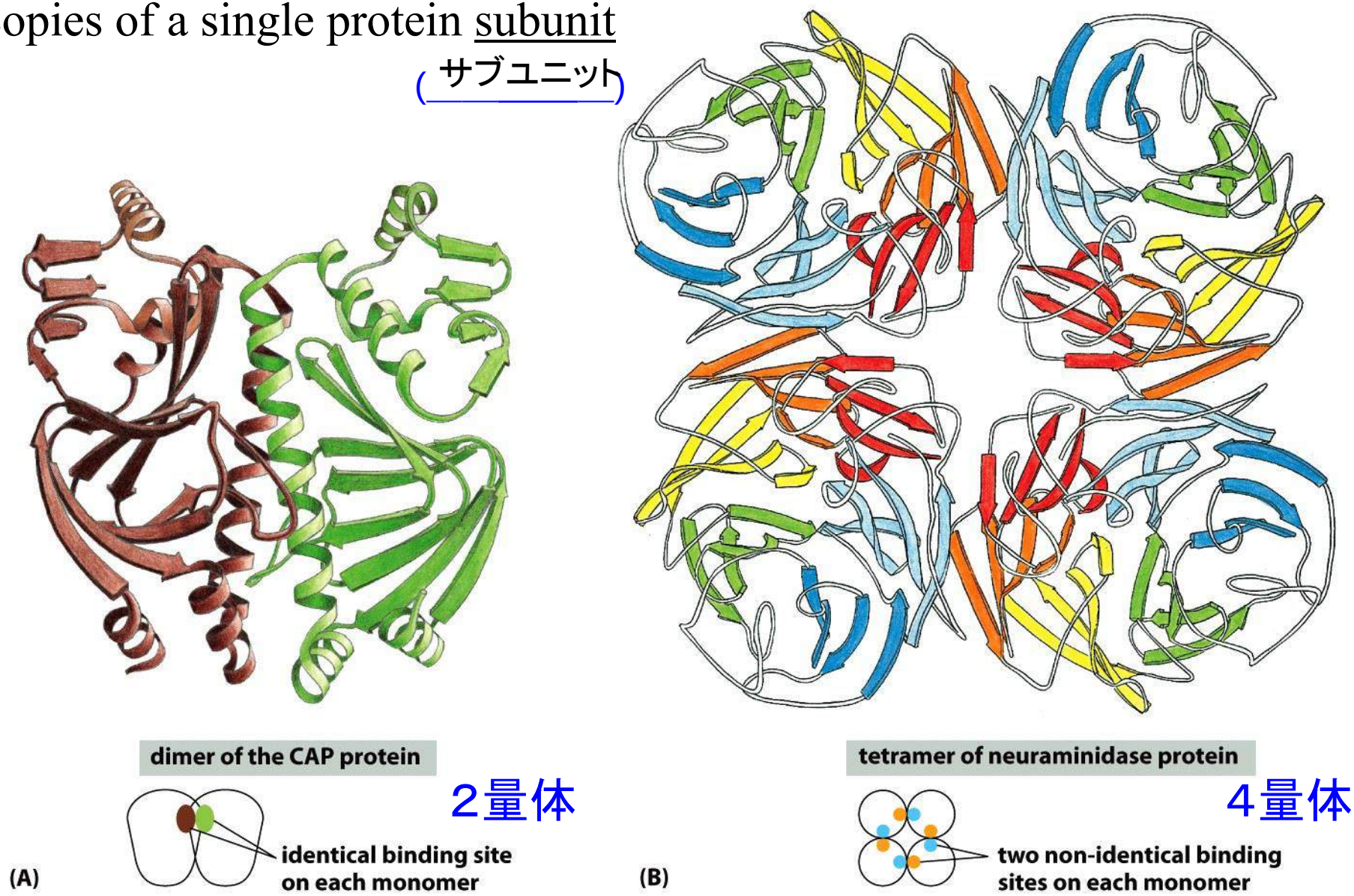


Figure 4-19 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 136p.

ヘモグロビン

４量体（ホモ２量体のヘテロ２量体）

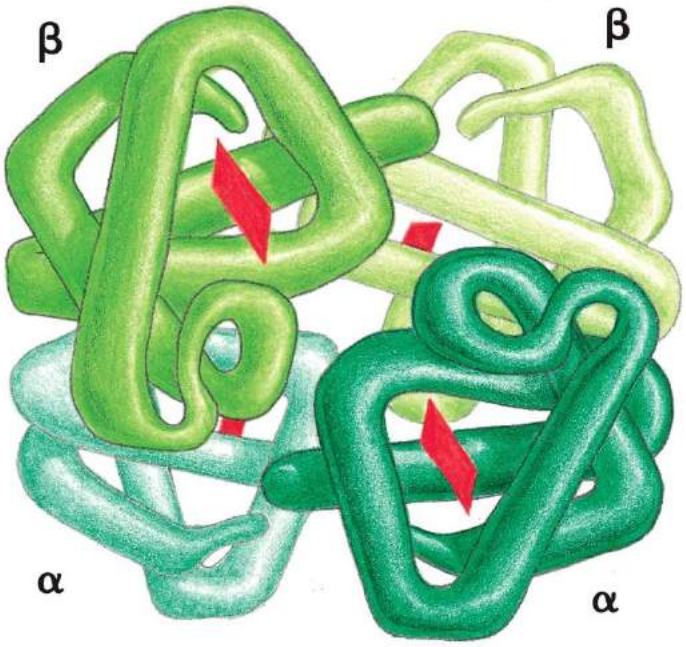
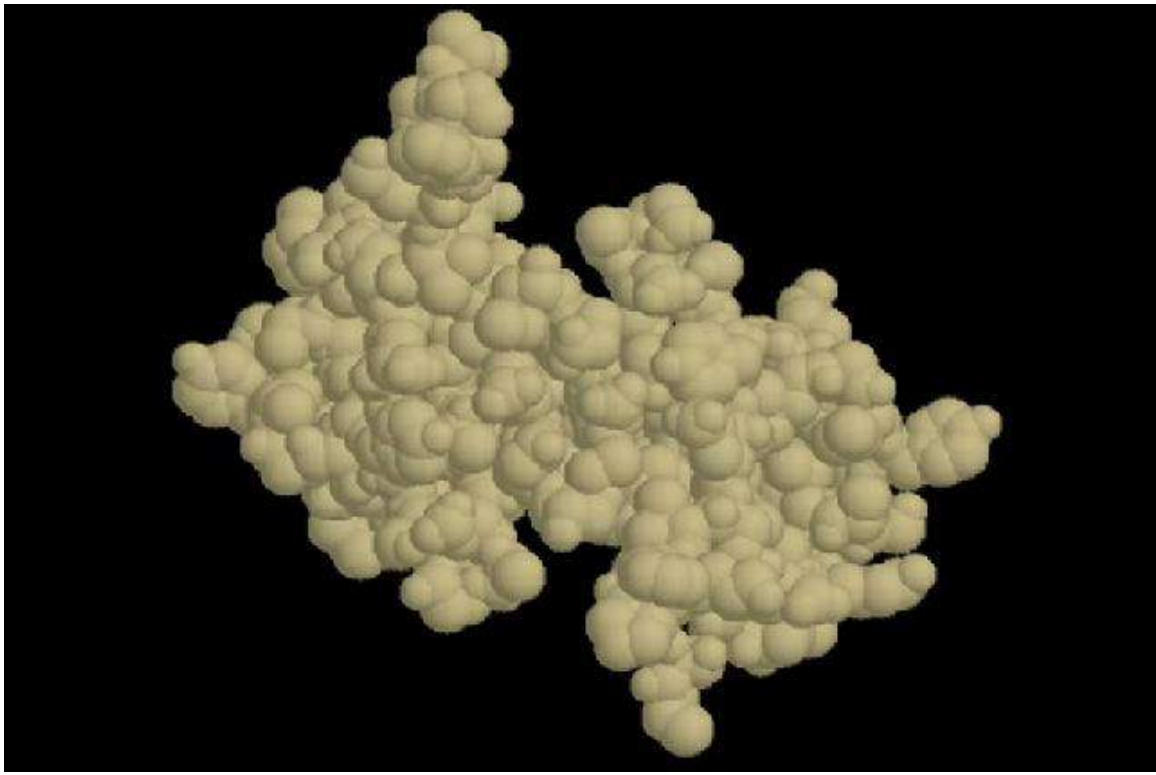


Figure 4-20 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 136p.



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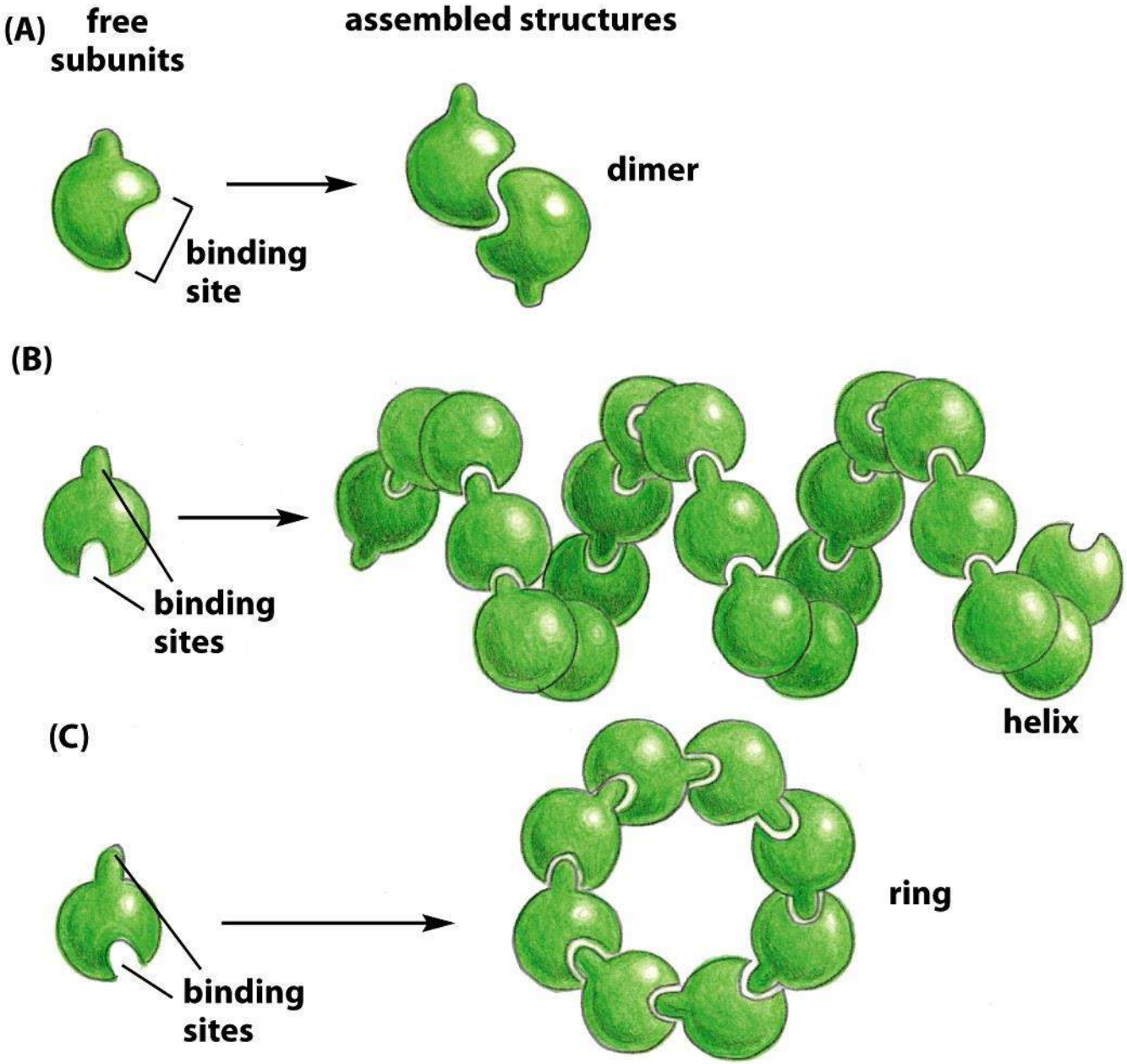


Figure 4-21 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 137p.

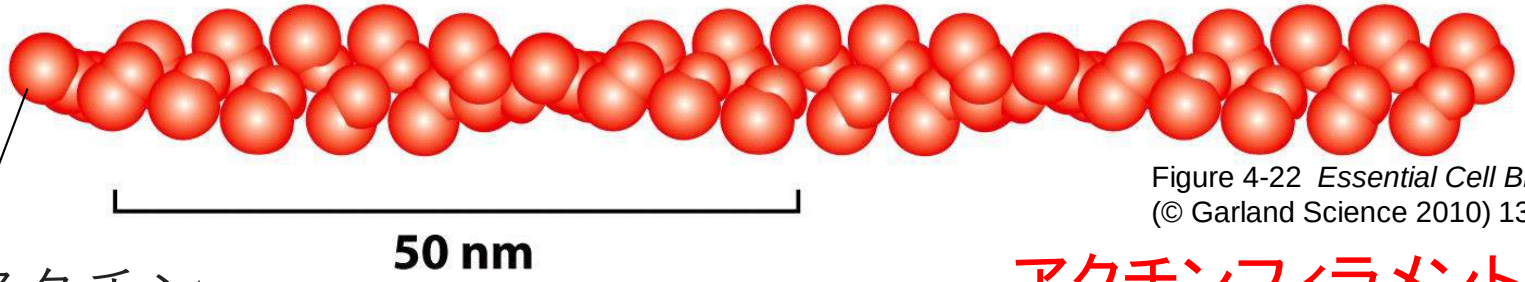


Figure 4-22 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 137p.

G-アクチン

アクチンフィラメント
（F-アクチン）

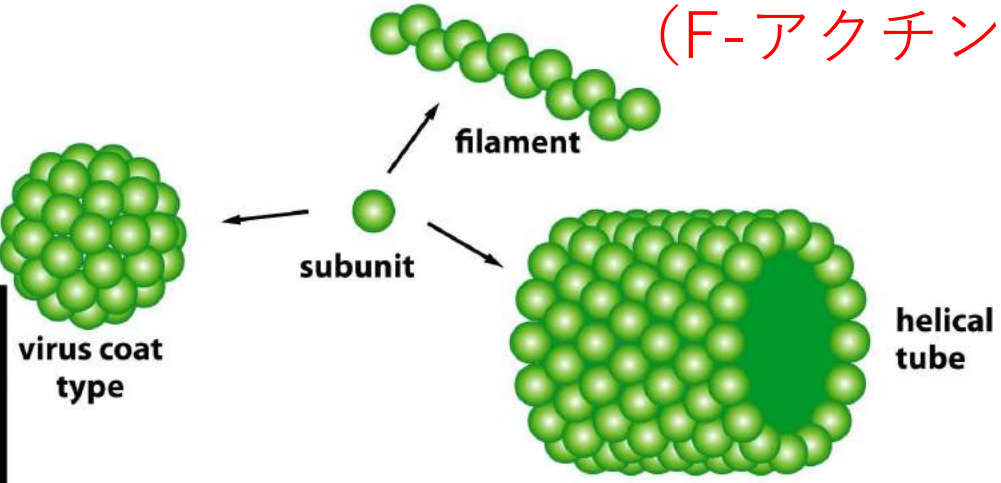


Figure 4-23 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 138p.

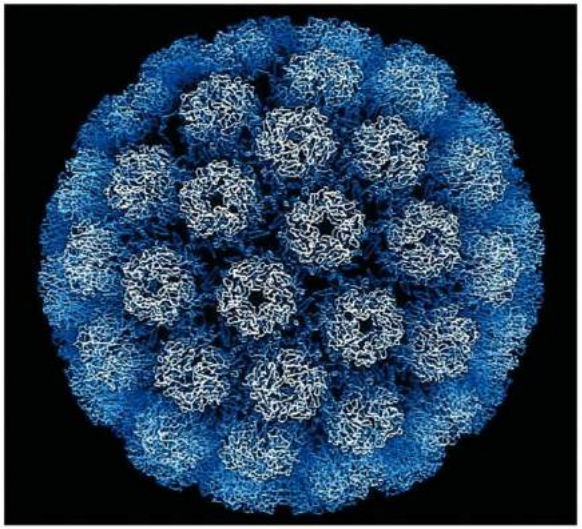


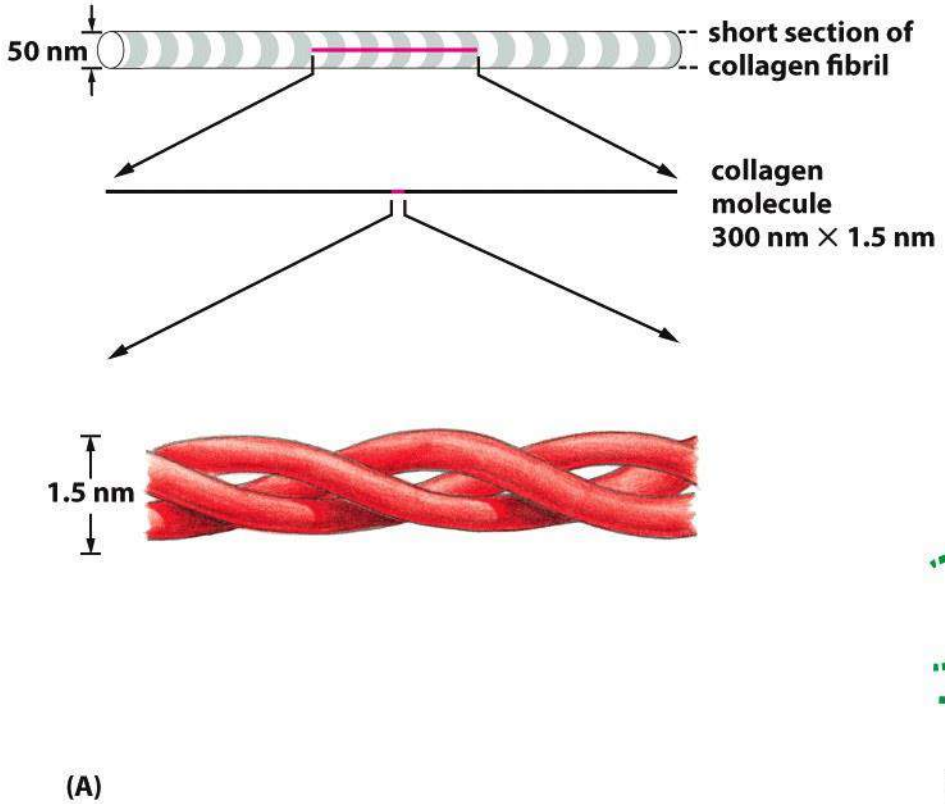
Figure 4-24 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 138p.

ウイルスのキャプシド

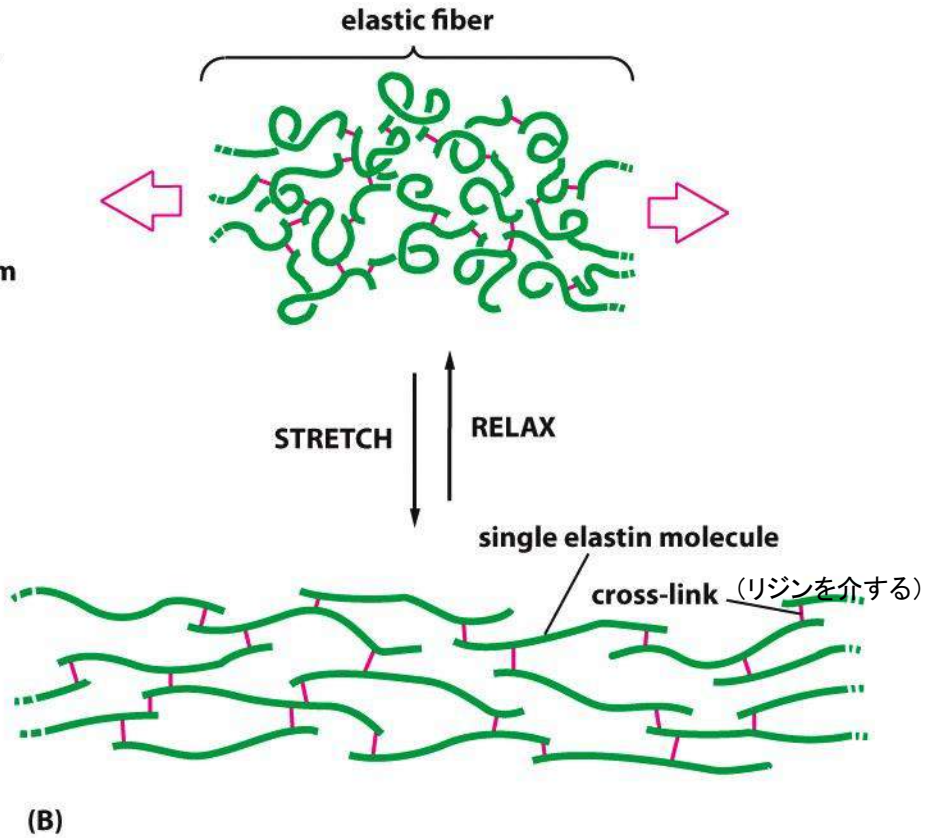
微小管
（ **α-チューブリンとβ-チューブリン**）

長い線維状のタンパク質

コラーゲン



エラスチン



皮膚、動脈、肺

Figure 4-25 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 139p.

タンパク質の架橋による安定化

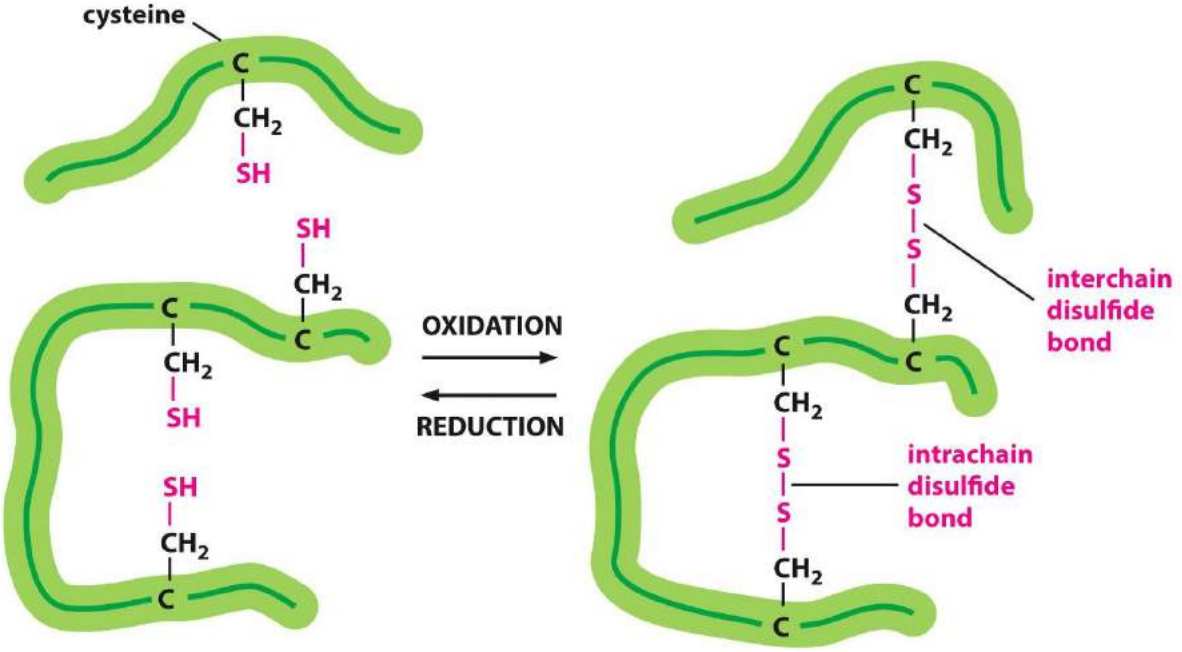
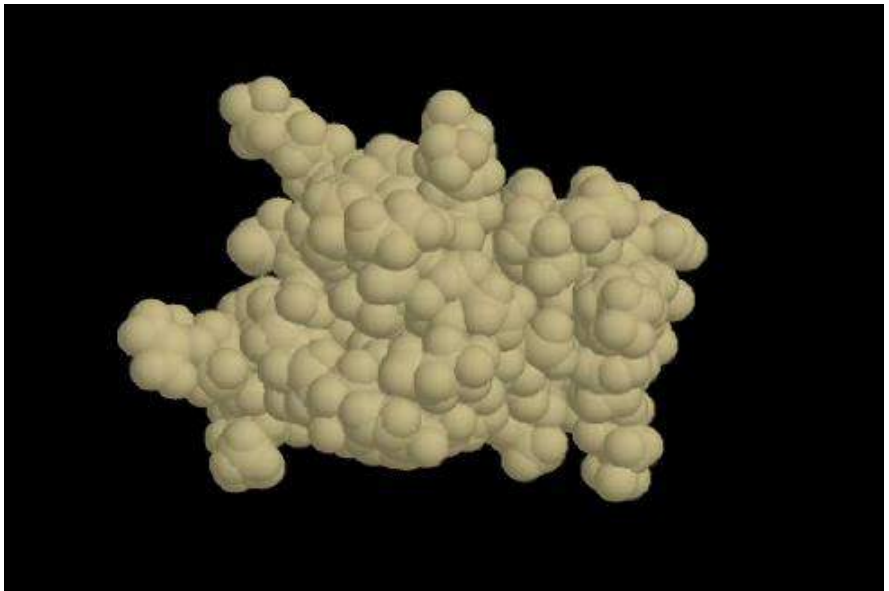


Figure 4-26 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 139p.

ジスルフィド結合

細胞外 に存在するタンパク質に特徴的



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How proteins work

All proteins bind to other molecules

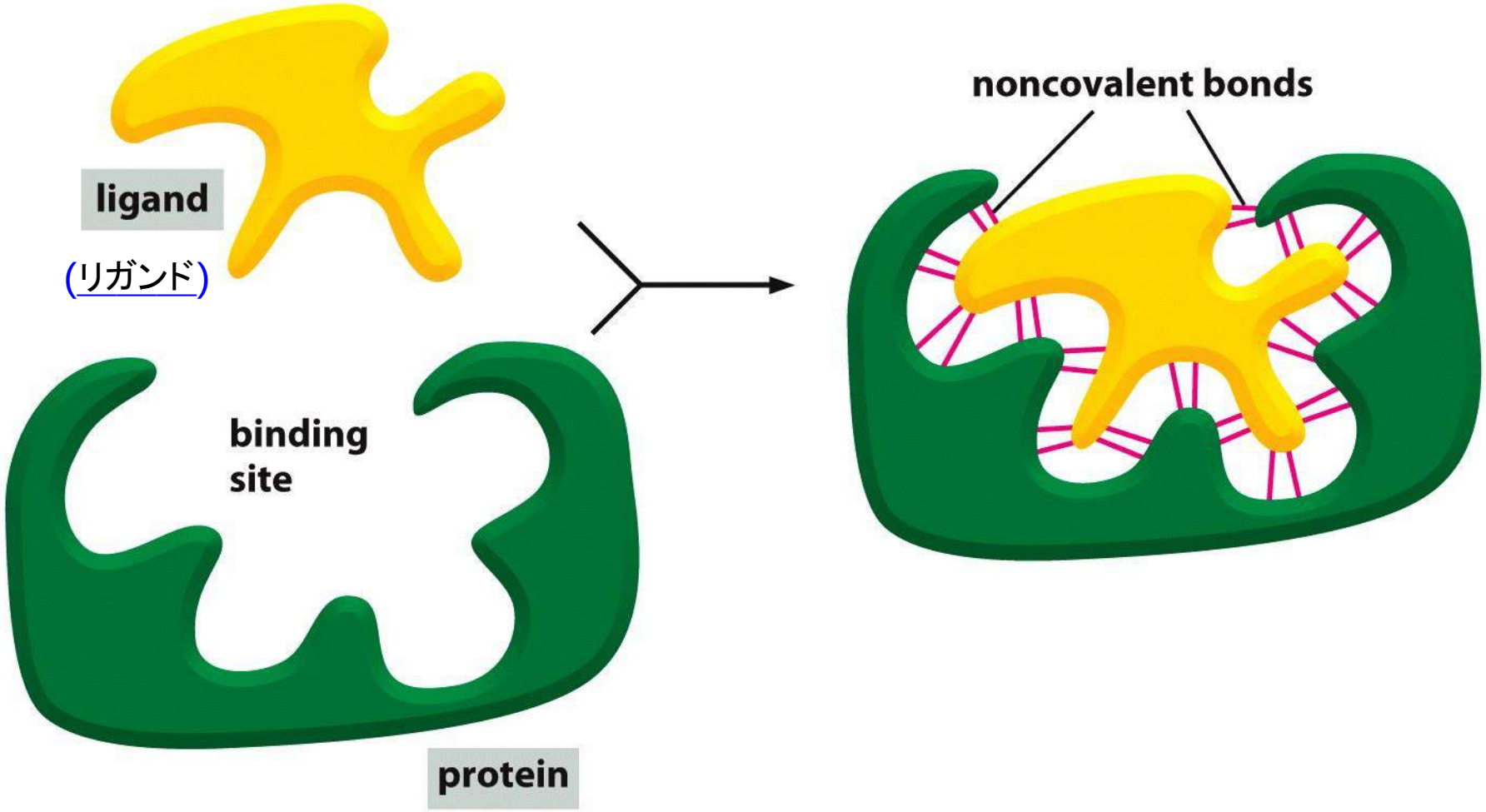
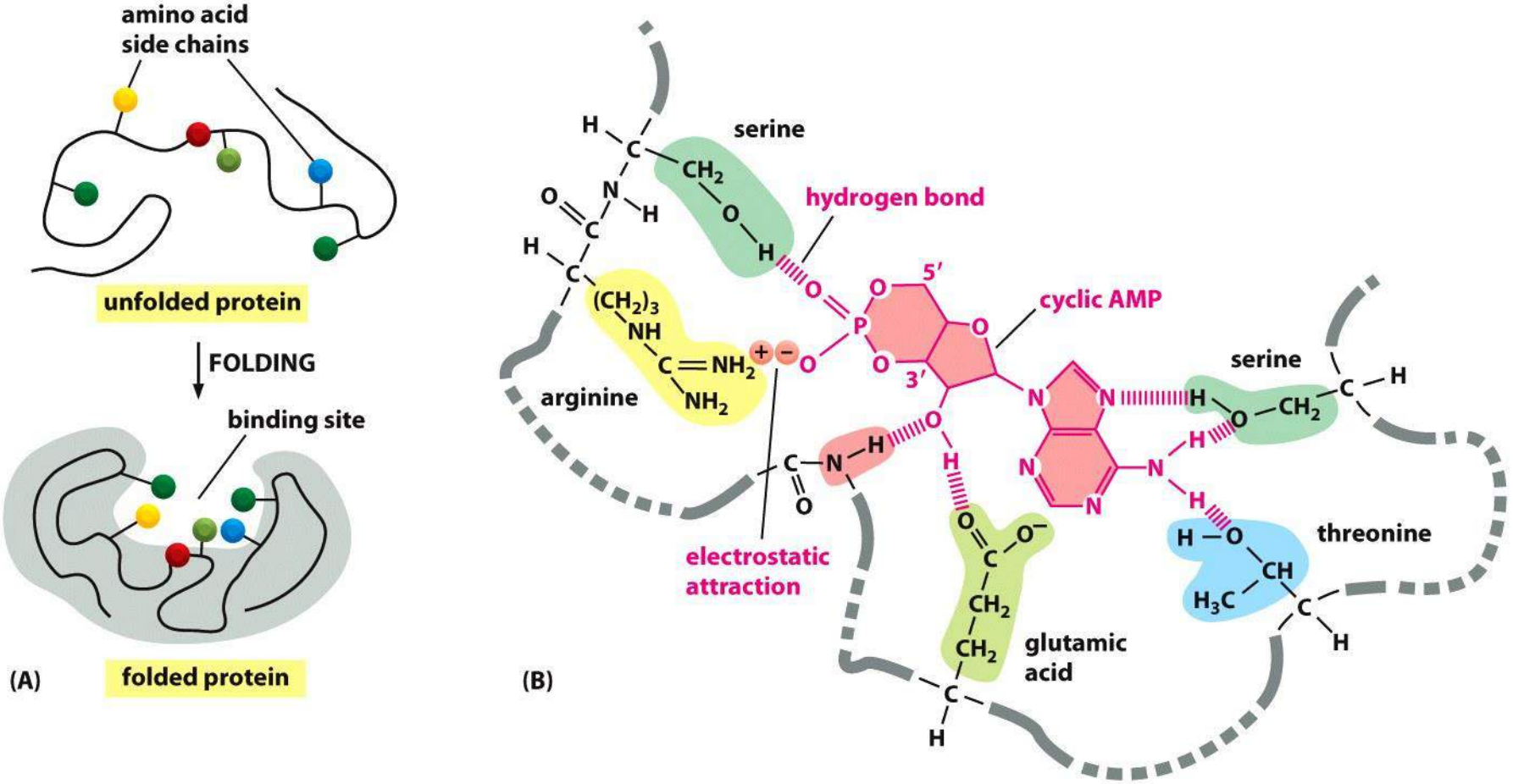


Figure 4-27 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 141p.



多数の非共有結合が相互作用に関与

Figure 4-28 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 141p.

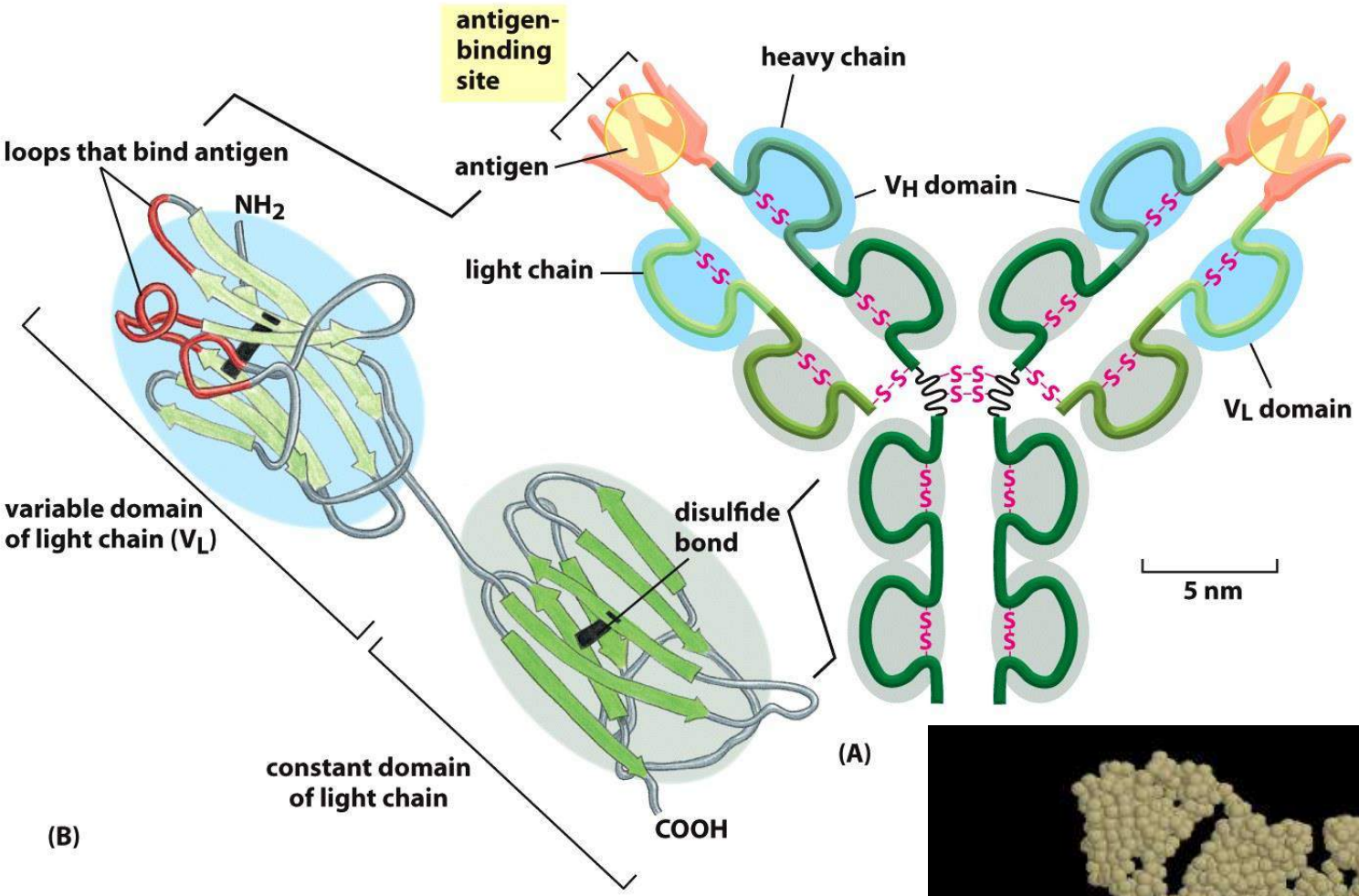
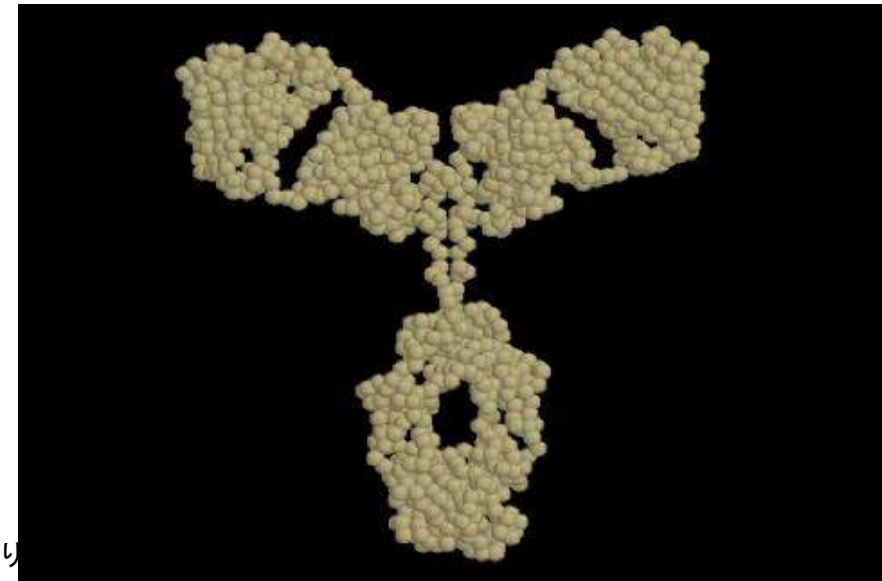


Figure 4-29 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 142p.



Binding sites of antibodies are especially versatile（多目的）

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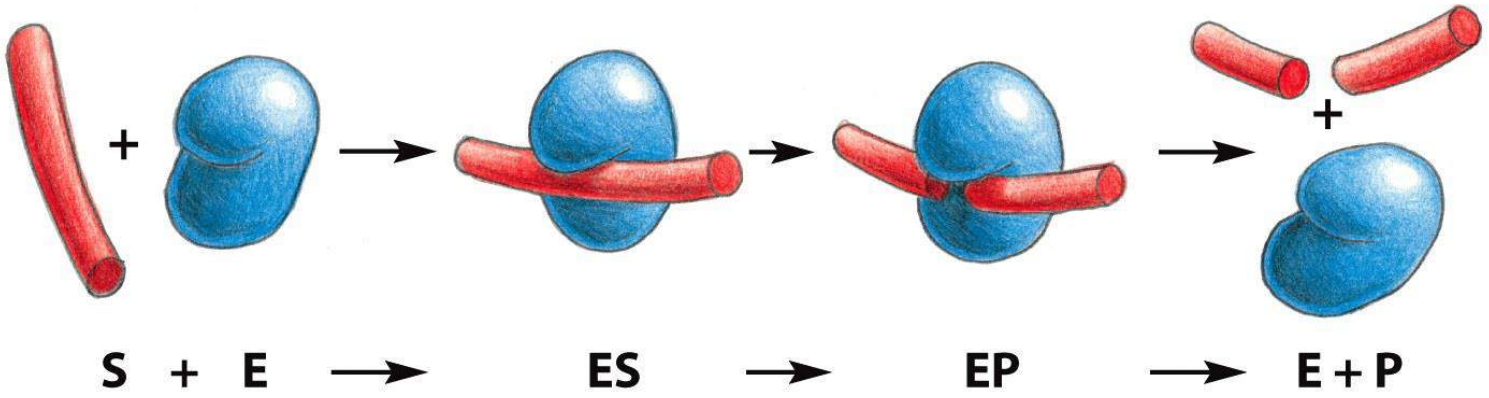
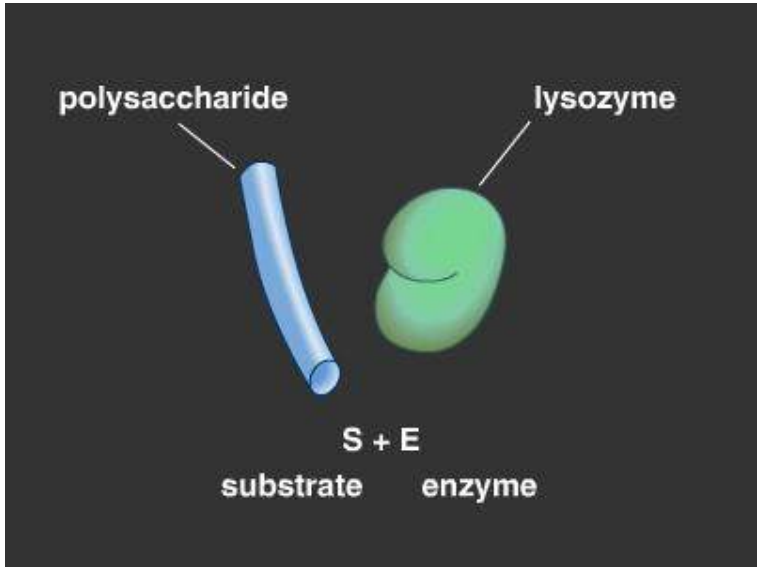
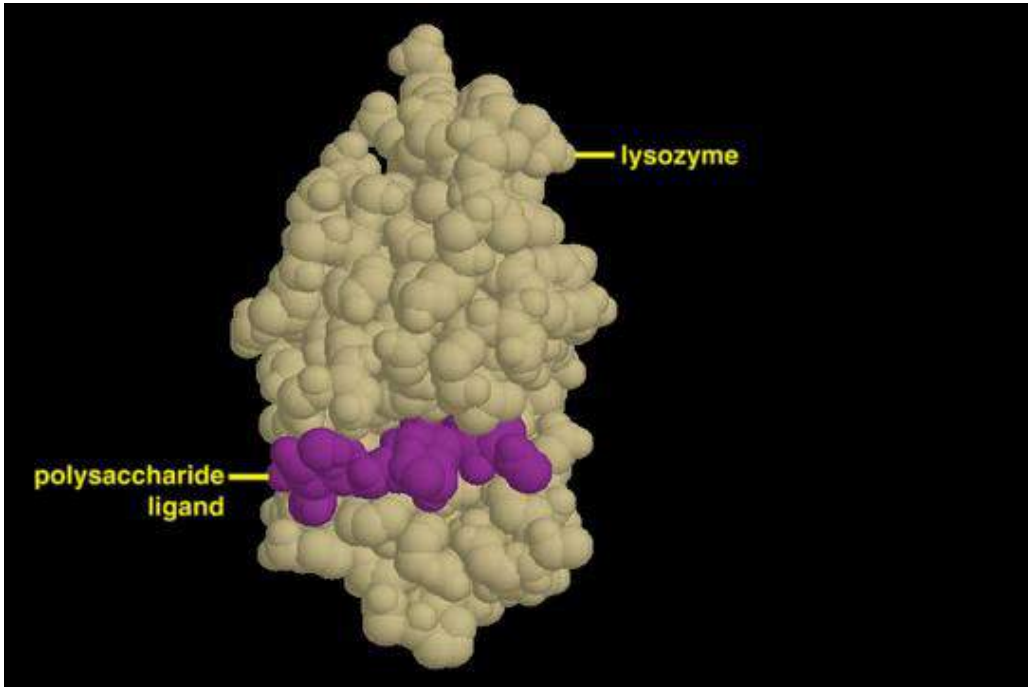


Figure 4-30(A) *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 146p.





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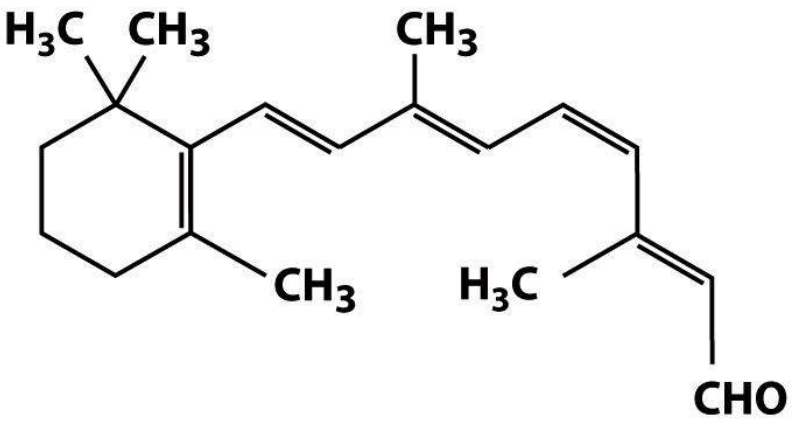
タンパク質に強く結合している小分子が特別な機能を付加する

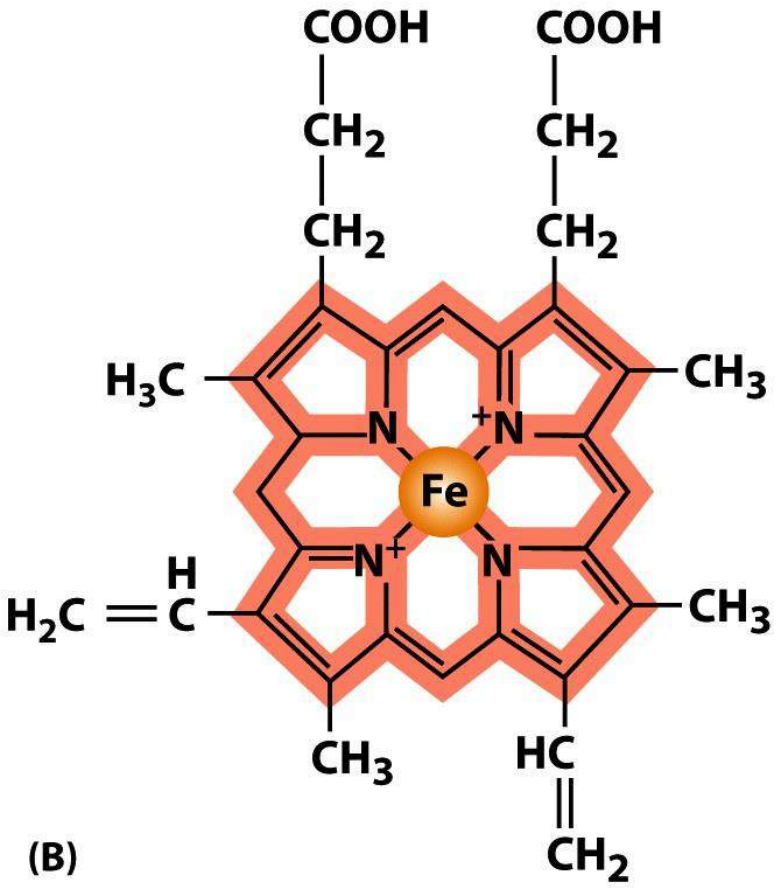


(A)

レチナール

ロドプシン

（7回膜貫通タンパク質）



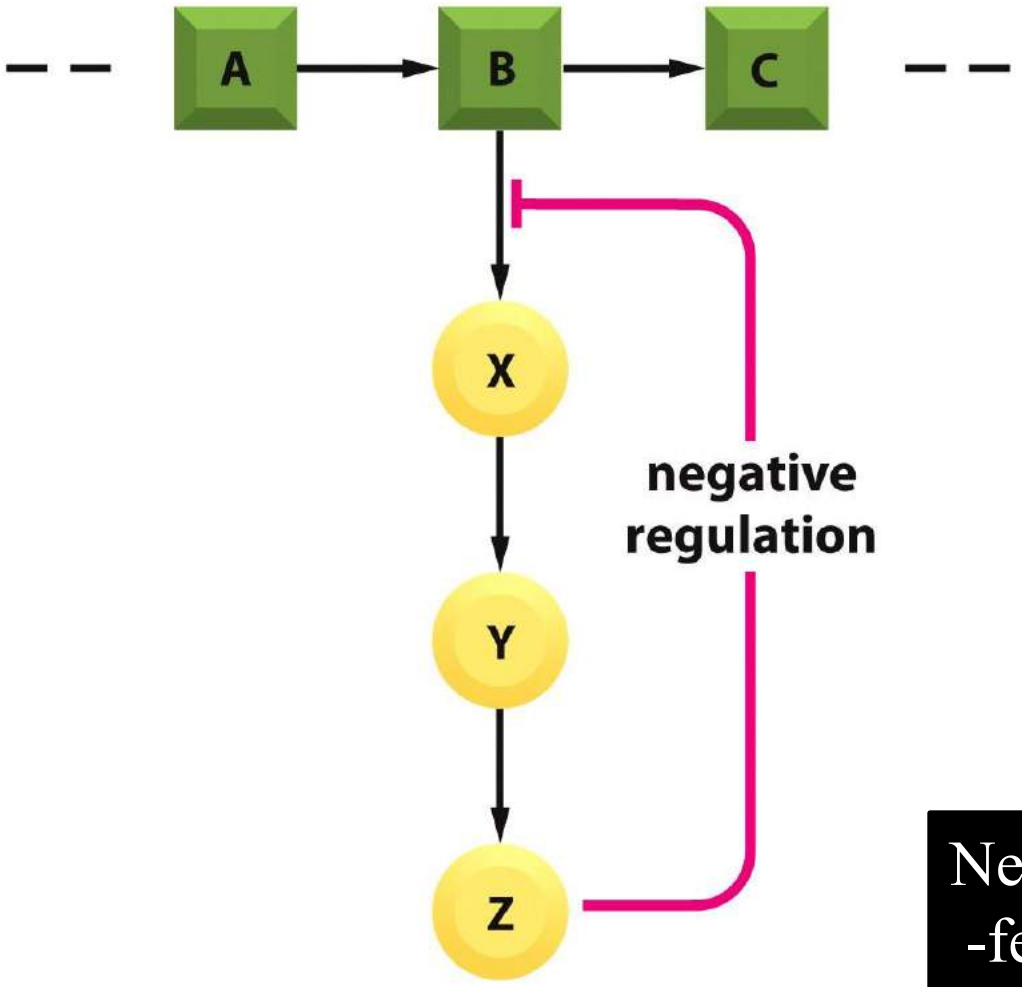
(B)

ヘム

ヘモグロビン

Figure 4-33 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 149p.

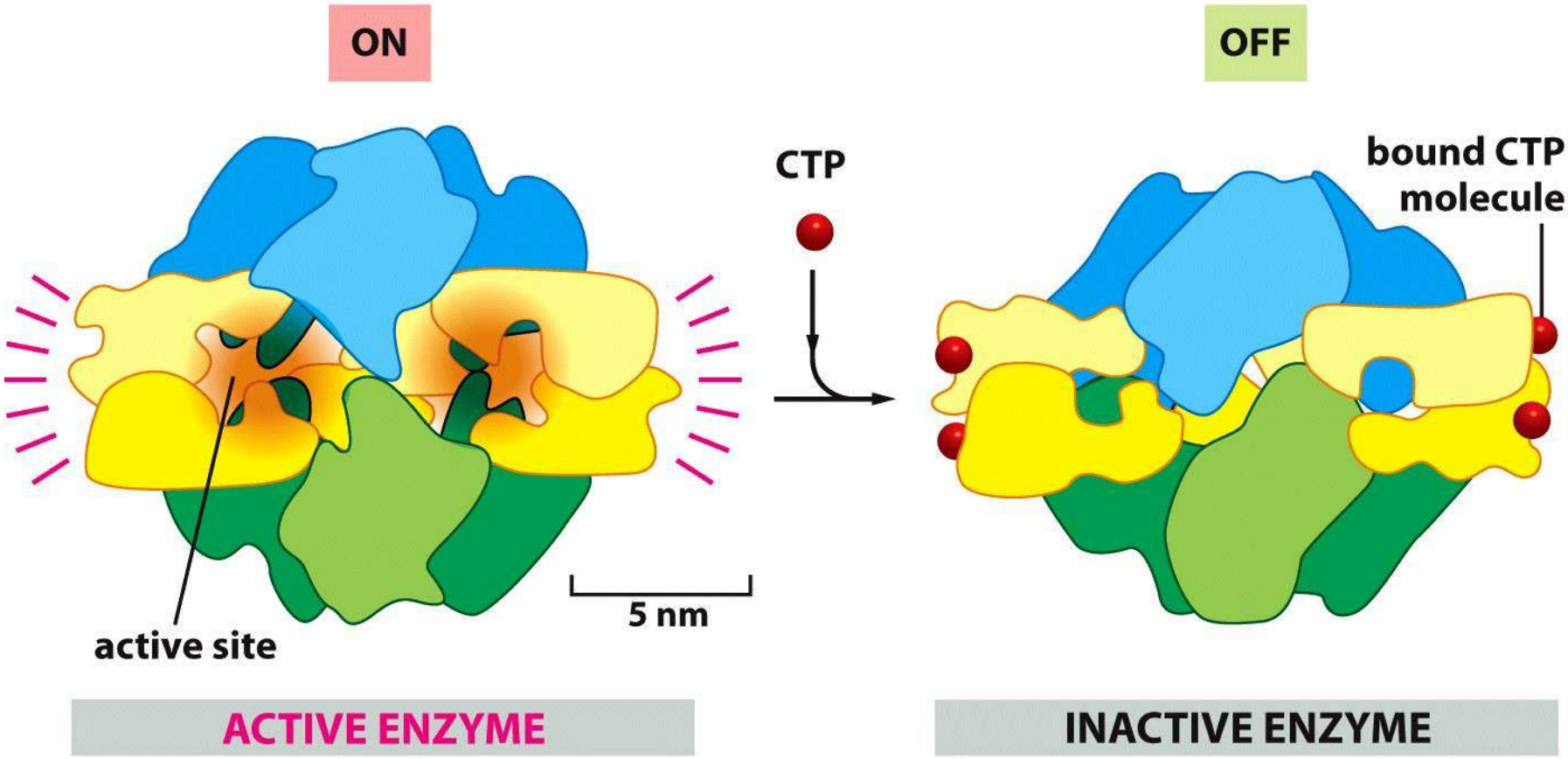
How proteins are controlled



Feedback inhibition regulates the flow through biosynthetic pathways

Negative regulation
-feedback inhibition
Positive regulation

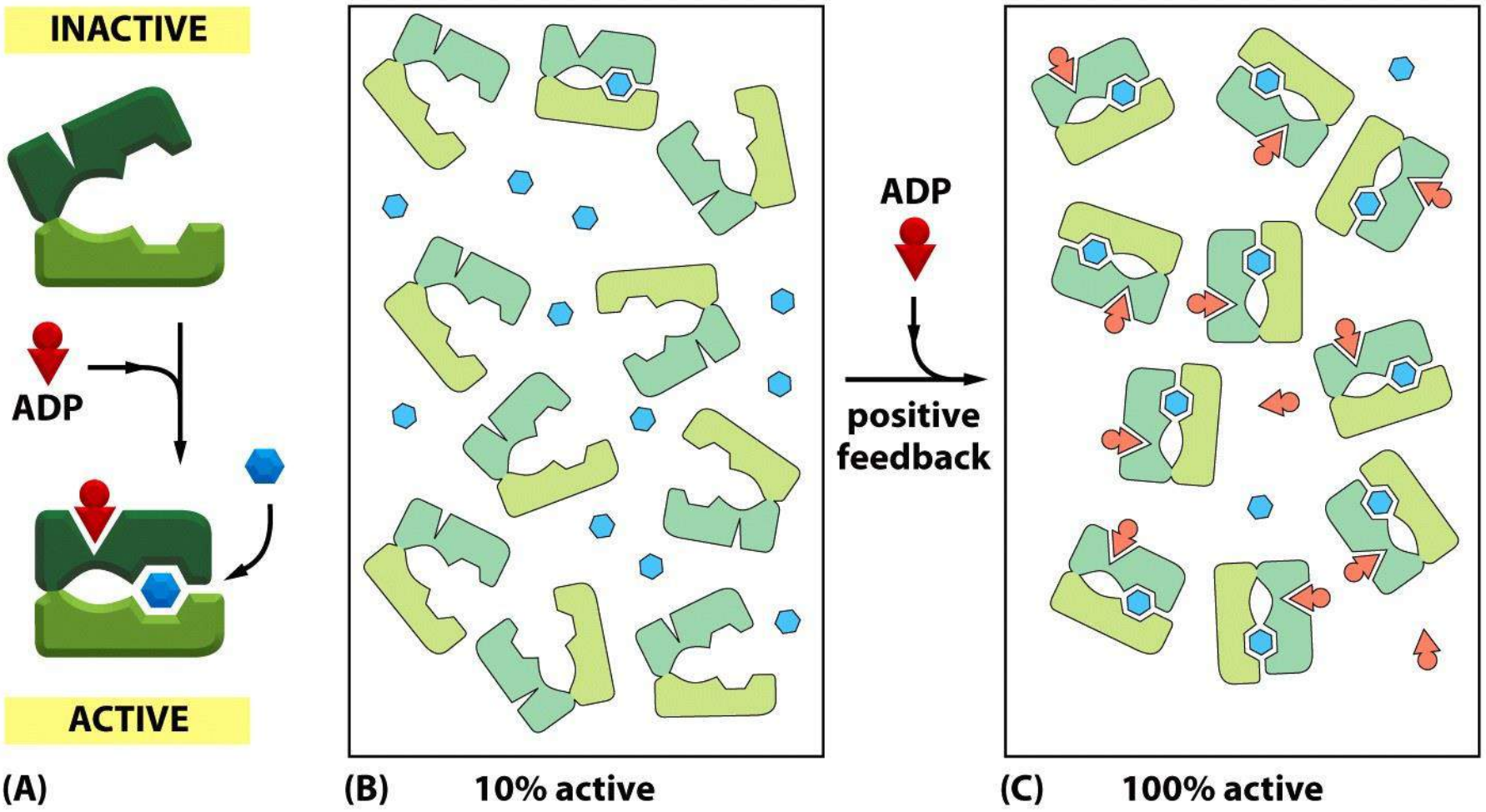
Figure 4-34 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 150p.



大腸菌のアスパラギン酸カルバモイル基転移酵素
シトシン3リン酸(CTP)が最終生成物

Figure 4-36 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 152p.

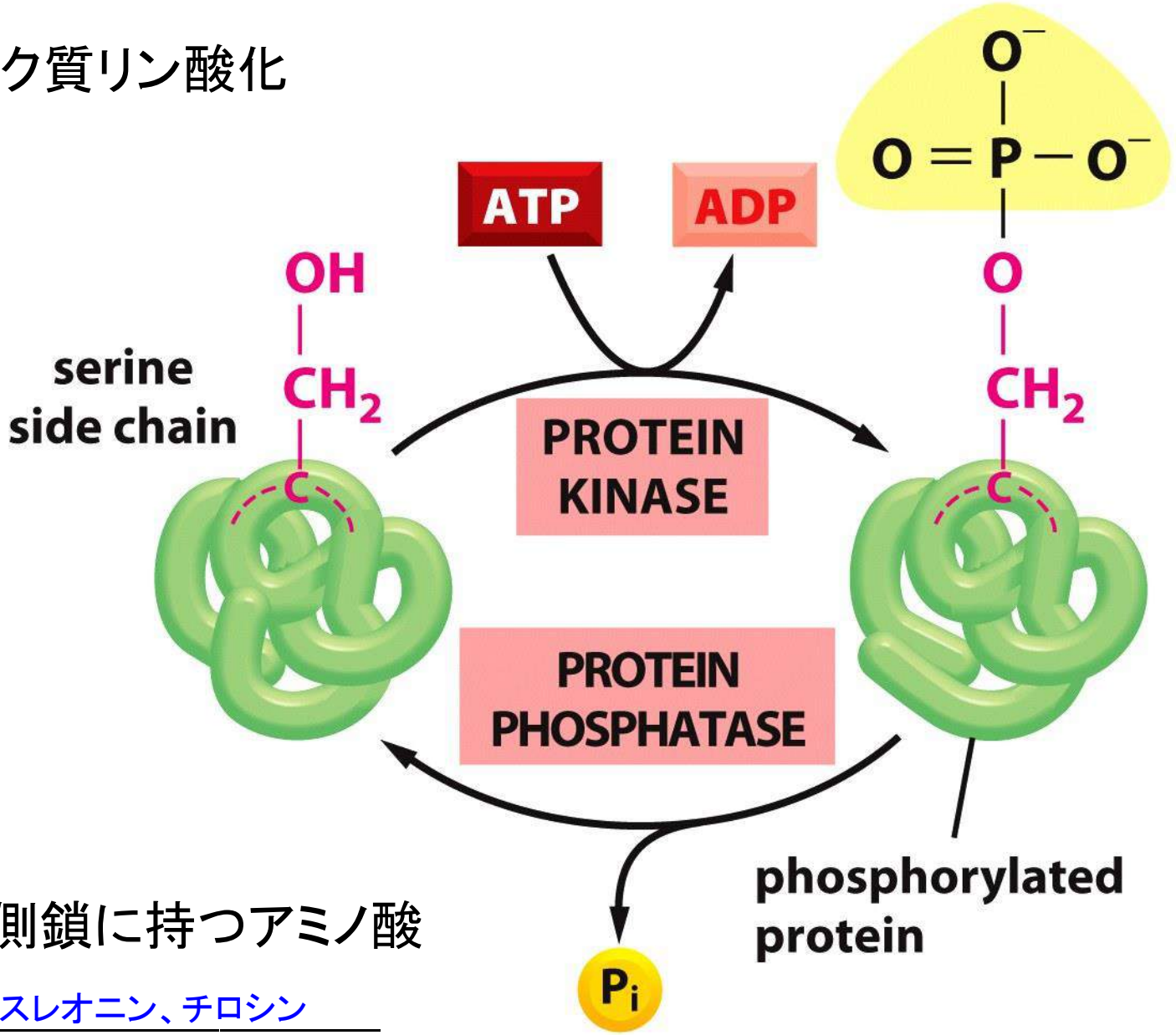
Allosteric Enzyme
-regulatory molecule
-substrate



糖の異化に関わる仮想の酵素

Figure 4-37 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 152p.

タンパク質リン酸化



-OHを側鎖に持つアミノ酸

セリン、スレオニン、チロシン

Figure 4-38 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 152p.

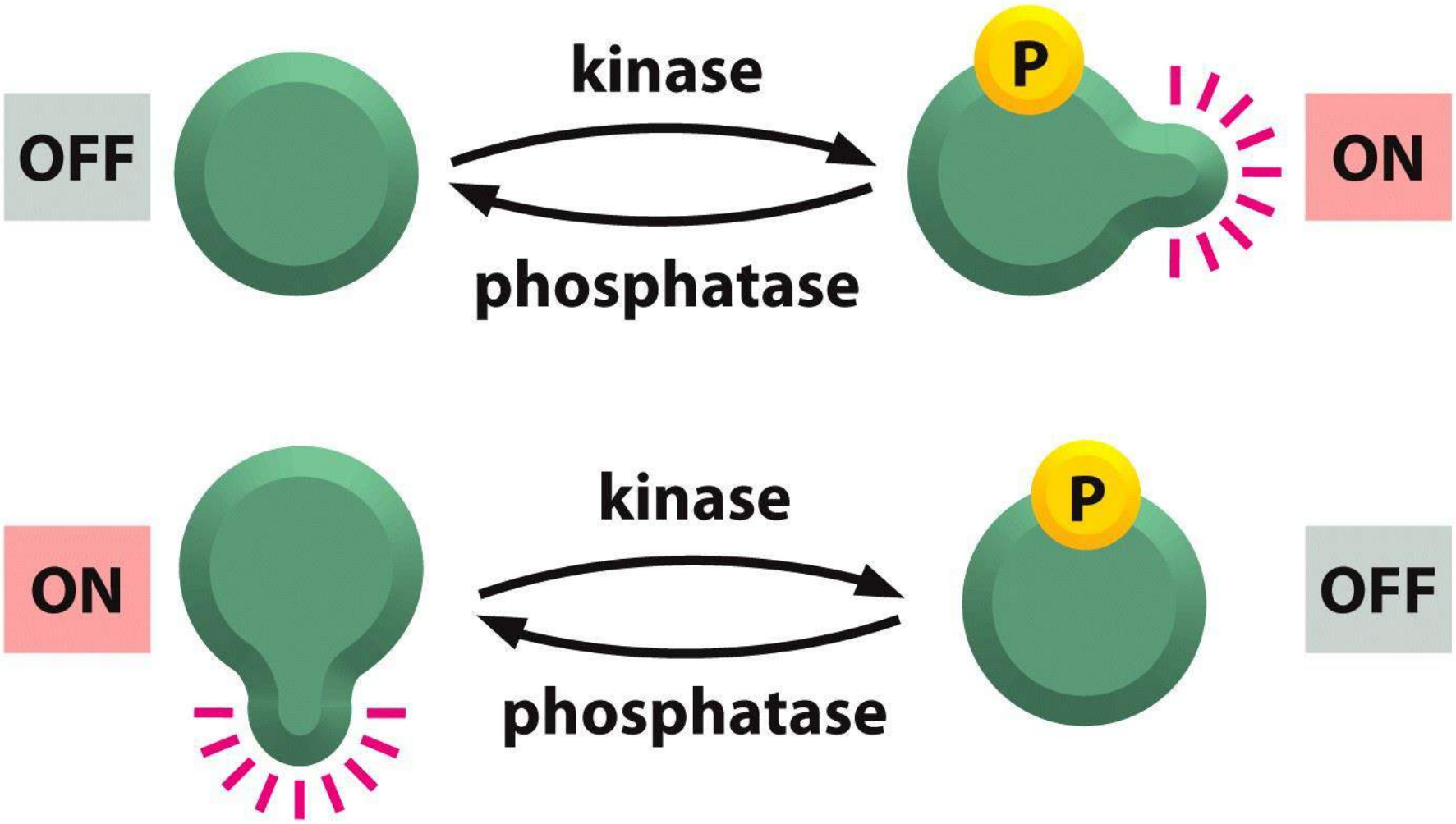


Figure 4-38(B) *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 153p.

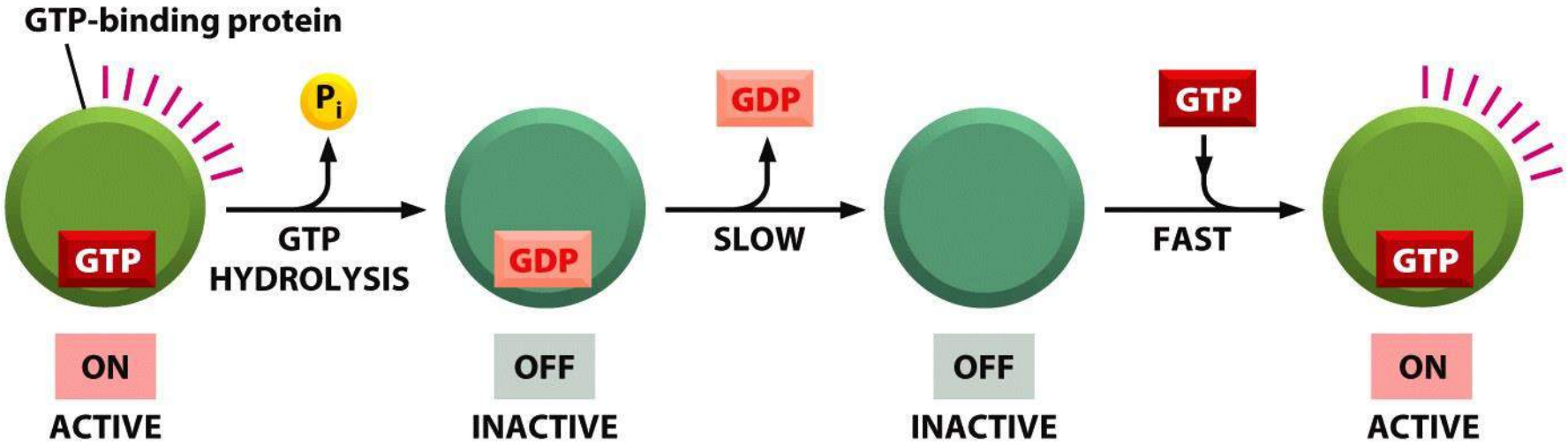
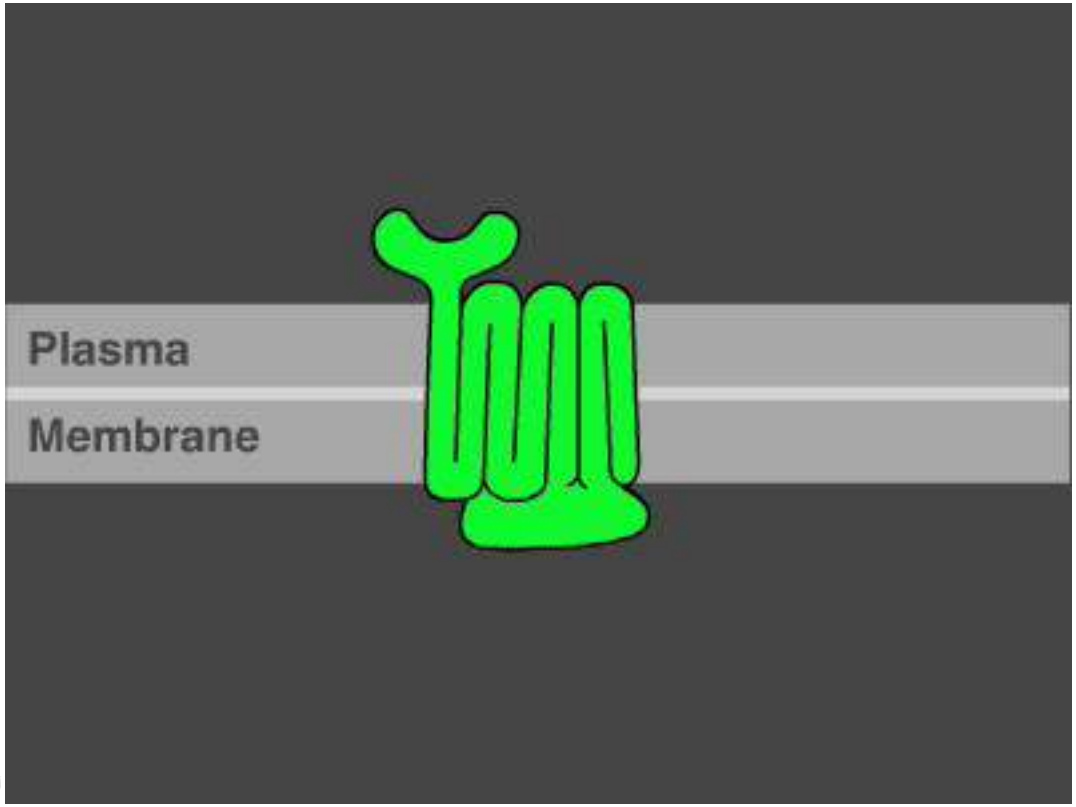


Figure 4-39 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 153p.



Essential Cell Biology, 3rd ed. (© Garland Science 2010)付属DVDより

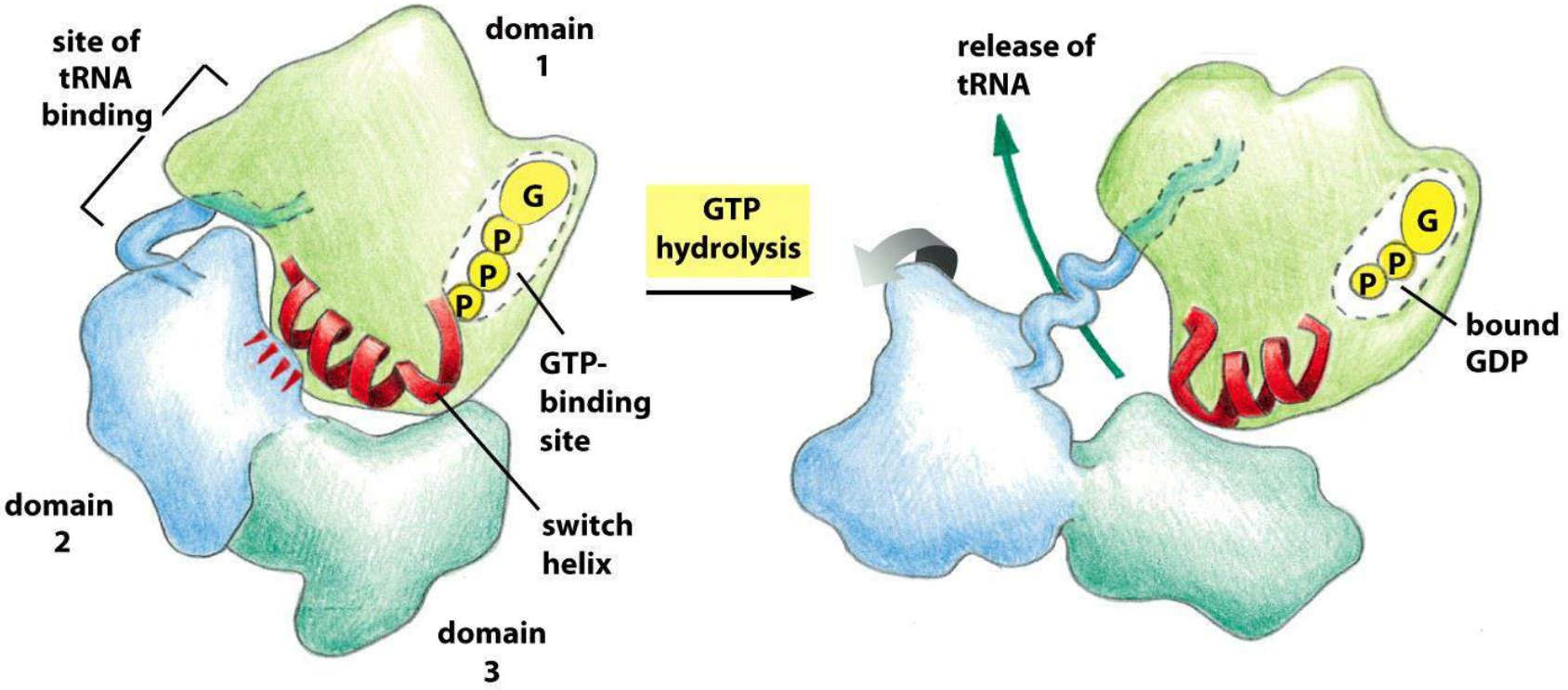
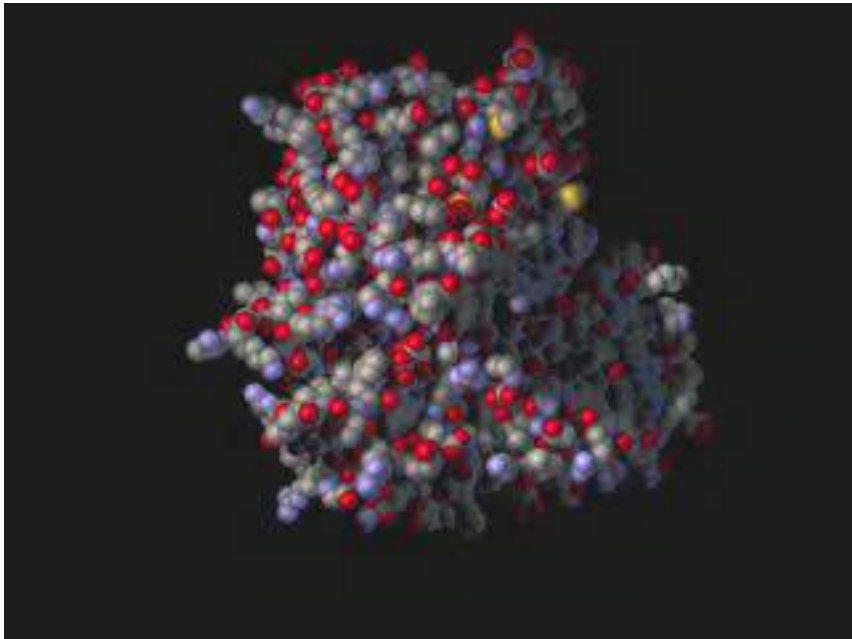


Figure 4-40 *Essential Cell Biology, 3rd ed.* (© Garland Science 2010) 154p.

細菌の伸長因子Tu (EF-Tu)

真核生物のEF1に相当

アミノアシルtRNA、GTPと結合し、リボソームのA部位にアミノアシルtRNAを供給する。



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分子構造解析手法

X線結晶構造解析法

X線溶液散乱法（SAXS）

核磁気共鳴法（NMR）

分子動力学シミュレーション