IHC, in the molecular era

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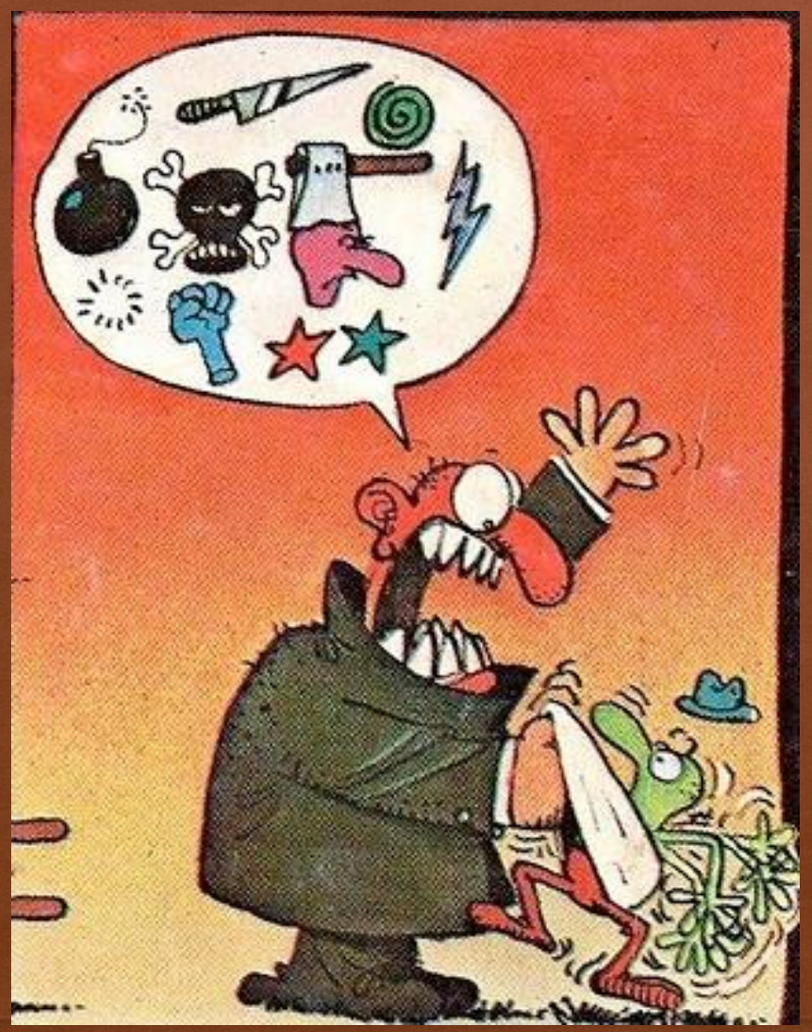
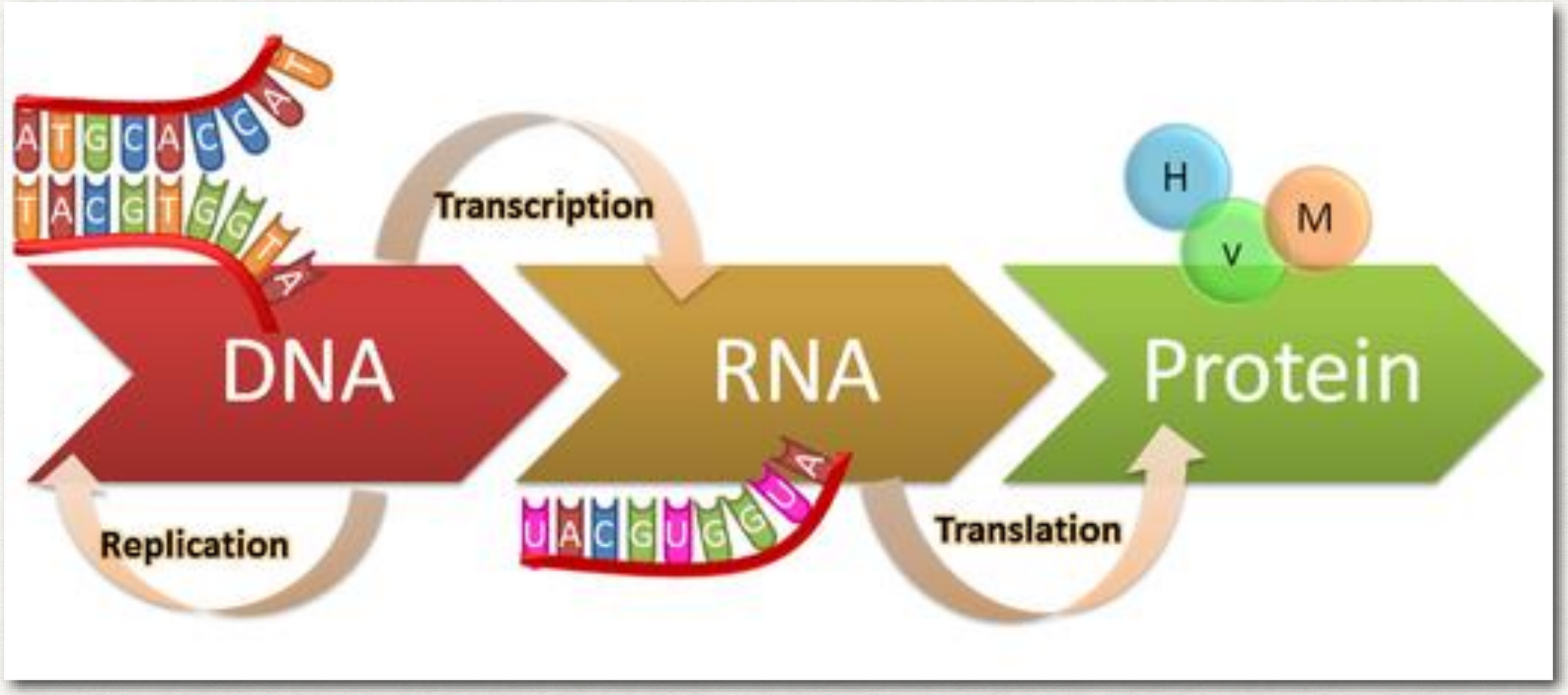
Includes at little repetition
From lung cancer



Predictive, diagnostic and prognostic markers

Predictive, diagnostic and prognostic markers

The central dogma



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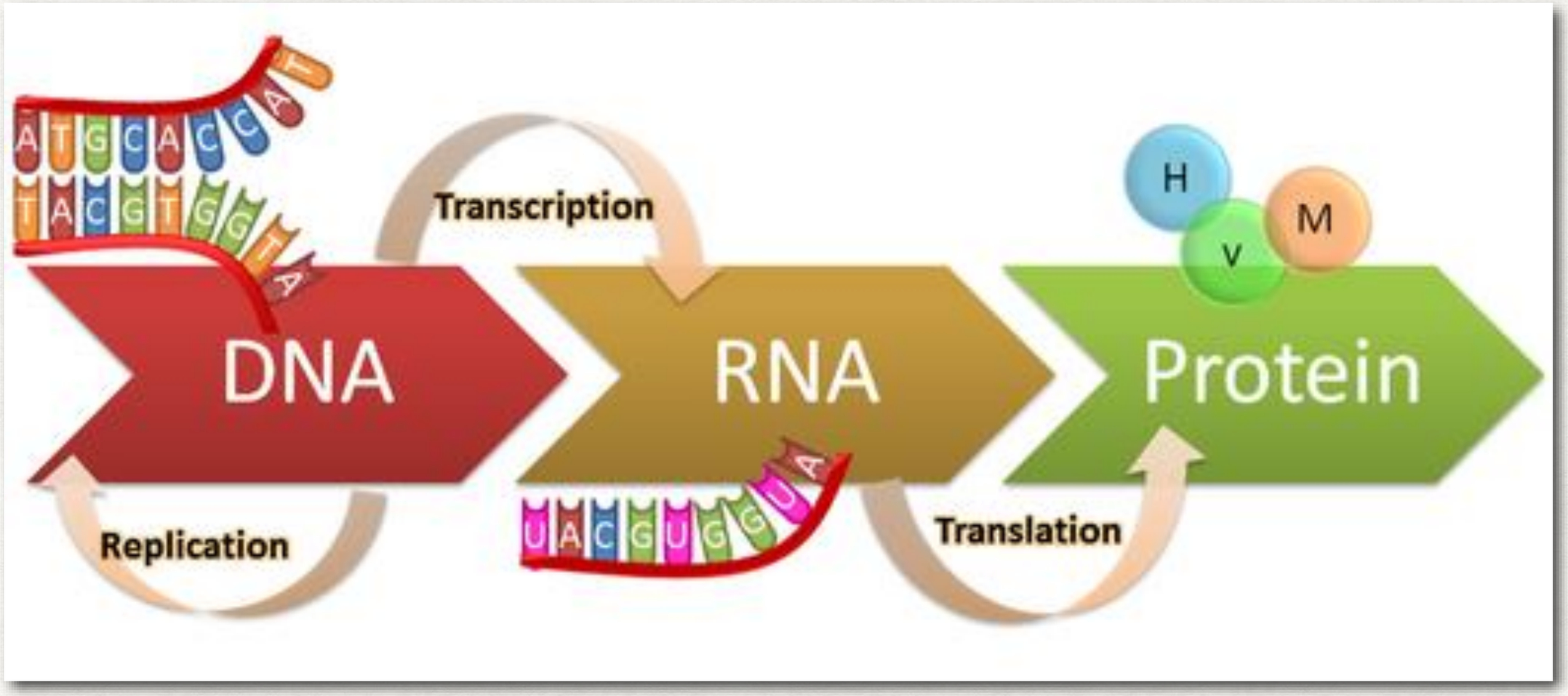
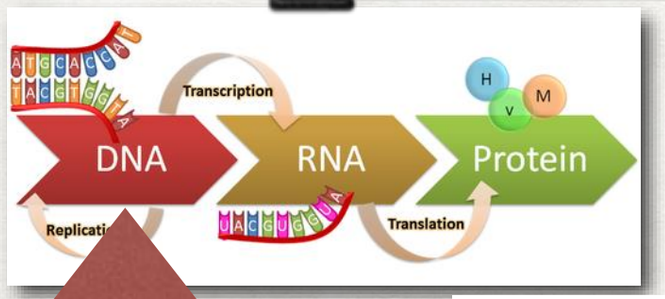


In-situ hybridization

Molecular methods (PCR, SEQ)

Immunohistochemistry

Predictive, diagnostic and prognostic markers



How do oncogenes and tumor suppressors work?

oncogene

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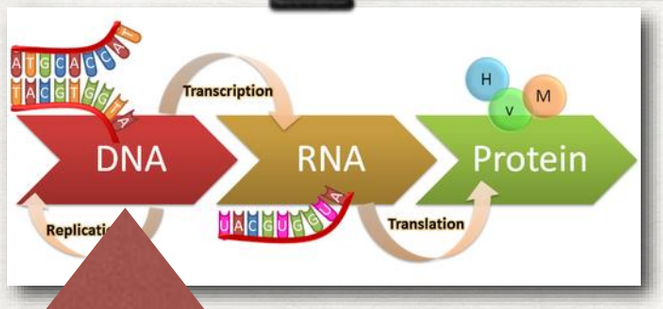
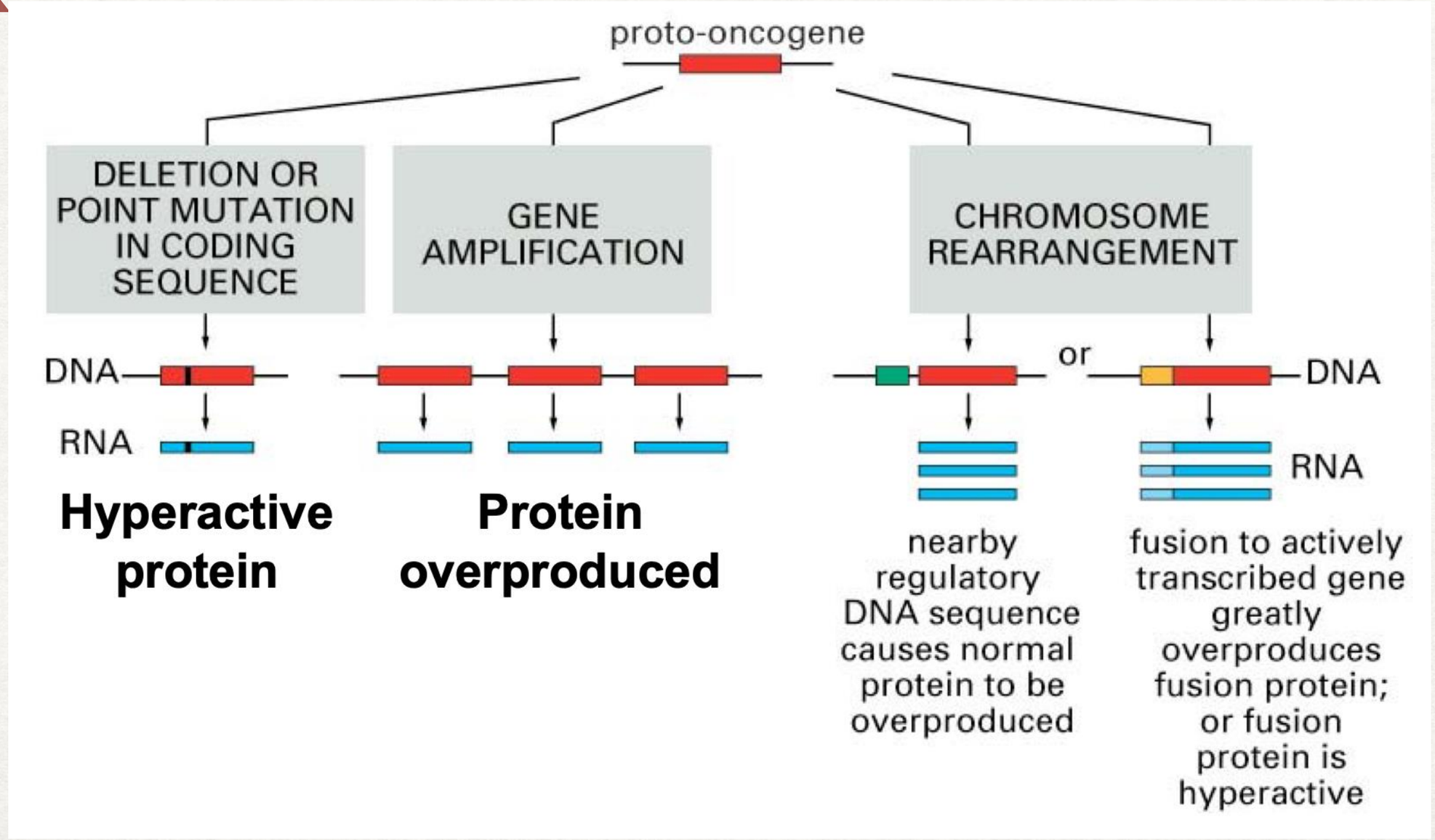
Figure 23–24. Molecular Biology of the Cell, 4th Edition.

Predictive, diagnostic and prognostic markers





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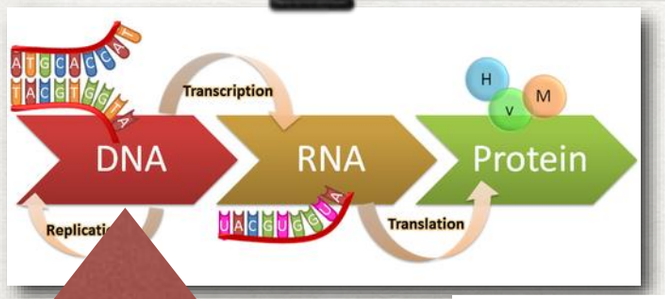

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Figure 23–24. Molecular Biology of the Cell, 4th Edition.

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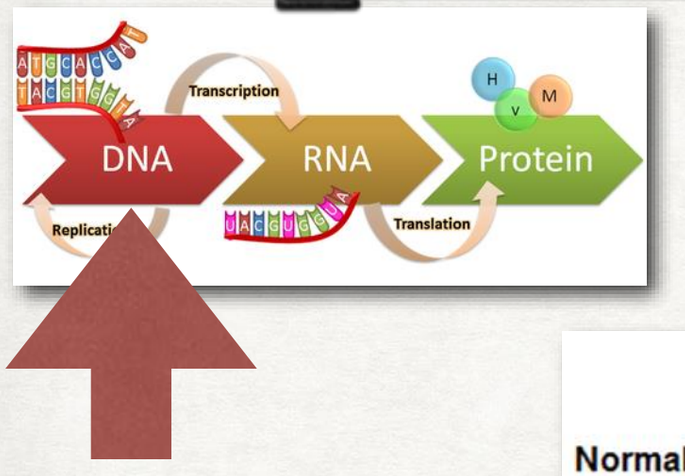
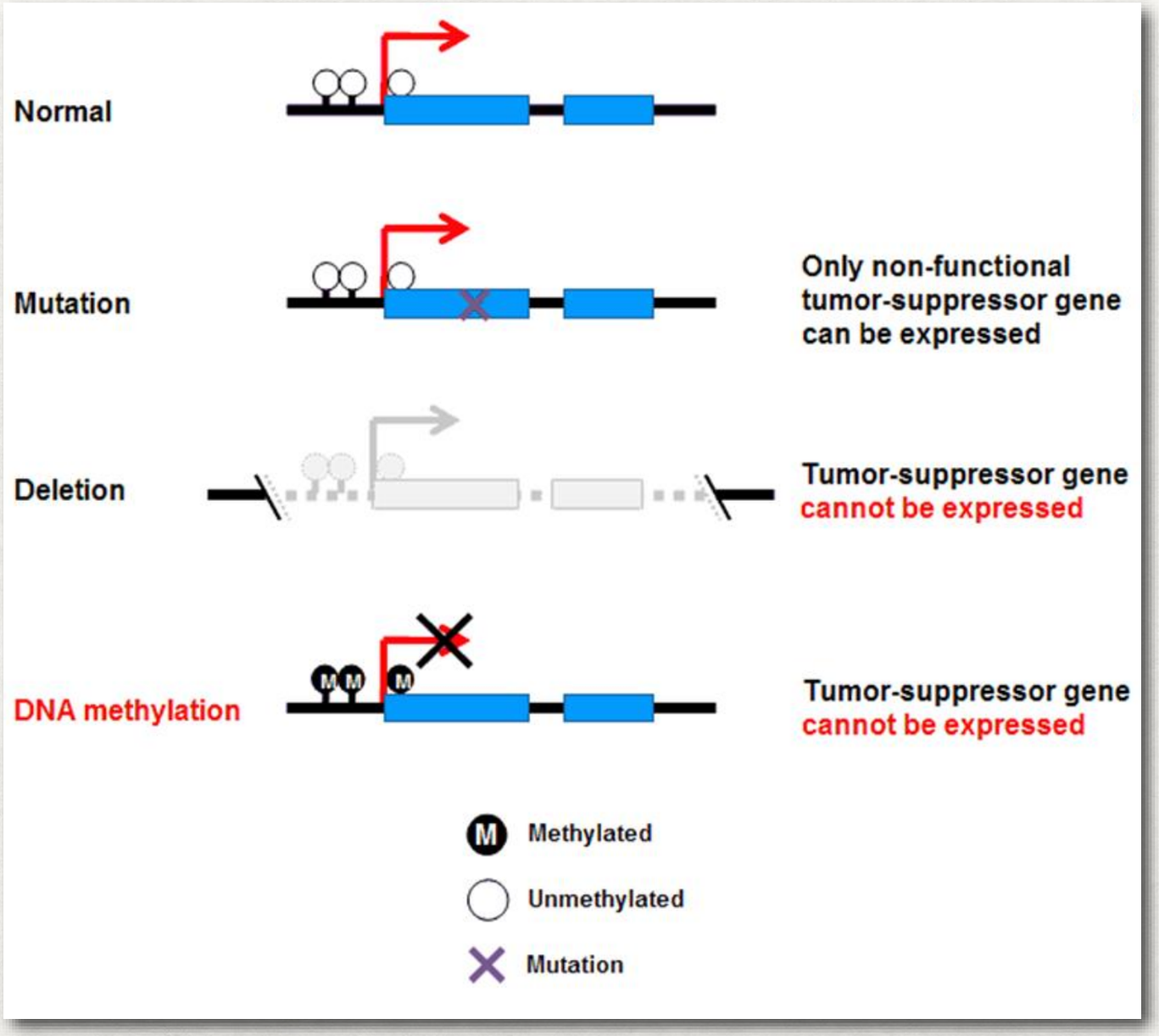
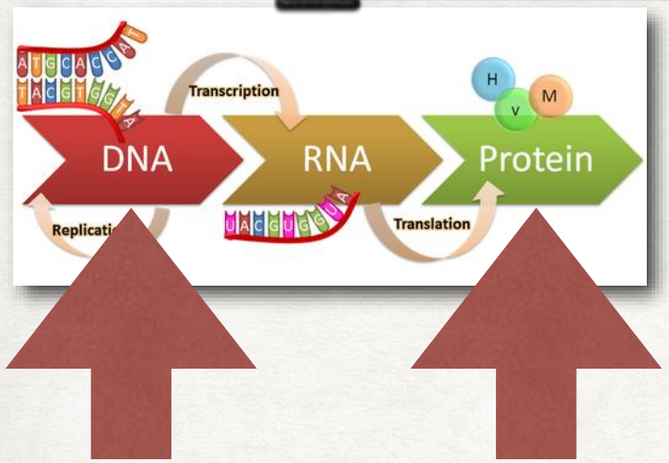


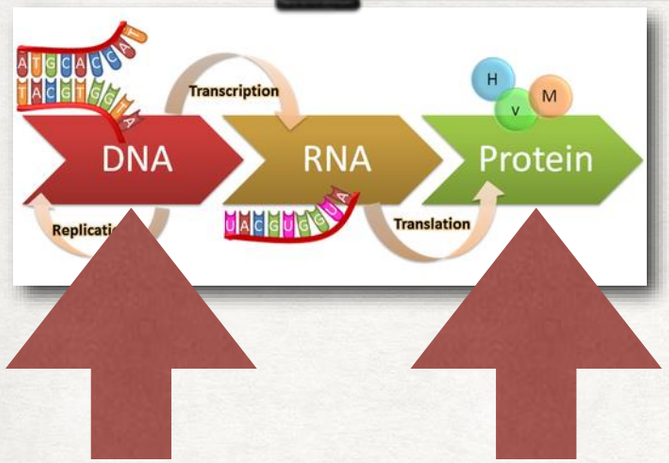


Predictive, diagnostic and prognostic markers



Mutation	Changed protein
Translocation	Absence of protein
Deletion	Abnormal localisation
Amplification	Over expression
Methylation	Fussion protein

Predictive, diagnostic and prognostic markers



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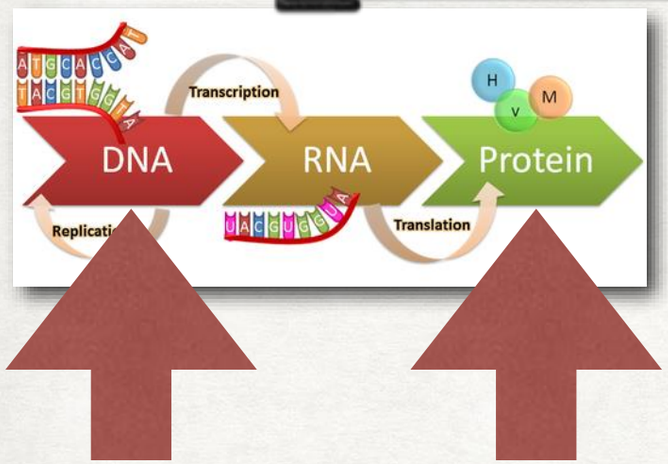
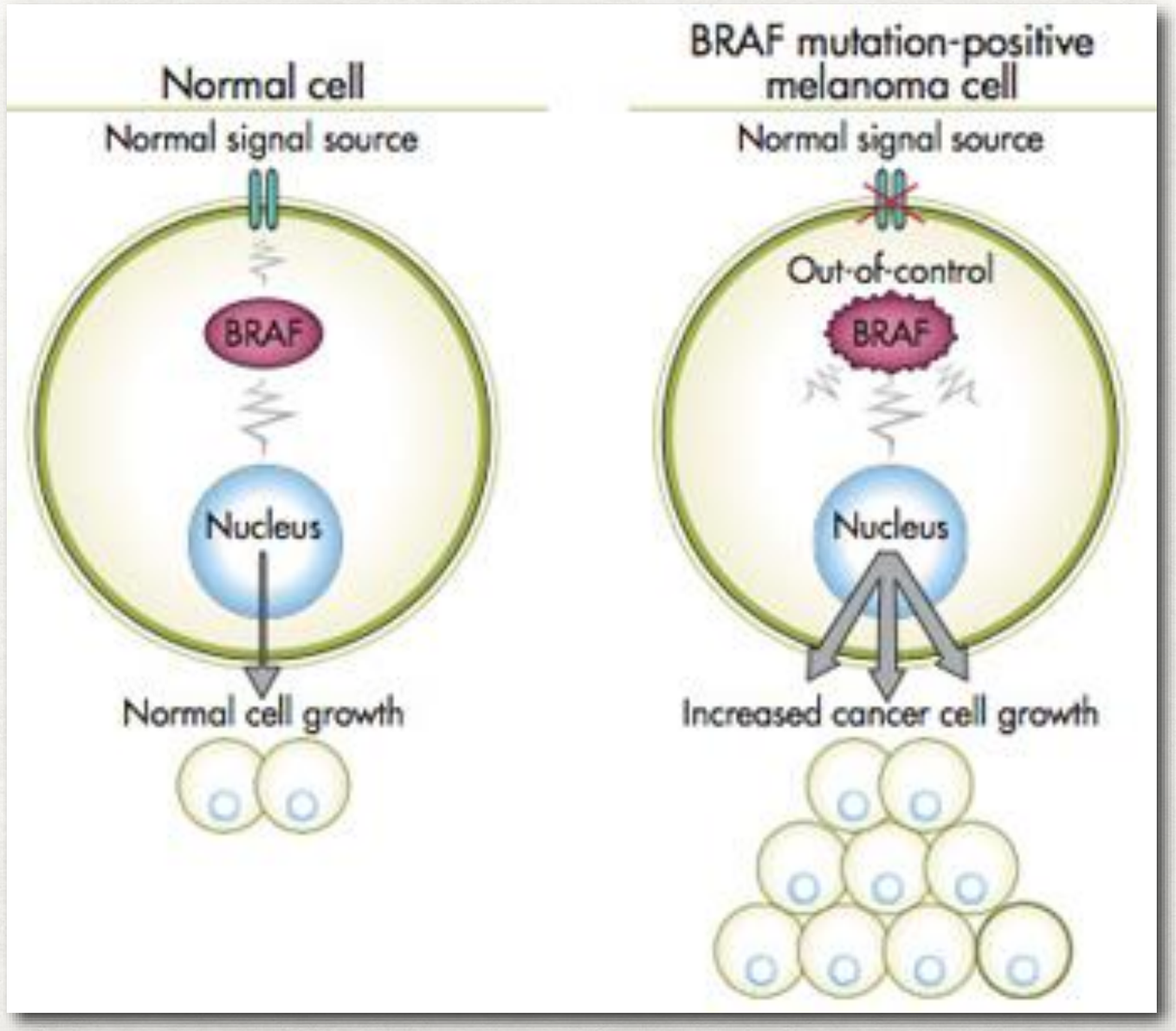
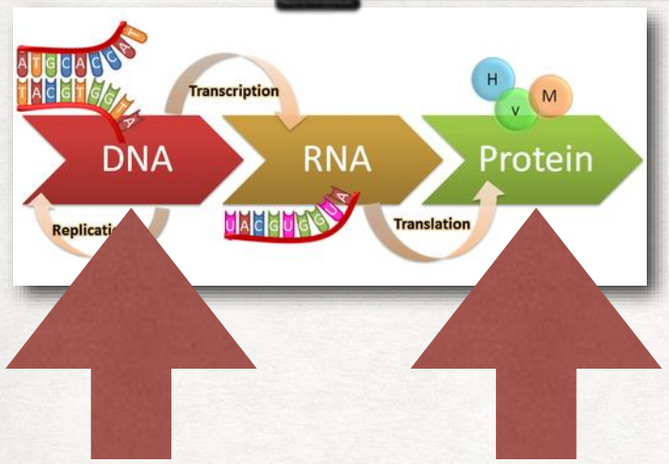


Mutated protein (auto activated)

Melanoma BRAF mutation



Predictive, diagnostic and prognostic markers



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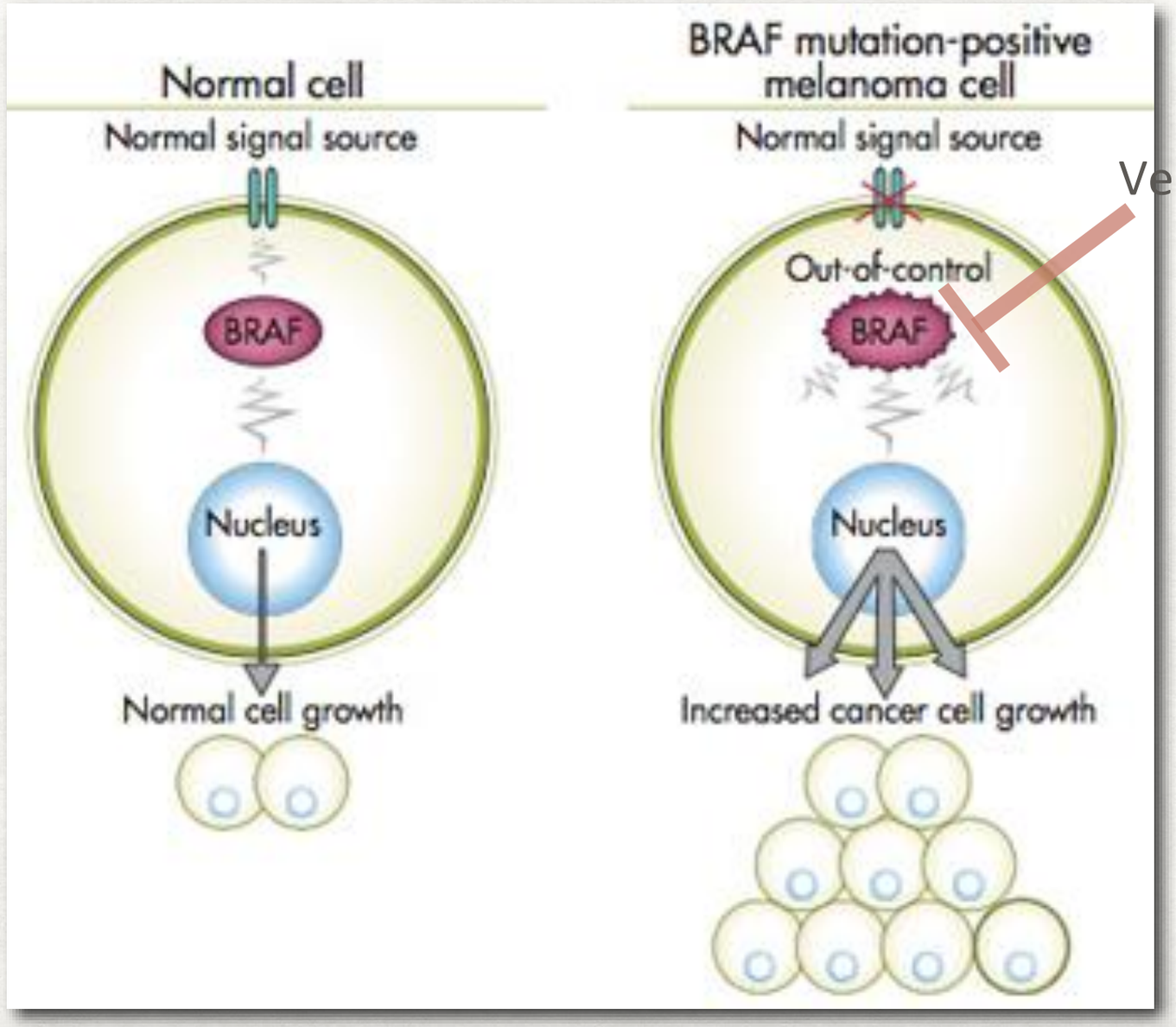
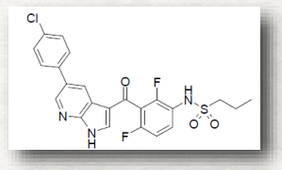
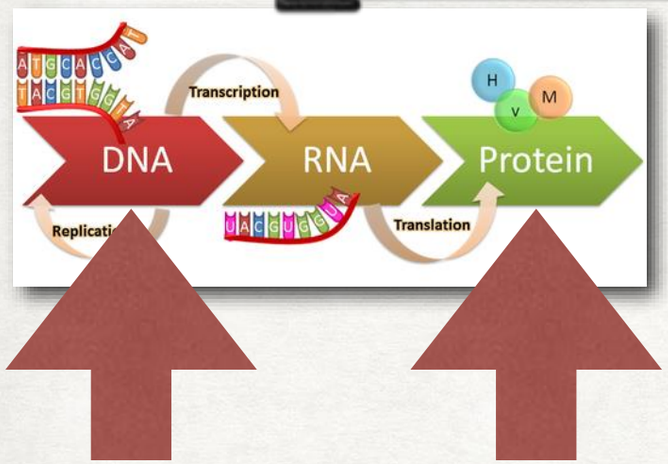


Vemurafinib



Predictive, diagnostic and prognostic markers



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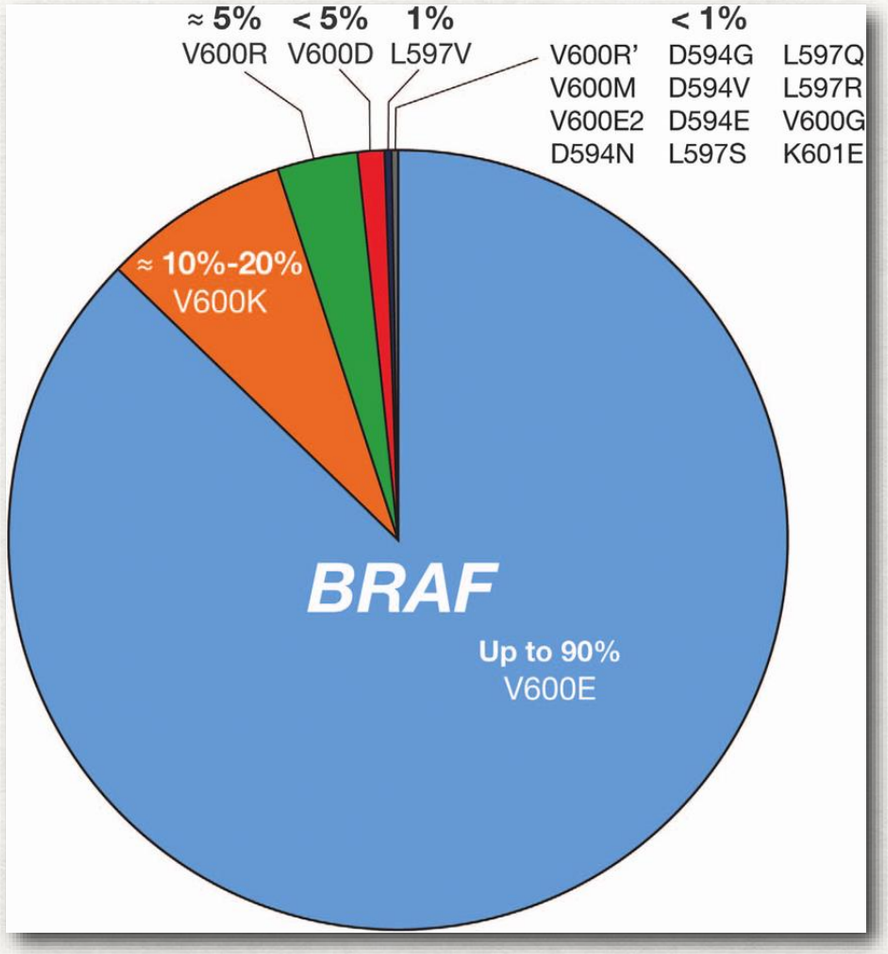

WT: GTG (valin)

V600E: GAG (glutamat)

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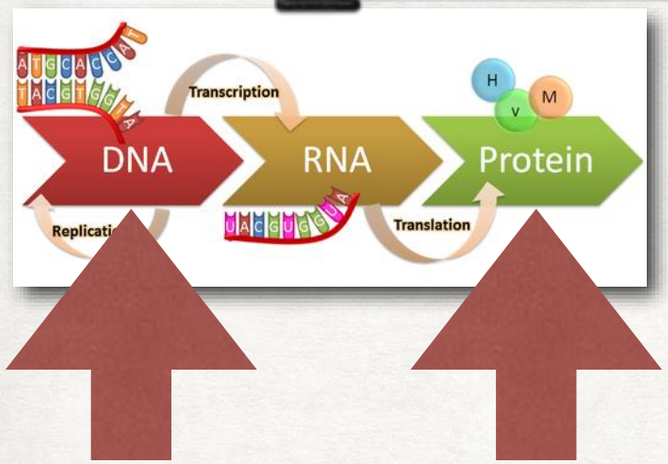
V600R: AGG (Arginin)

Predictive, diagnostic and prognostic markers



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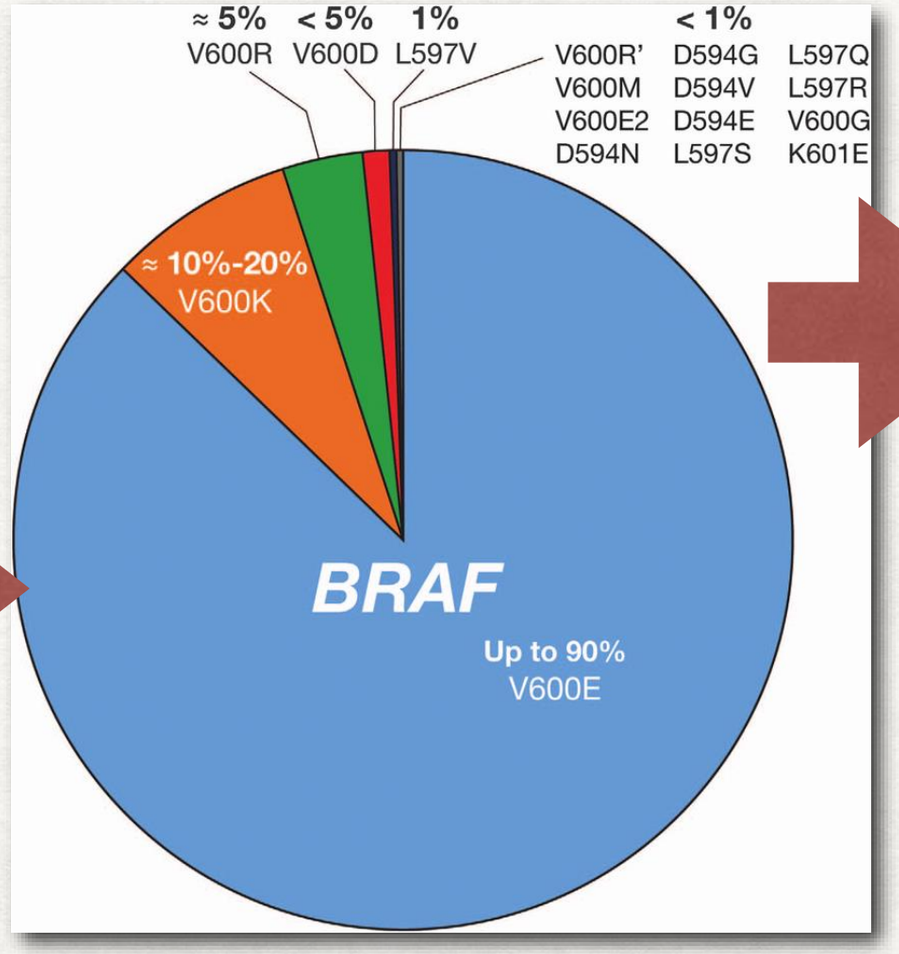

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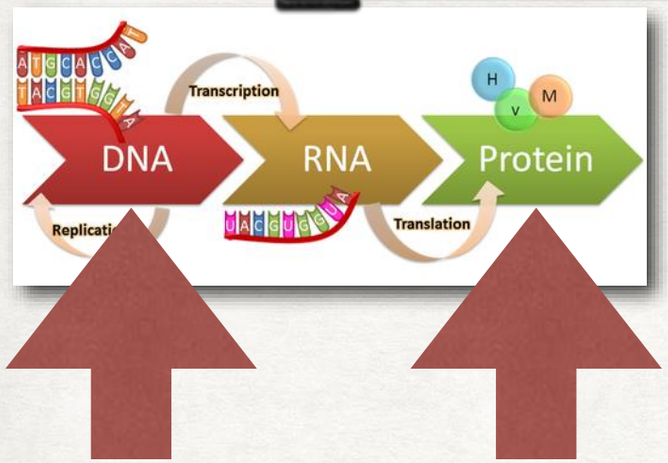

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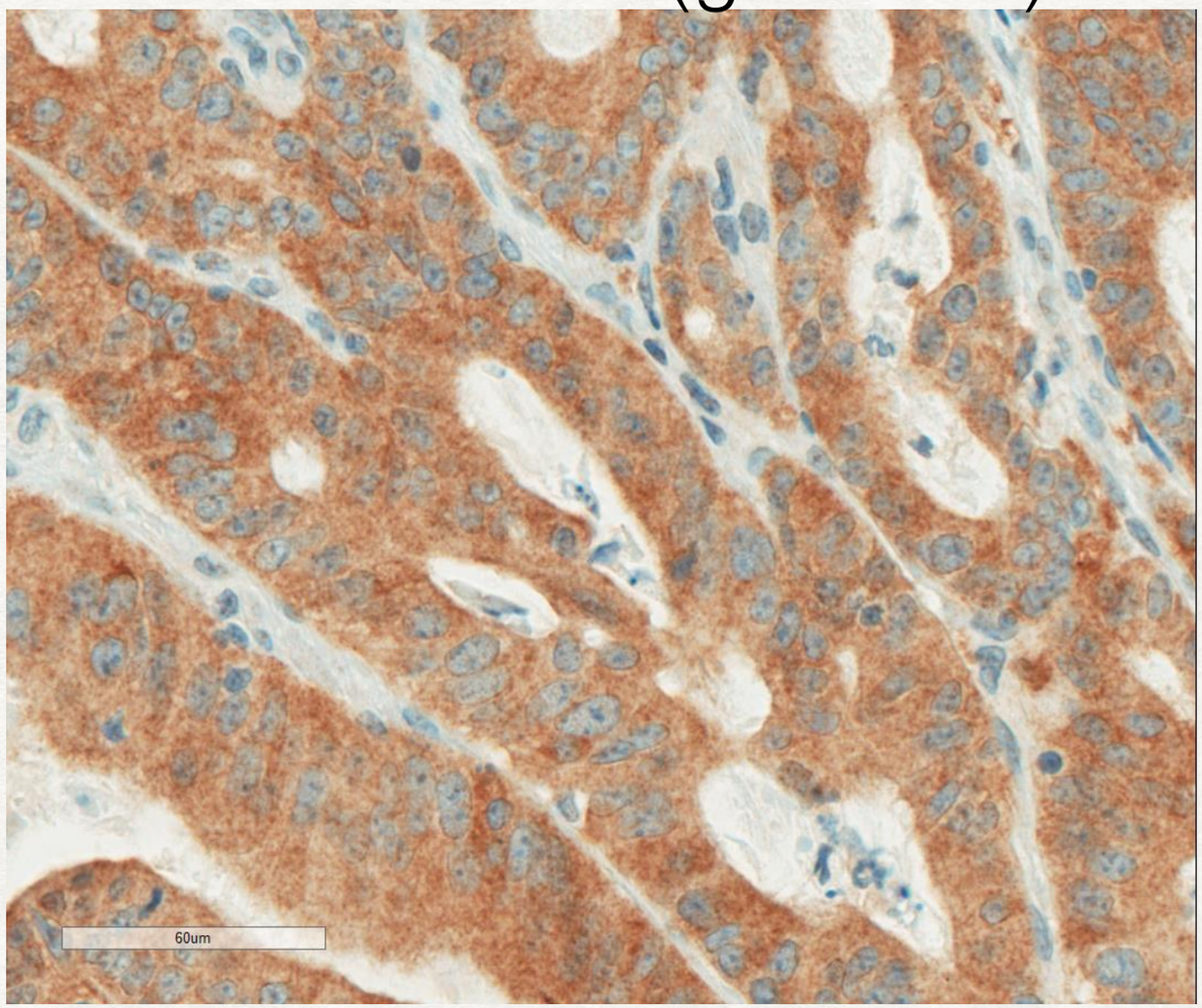
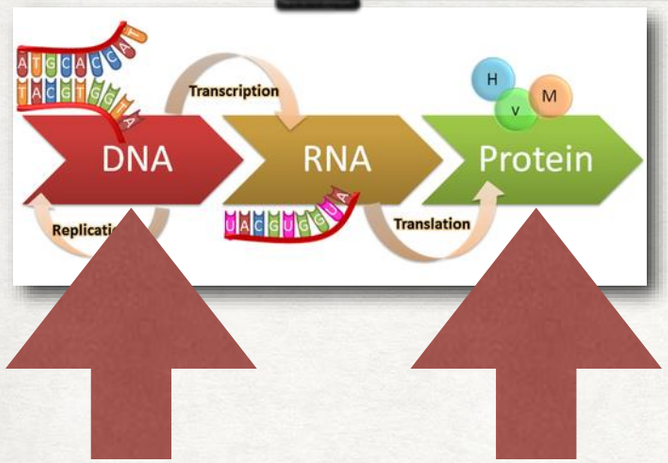


BRAF V600E (VE1)
Mouse Monoclonal Primary Antibode

VENTANA Roche

Predictive, diagnostic and prognostic markers



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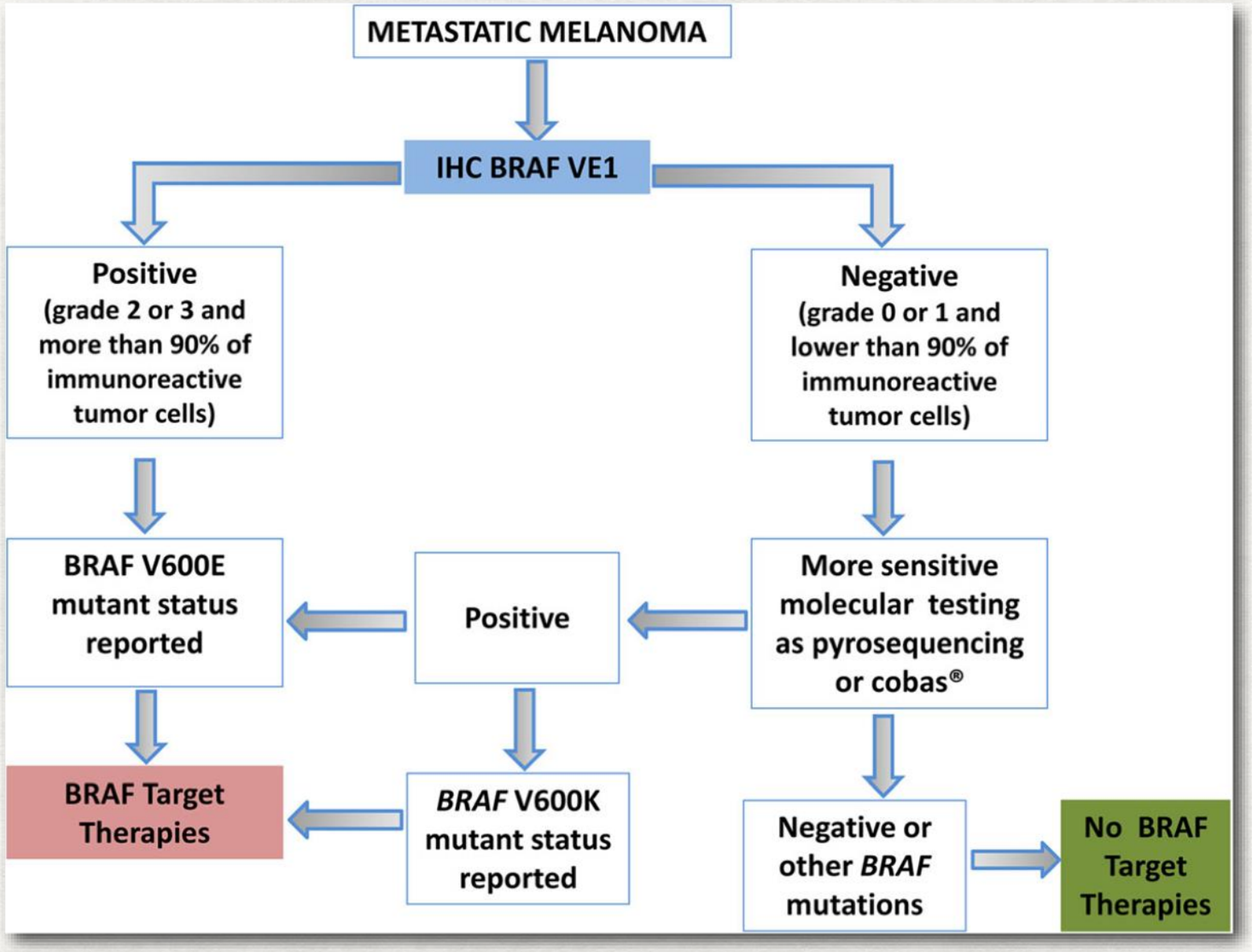
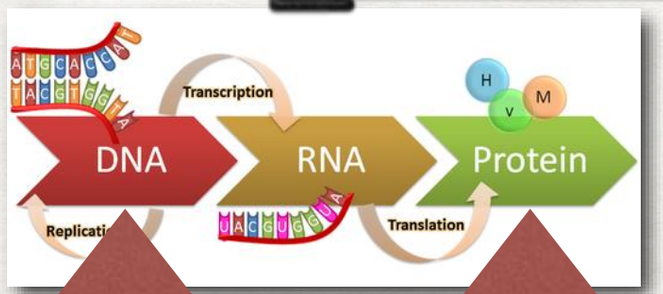


Schirosi *et al. BMC Cancer* (2016) 16:905
DOI 10.1186/s12885-016-2951-4

Predictive, diagnostic and prognostic markers

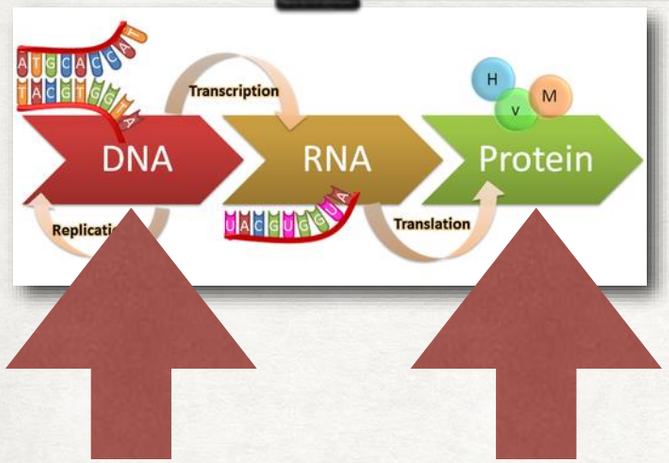


Mutated protein (auto activated)

Immunohistochemistry
BRAF V600E

Mutation analysis of BRAF gene

Predictive, diagnostic and prognostic markers



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Absence of protein

Abnormal localisation

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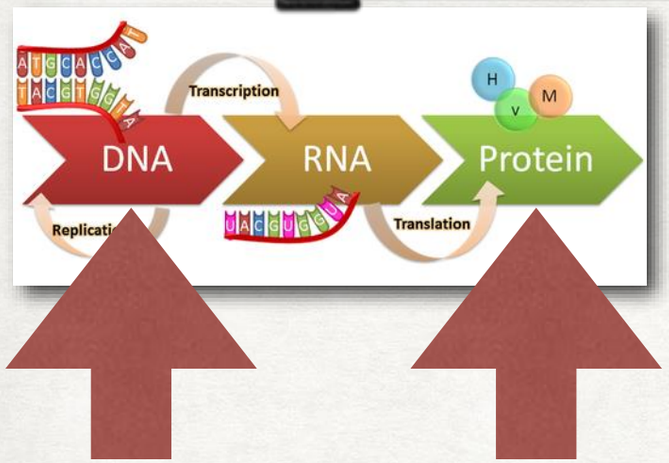
Fussion protein

Predictive, diagnostic and prognostic markers



Often combination of
Deletion
Mutation
Methylation

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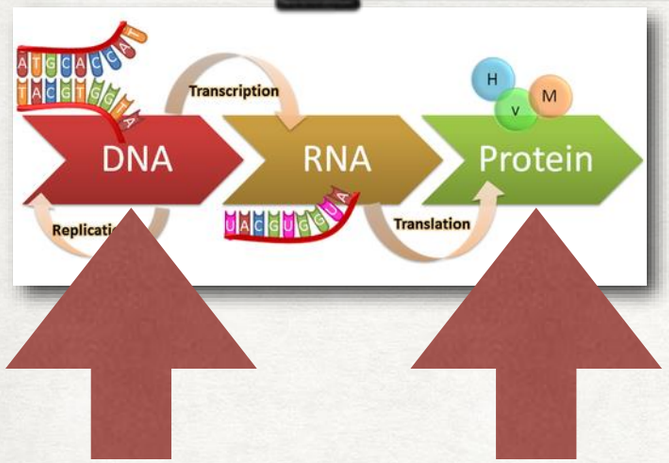

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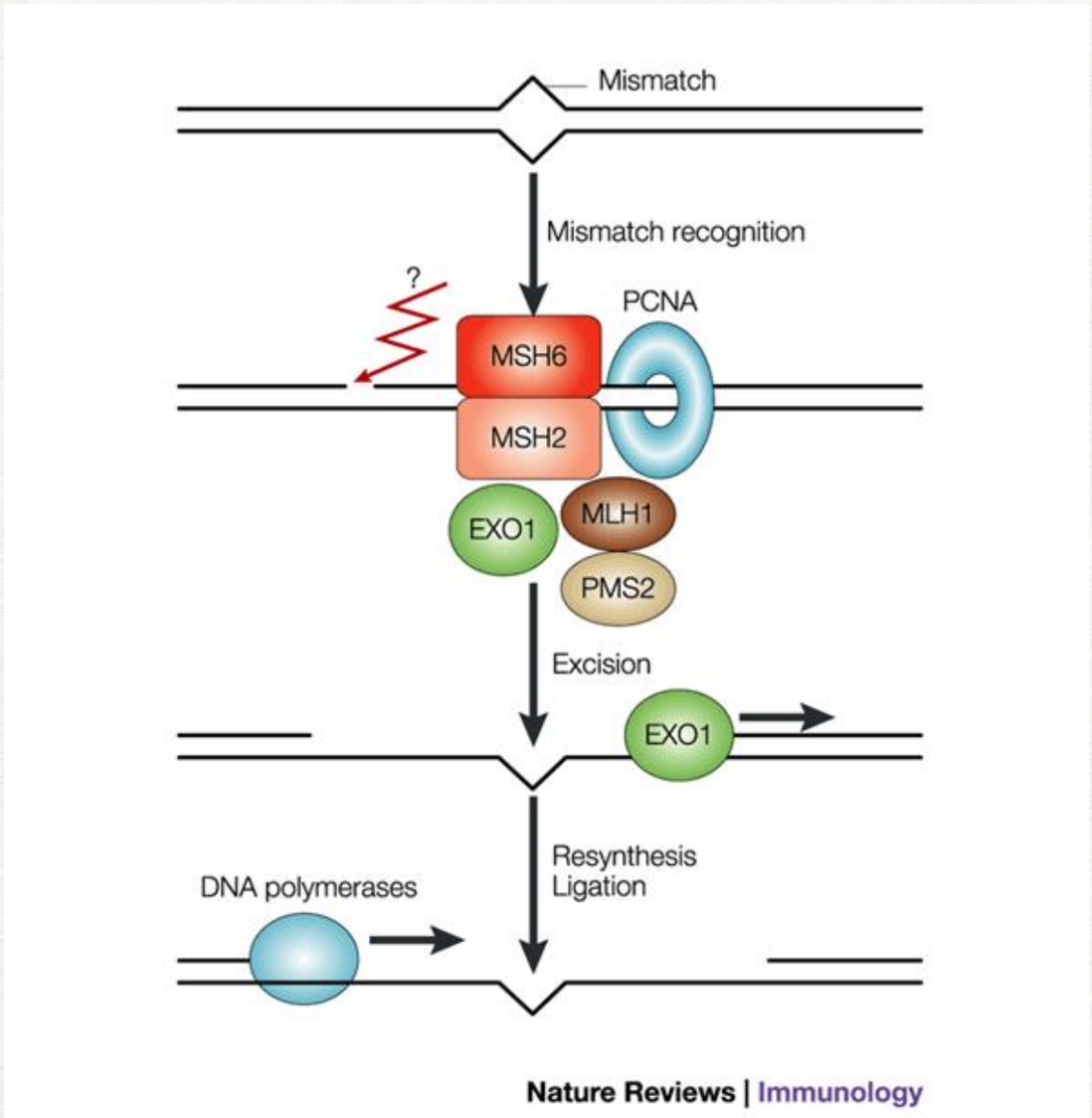

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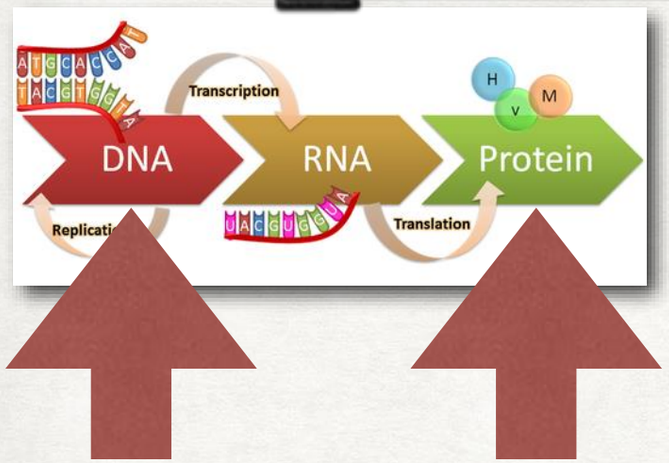
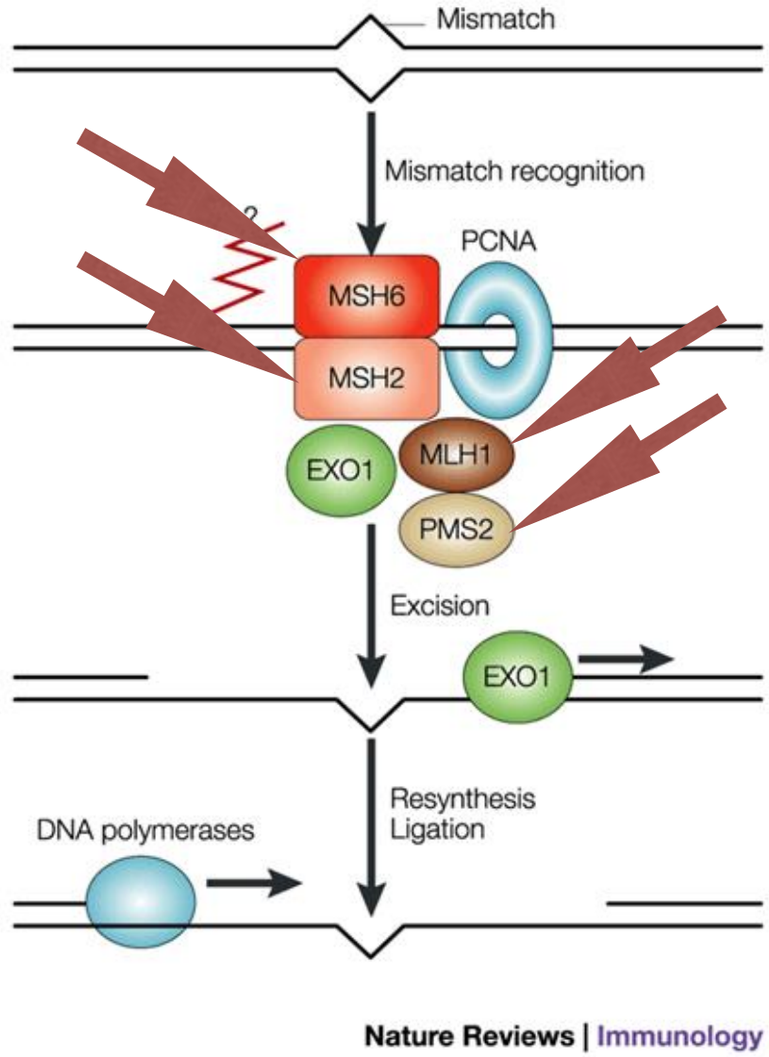


Absence of protein

Mutation
(Methylation)

Mismatch Repair deficiency
Microsatelite instability



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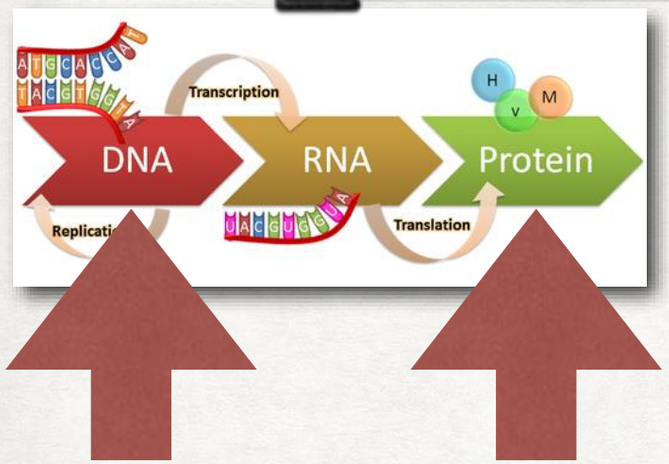
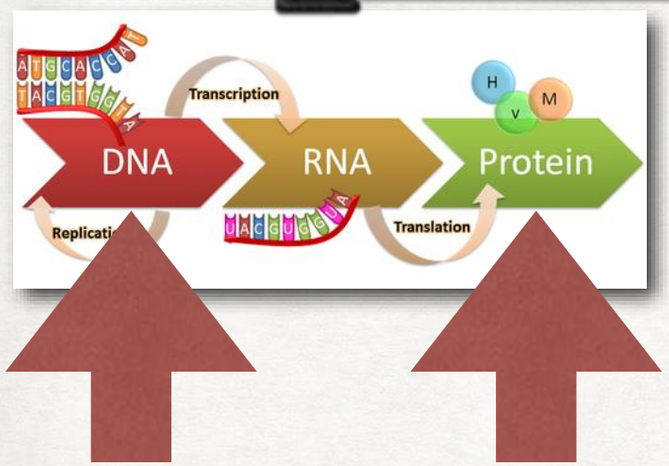


Absence of protein

Identify colon cancer patients with inherited colon cancer (Lynch syndrome)

Identify patients with sporadic MSI colon cancers

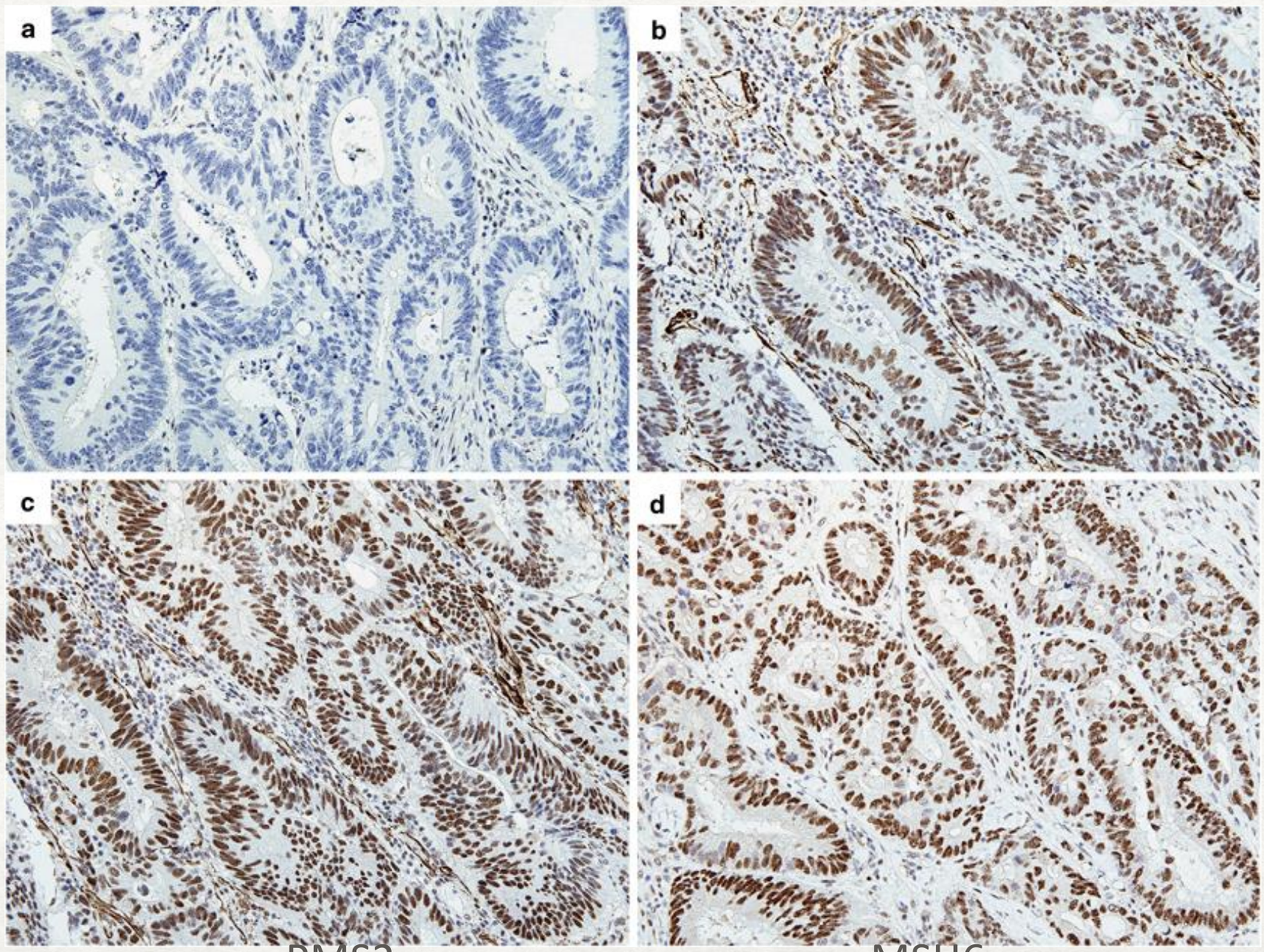
Predictive, diagnostic and prognostic markers



Absence of protein

MLH1

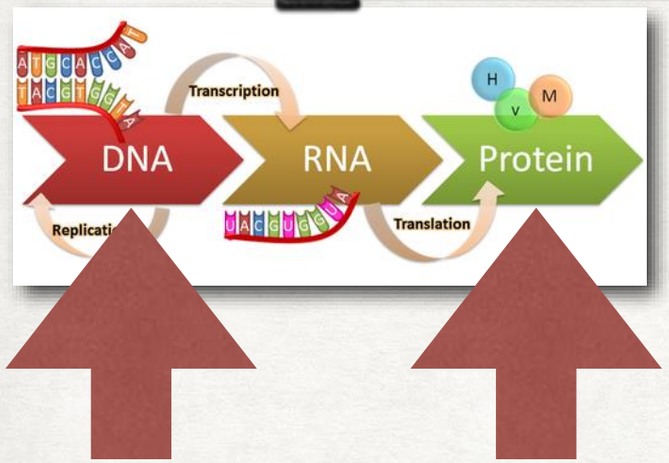
MLH6



PMS2

MSH6

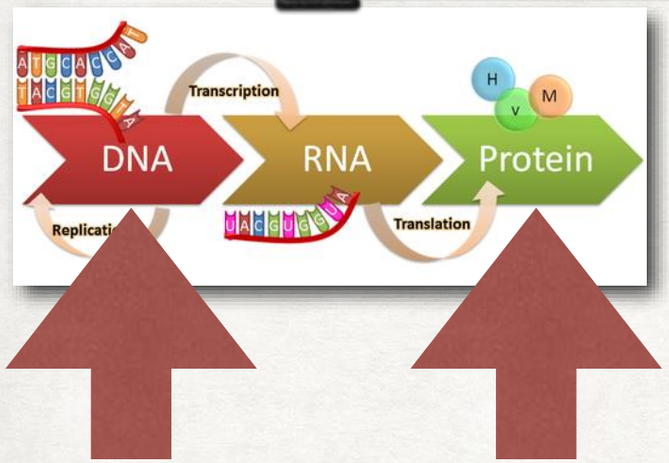
Predictive, diagnostic and prognostic markers



Immunohistochemistry
of MLH1, PMS2, MLH6 and MSH2

Mutation of MLH1, PMS2, MLH6 and MSH2 genes
Measurement of length of Microsatilites

Predictive, diagnostic and prognostic markers



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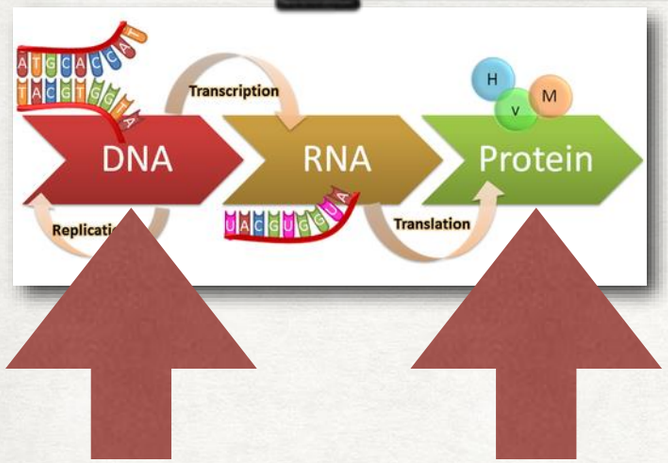
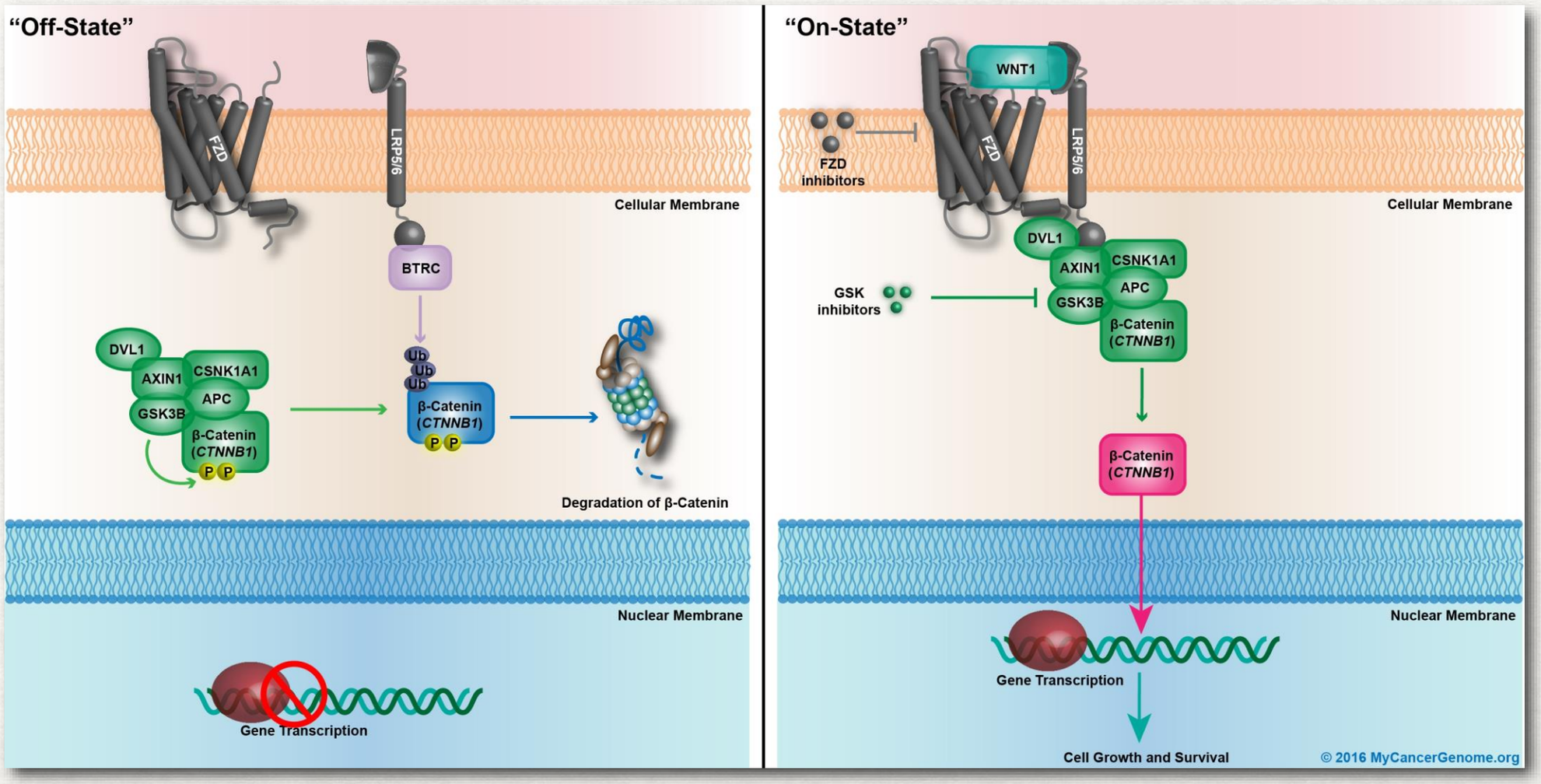
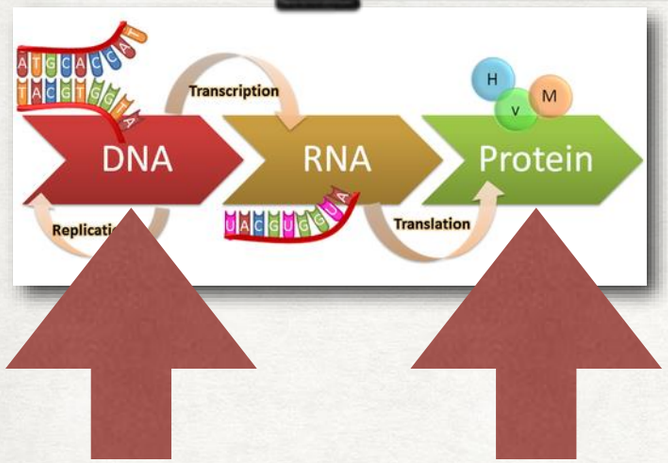
Predictive, diagnostic and prognostic markers



Abnormal localisation

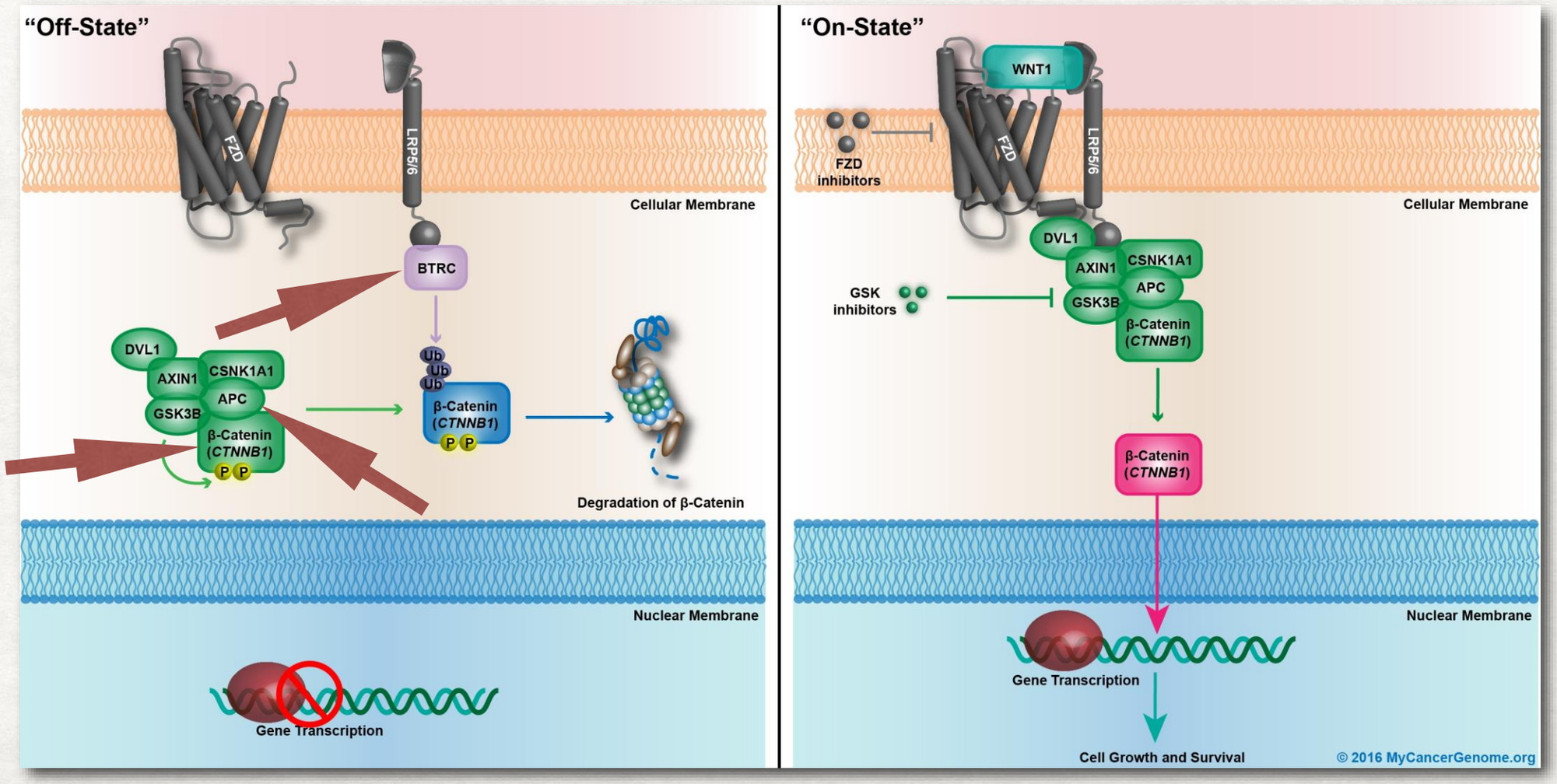


Predictive, diagnostic and prognostic markers



Abnormal localisation

Mutations



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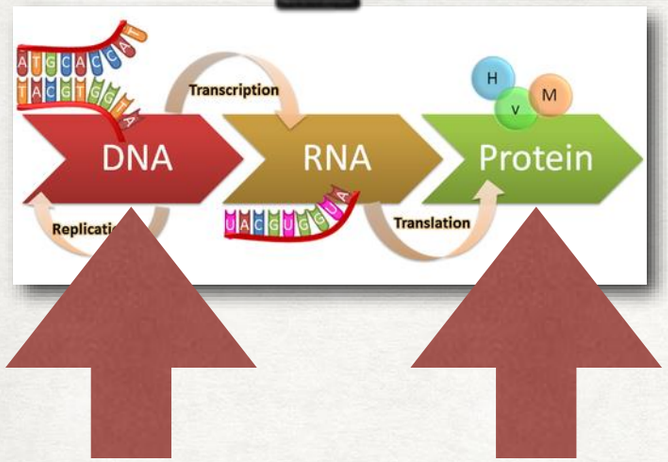

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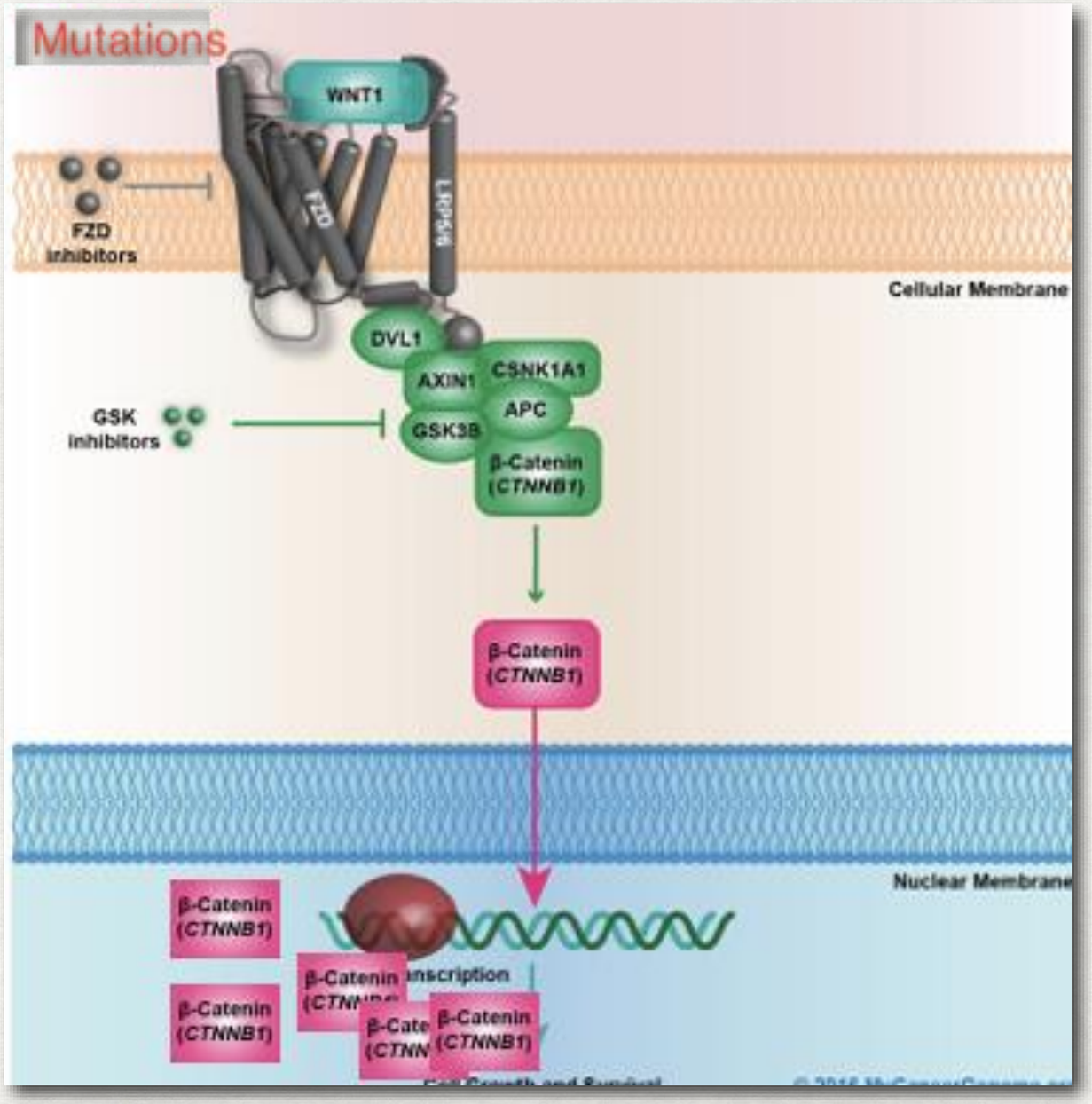
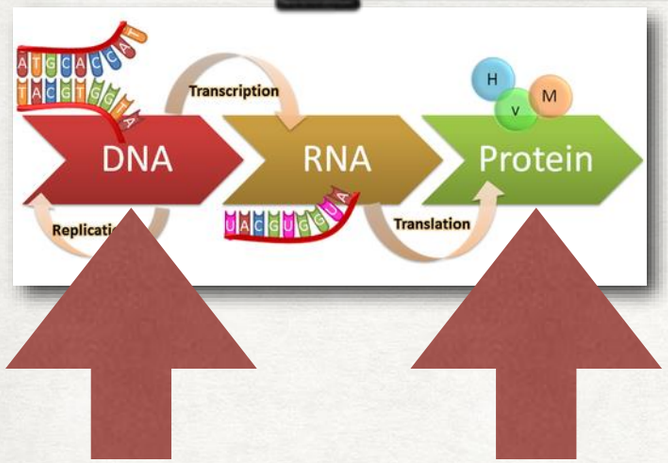
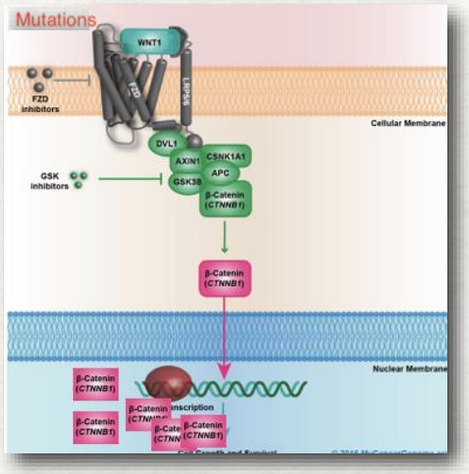


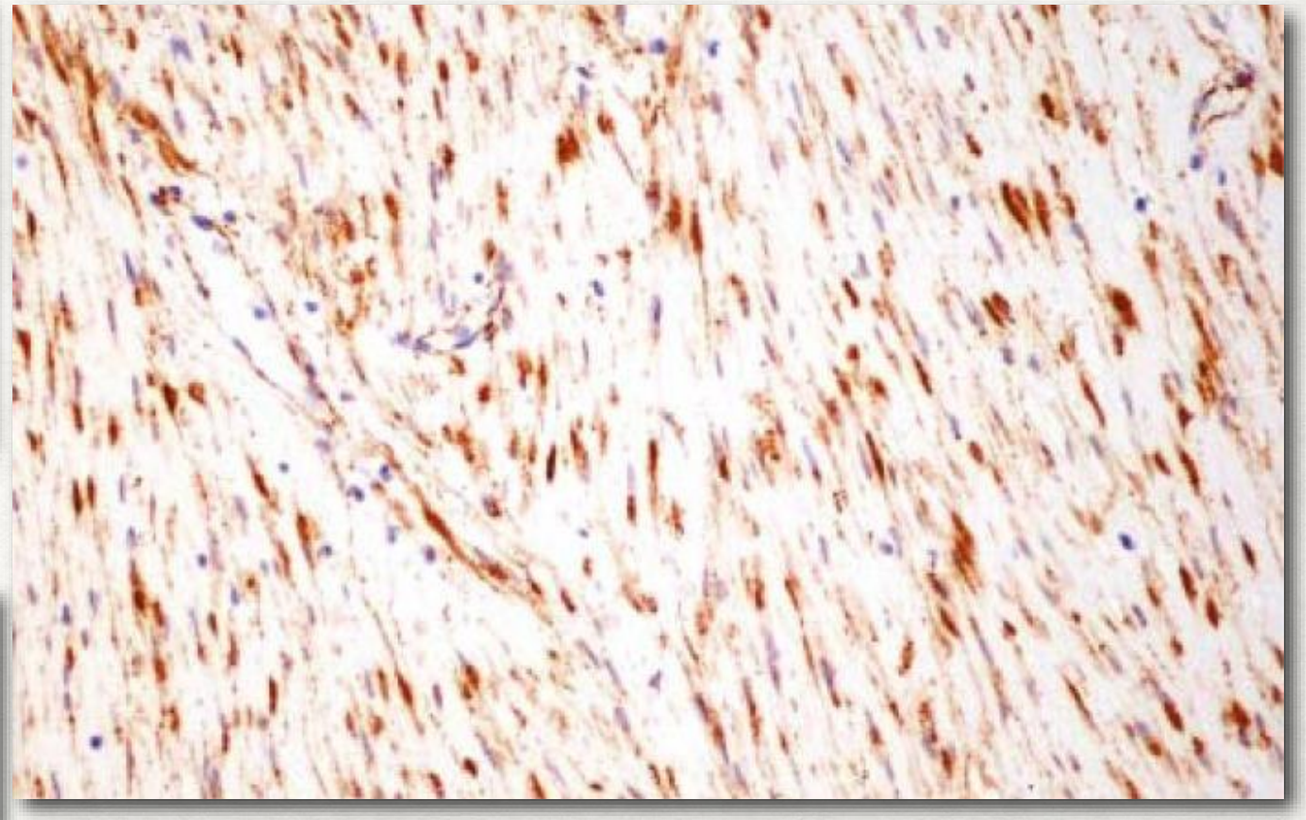
Mutations

Predictive, diagnostic and prognostic markers

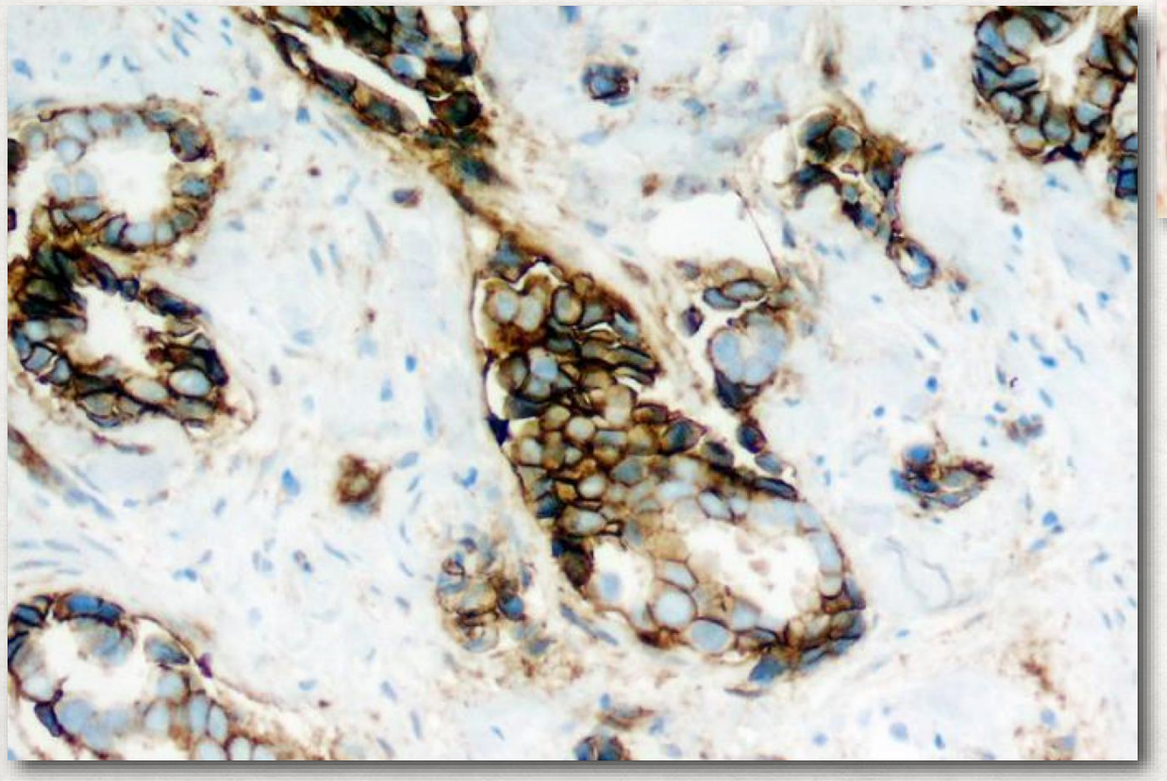


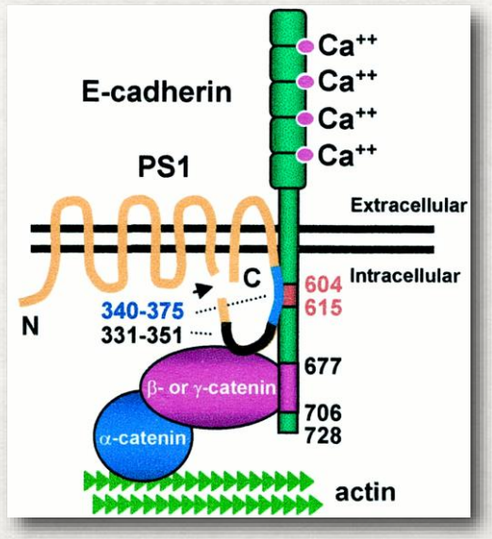


Abnormal localisation

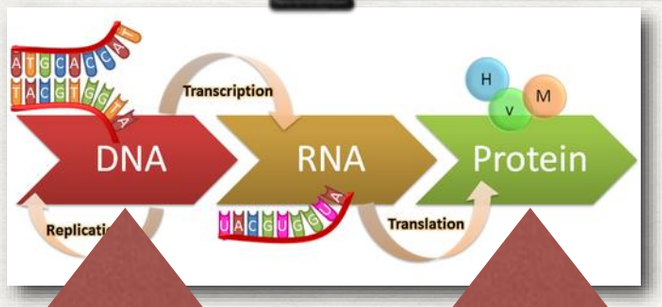


Normal lokalisation

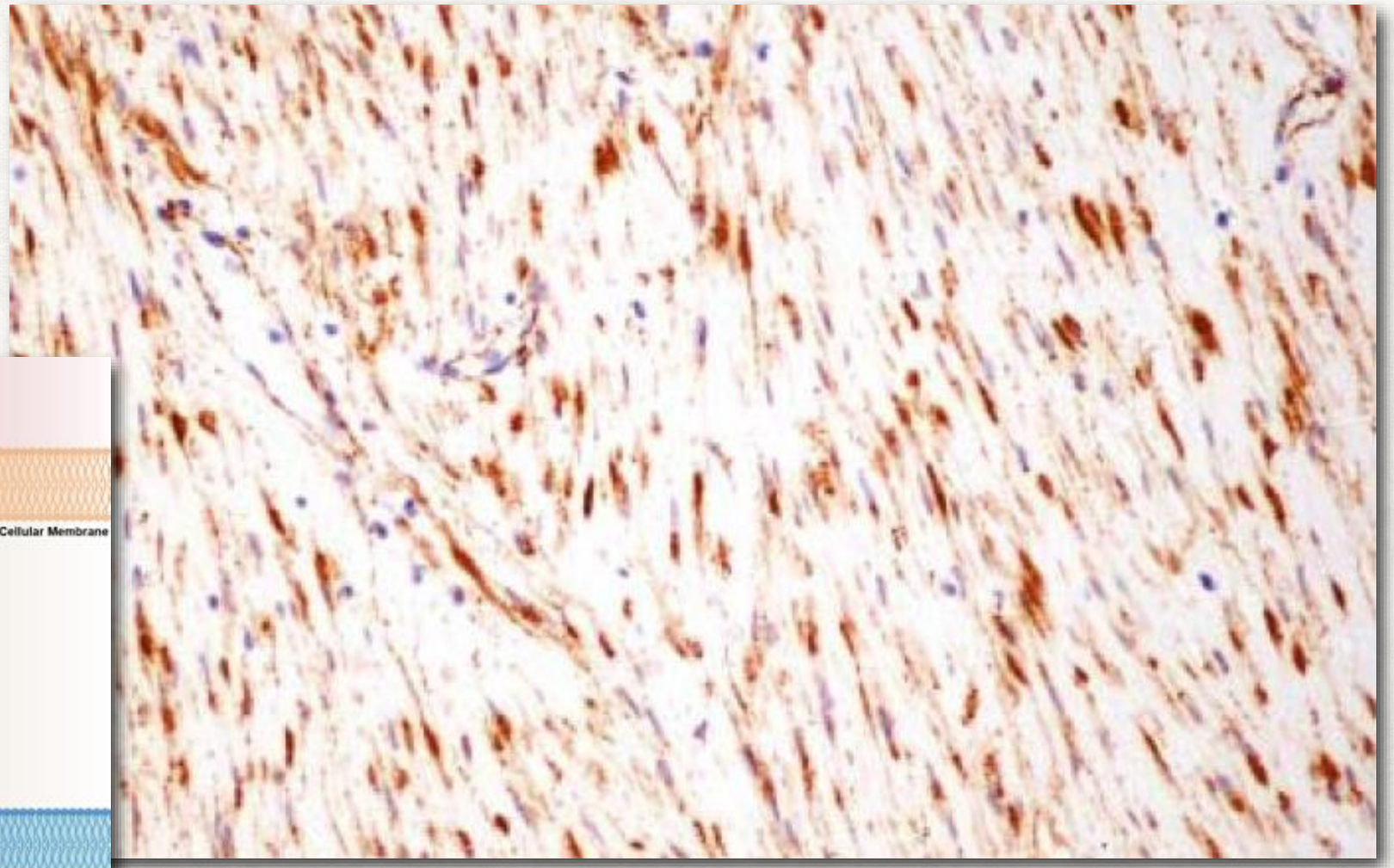




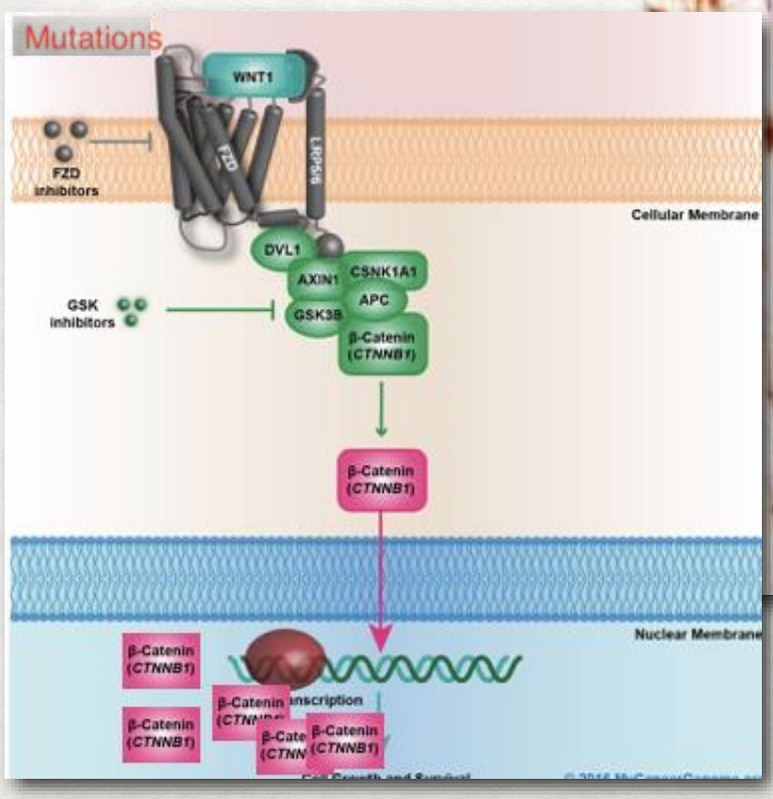
Predictive, diagnostic and prognostic markers



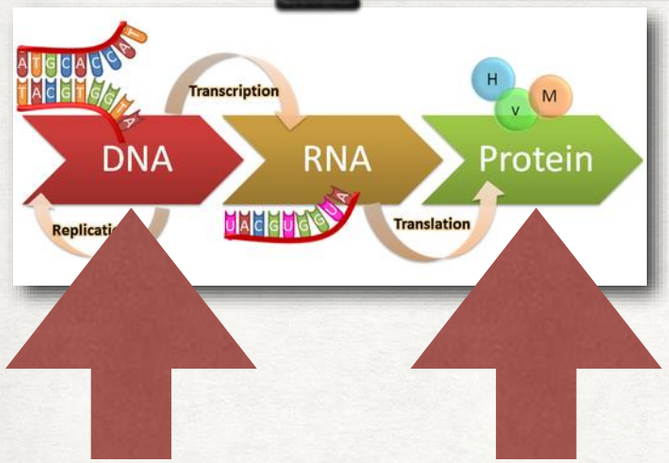
Abnormal localisation



Agressive fibromatosis



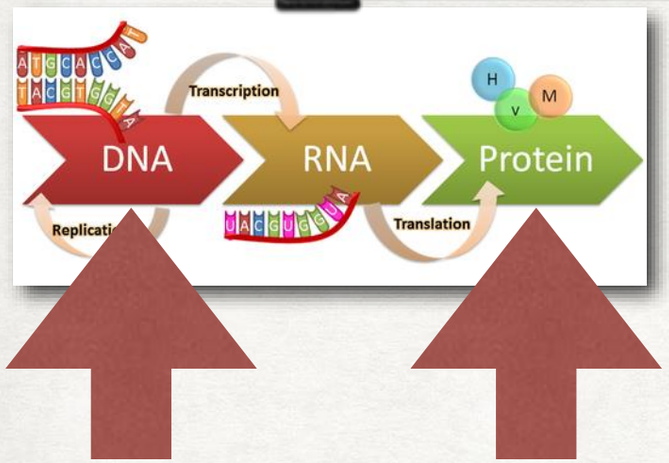
Predictive, diagnostic and prognostic markers



Immunohistochemistry
of B-cathenin

Mutations of B-cathenin, APC og BTRC

Predictive, diagnostic and prognostic markers



Mutation

Translocation

Deletion

Amplification

Methylation

Changed protein

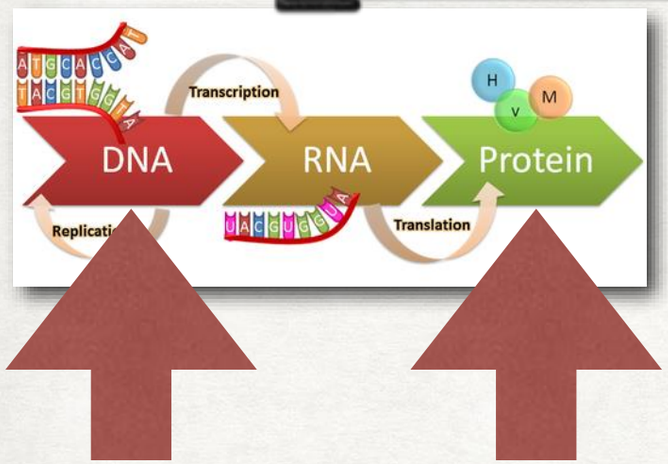
Absence of protein

Abnormal localisation

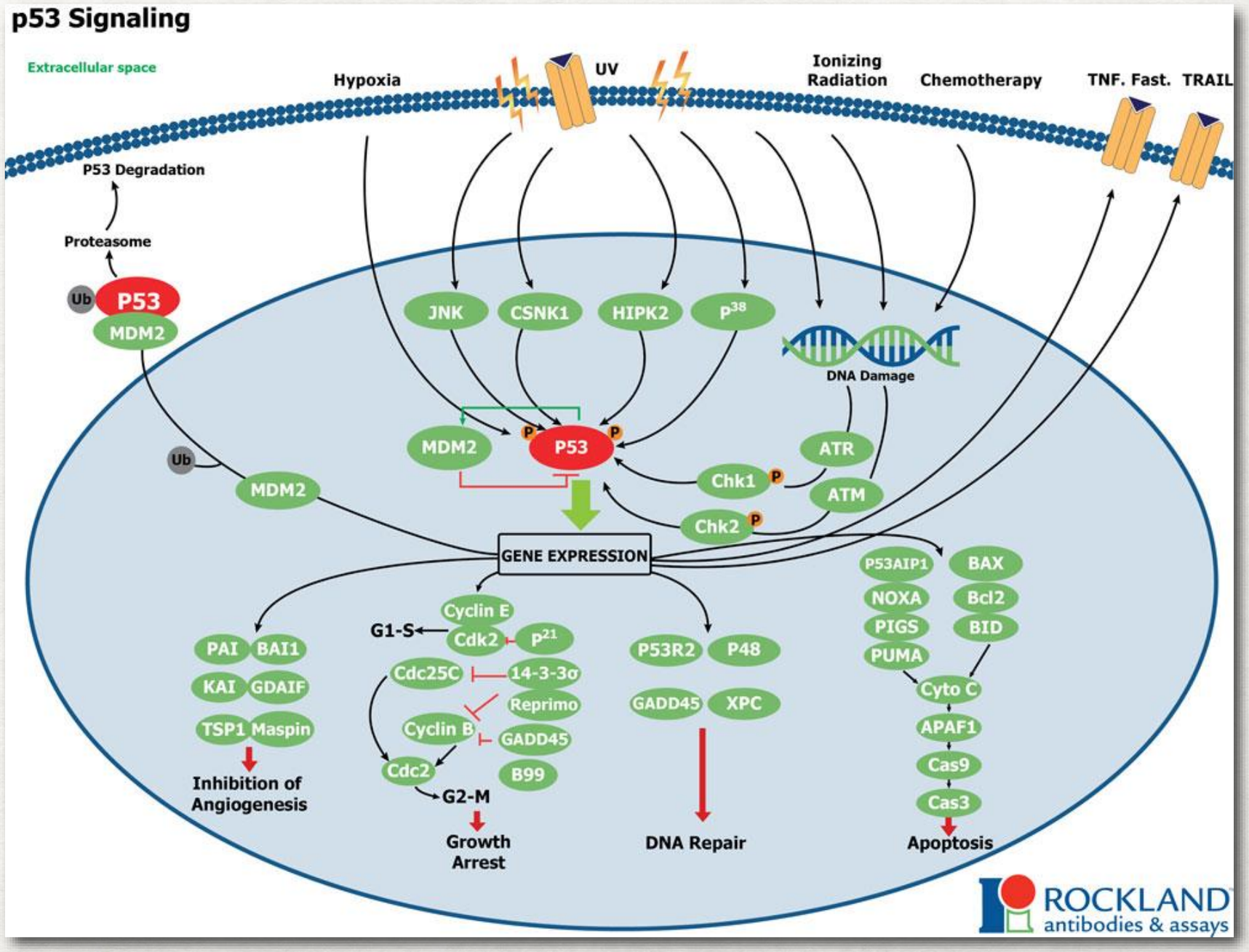
Over expression

Fussion protein

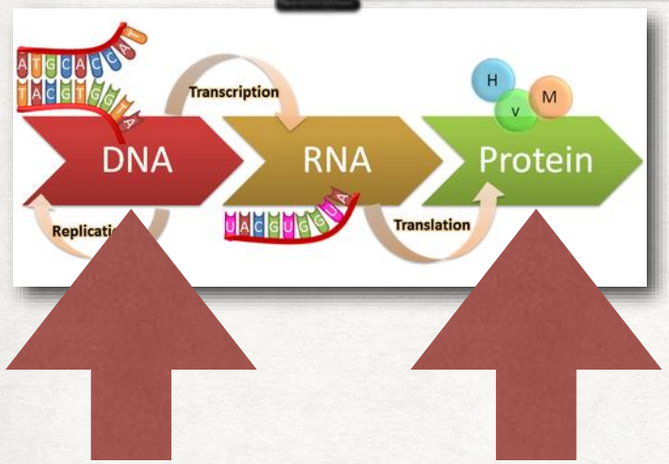
Predictive, diagnostic and prognostic markers



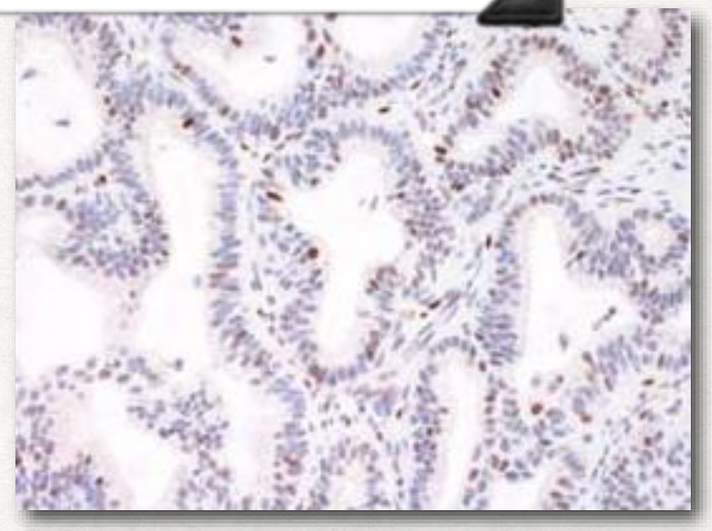
Over ekspression



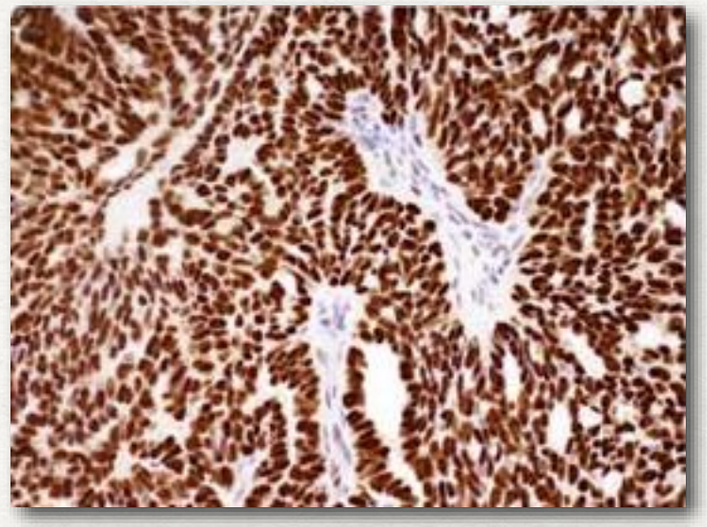
Predictive, diagnostic and prognostic markers



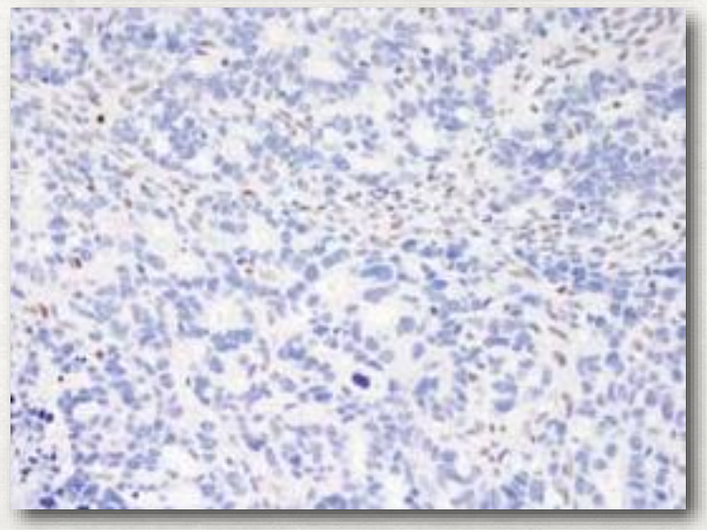
Normal expression



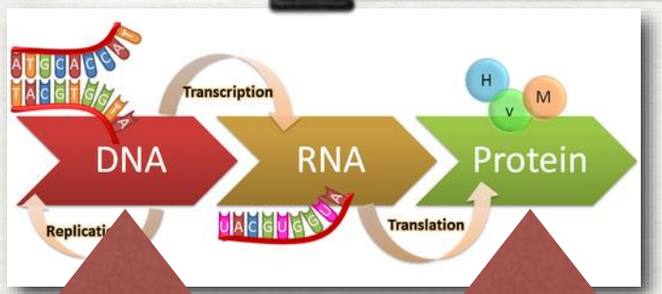
Some mutations cause (besides inactivation) that the P53 protein does not degrade and accumulates in the nucleus



Large deletions cause lack of protein expression



Predictive, diagnostic and prognostic markers



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ORIGINAL PAPER

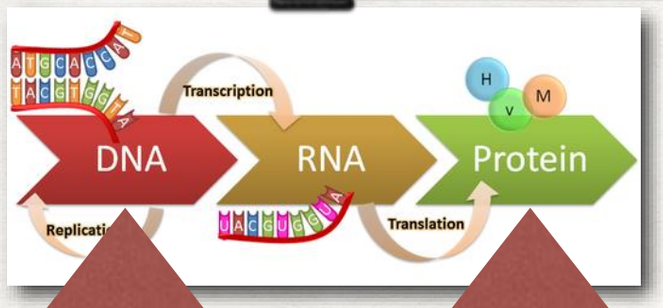
The biological and clinical value of p53 expression in pelvic high-grade serous carcinomas

Martin Köbel,[1] Alexander Reuss,[2] Andreas du Bois,[3] Stefan Kommoss,[3] Friedrich Kommoss,[3] Dongxia Gao,[4] Steve E Kalloger,[4] David G Huntsman[4] and C Blake Gilks[4]*

[1] *Department of Pathology and Laboratory Medicine, Calgary Laboratory Services/Alberta Health Services and University of Calgary, Canada*
[2] *Coordinating Centre for Clinical Trials (KKS), University Marburg (AGO-OVAR Statistical Centre), Germany*
[3] *Arbeitsgemeinschaft Gynaekologische Onkologie Studiengruppe (AGO-OVAR), Germany*
[4] *Genetic Pathology Evaluation Centre of the Prostate Research Centre, Department of Pathology, Vancouver General Hospital and British Columbia Cancer Agency, Vancouver, BC, Canada*

stage, residual tumour, and stratification by cohort. The association of complete absence of p53 expression with unfavourable outcome suggests functional differences of *TP53* mutations underlying overexpression, compared to those underlying complete absence of expression.

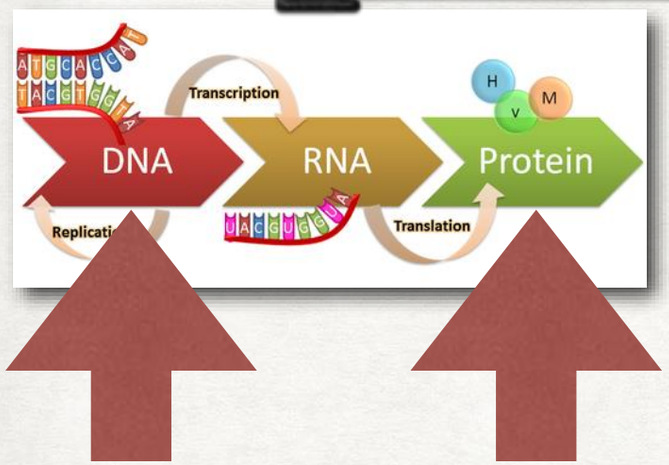
Predictive, diagnostic and prognostic markers



Immunohistochemistry of p53

NGS of the p53 gene

Predictive, diagnostic and prognostic markers



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Abnormal localisation

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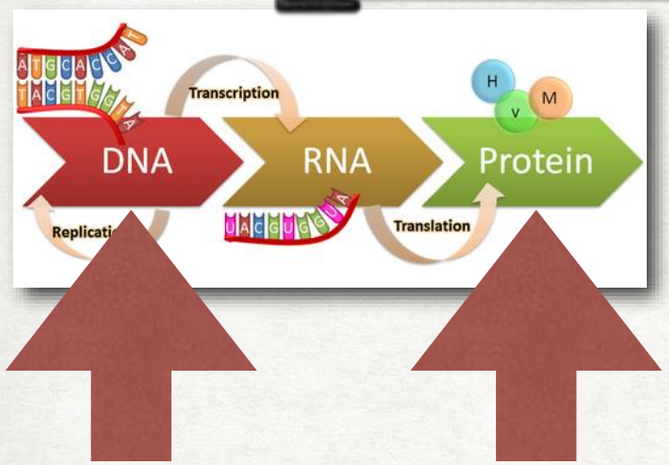
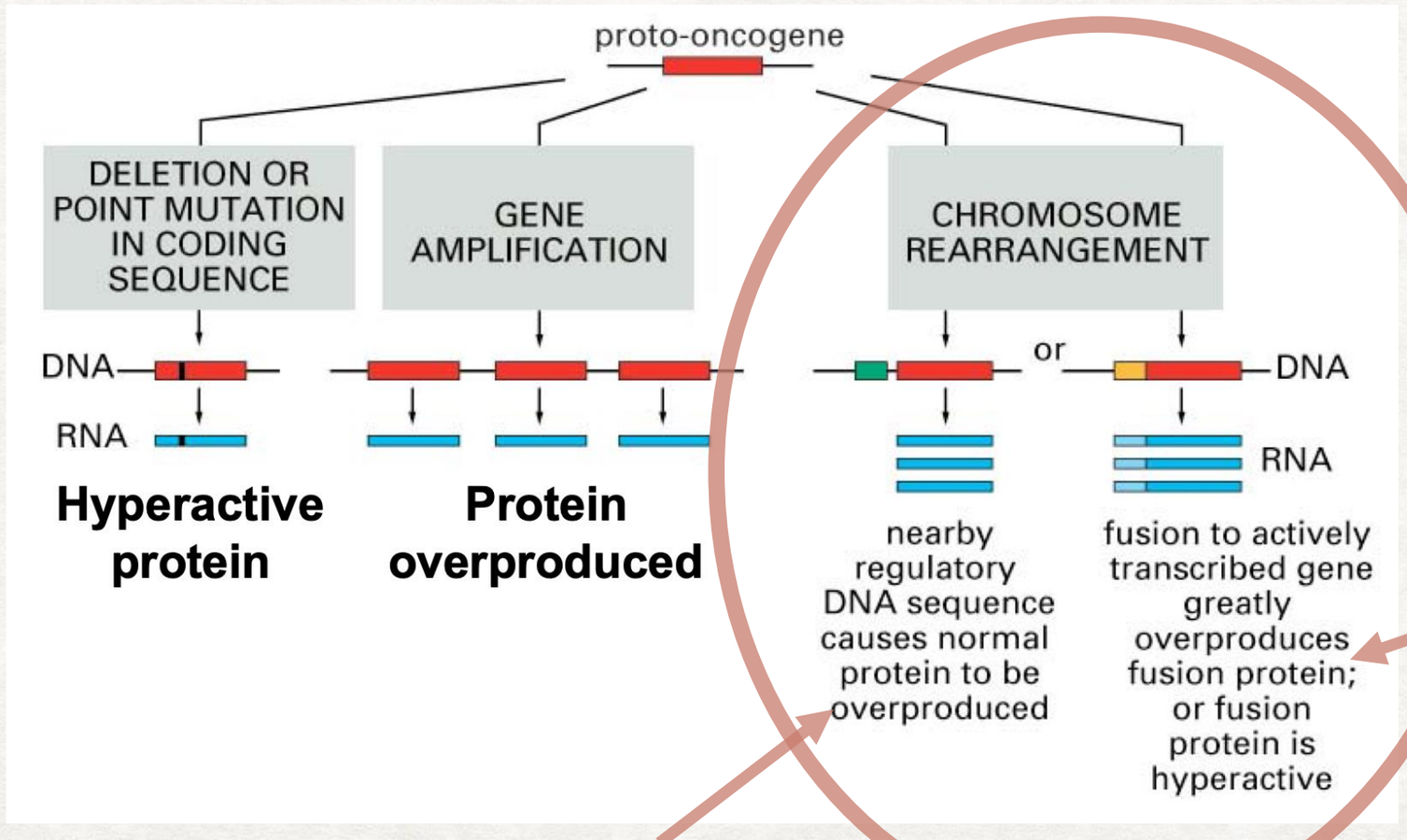
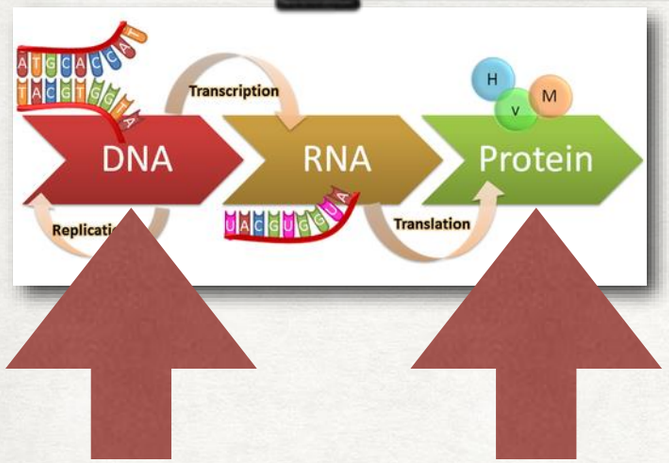
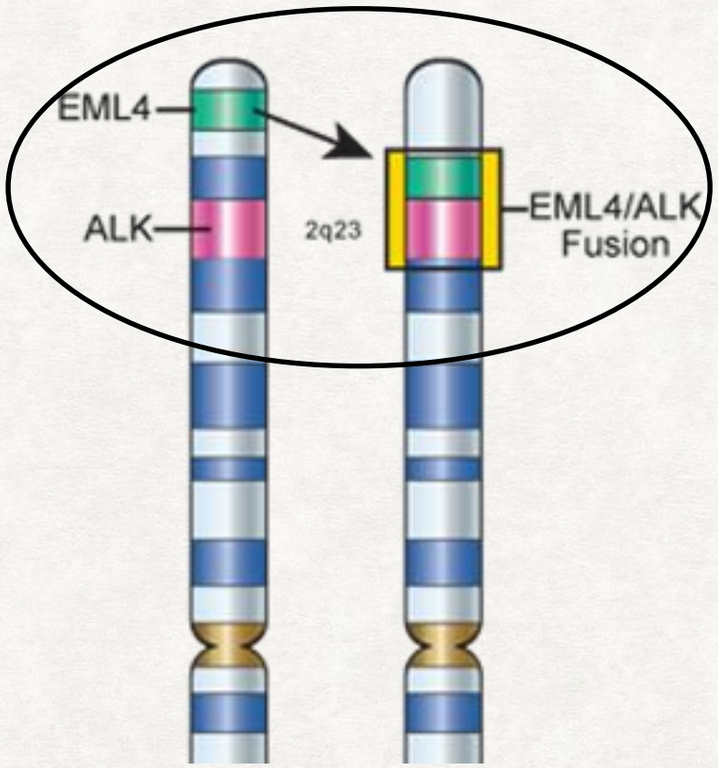
Predictive, diagnostic and prognostic markers



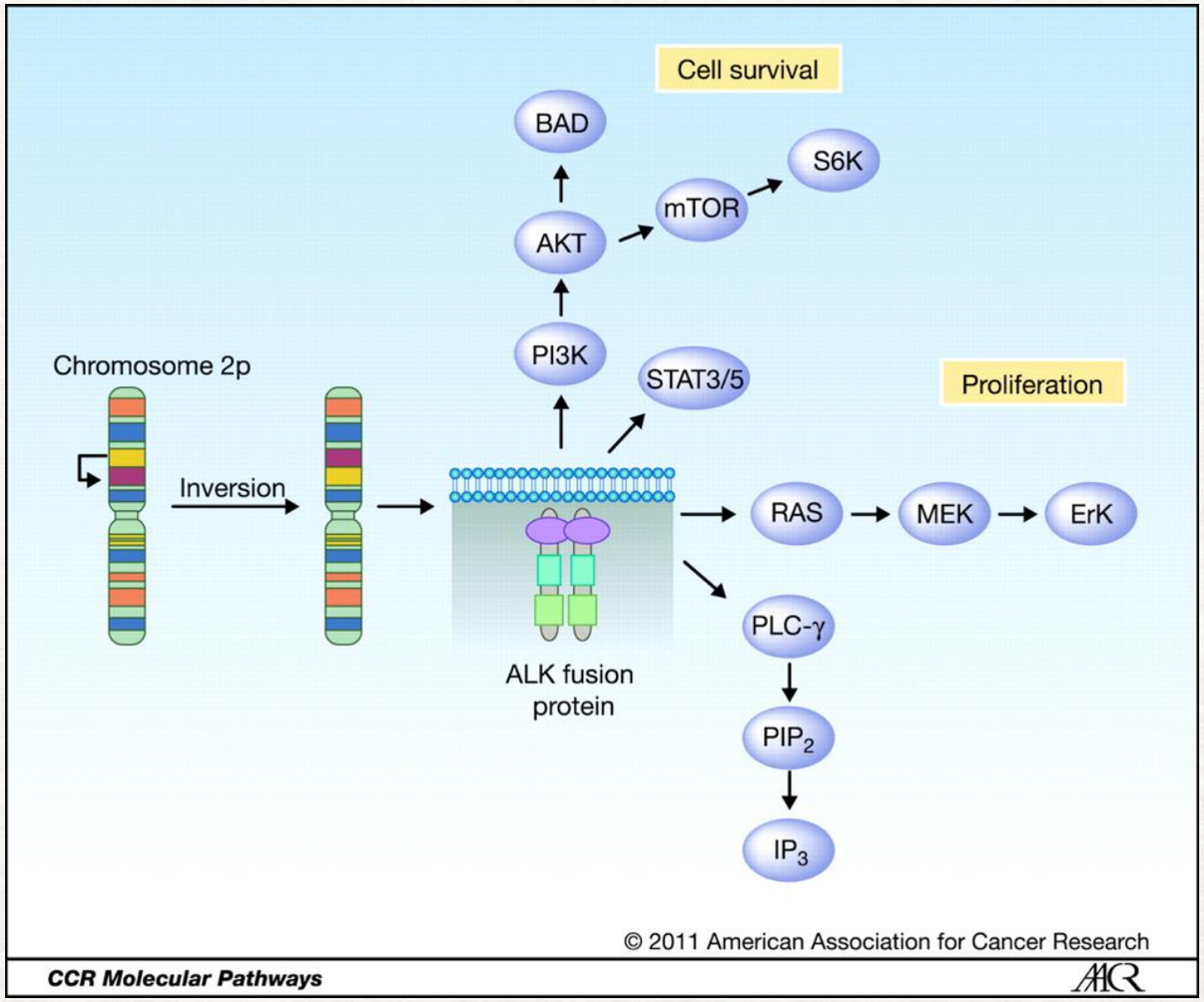


Predictive, diagnostic and prognostic markers

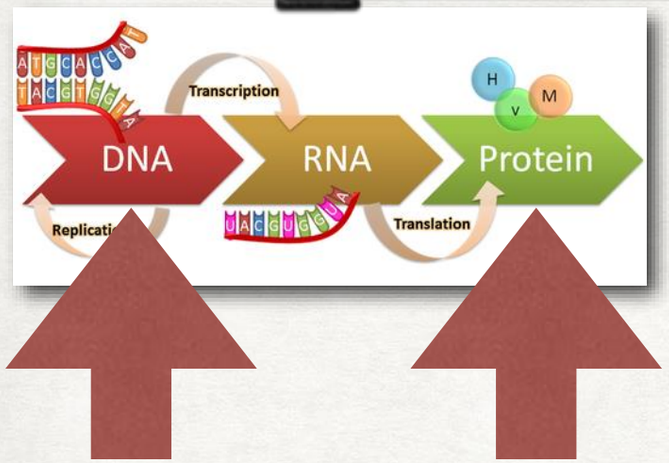




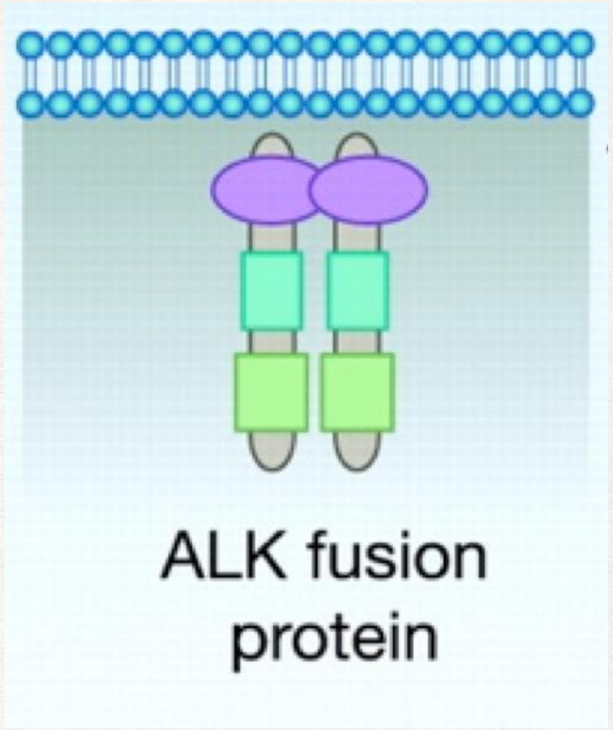
Lunge adenocarcinomer



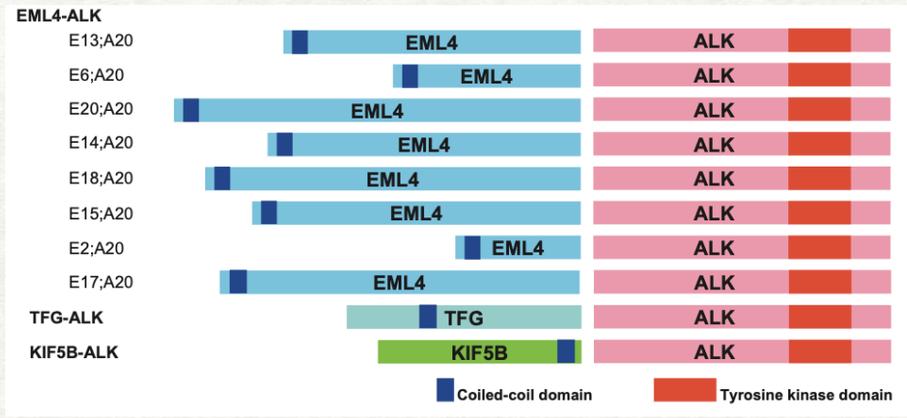
Predictive, diagnostic and prognostic markers



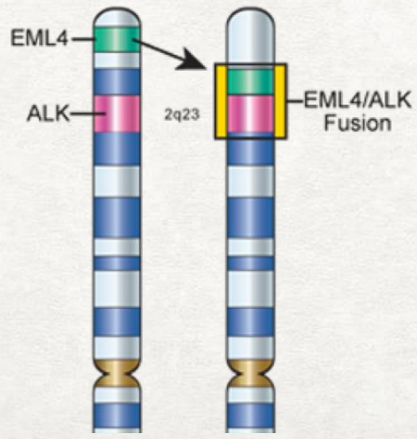
Detektion af fusion protein



Detektion af fusions RNA



Detektion af chromosomale Forandringer



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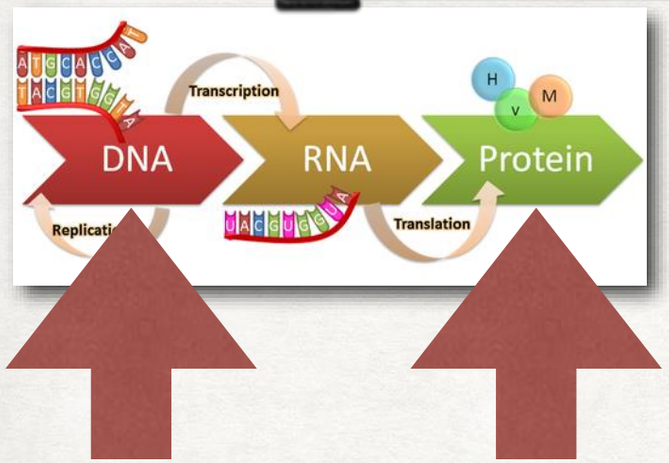
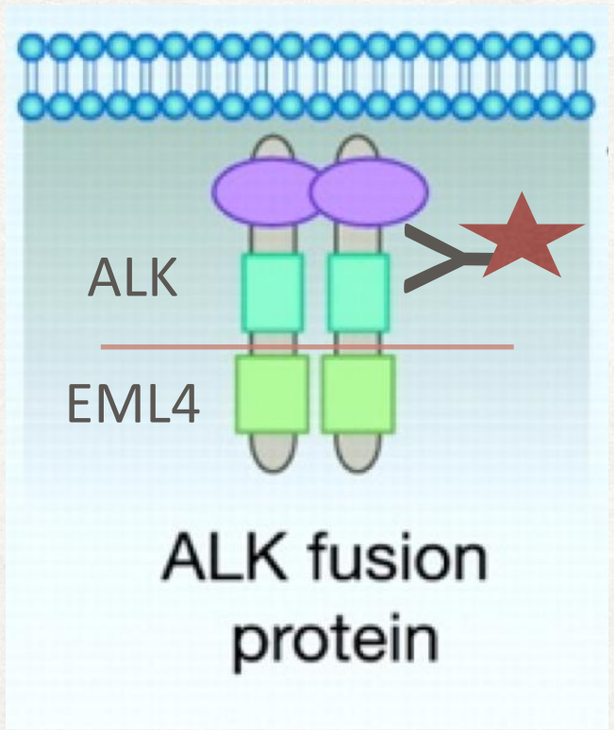
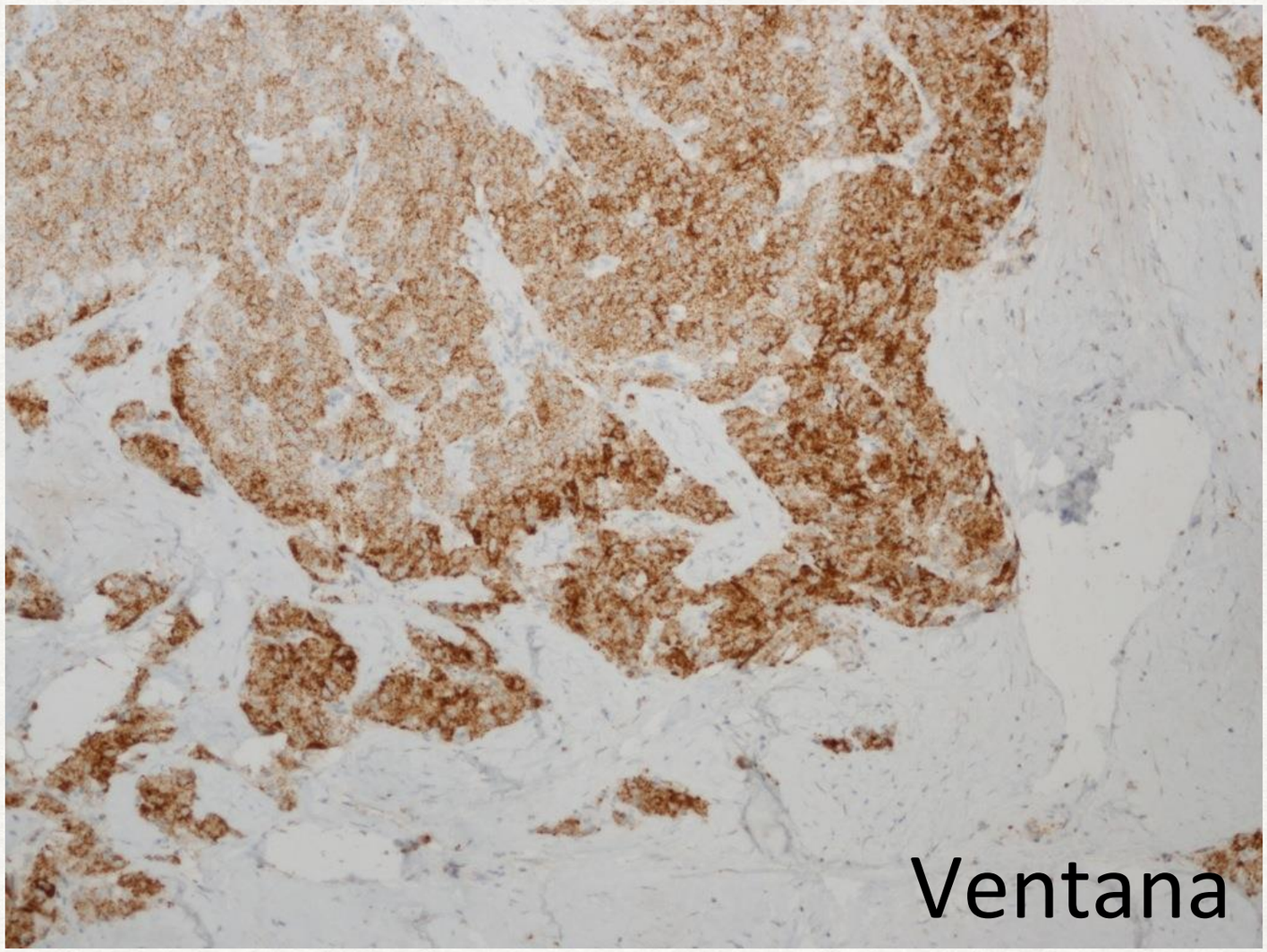
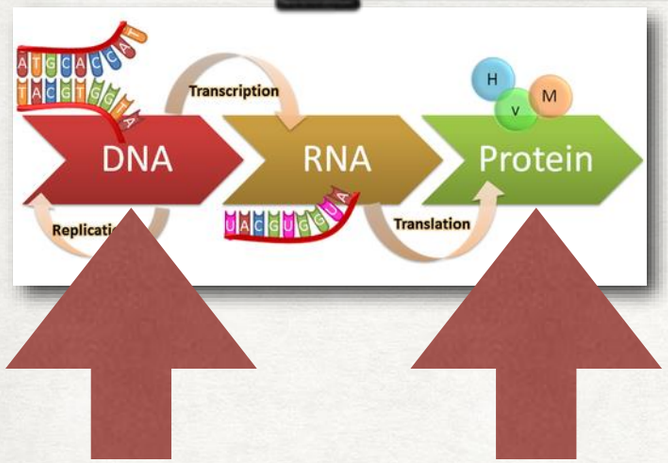






Detects ALK independent of fusion partner

Predictive, diagnostic and prognostic markers



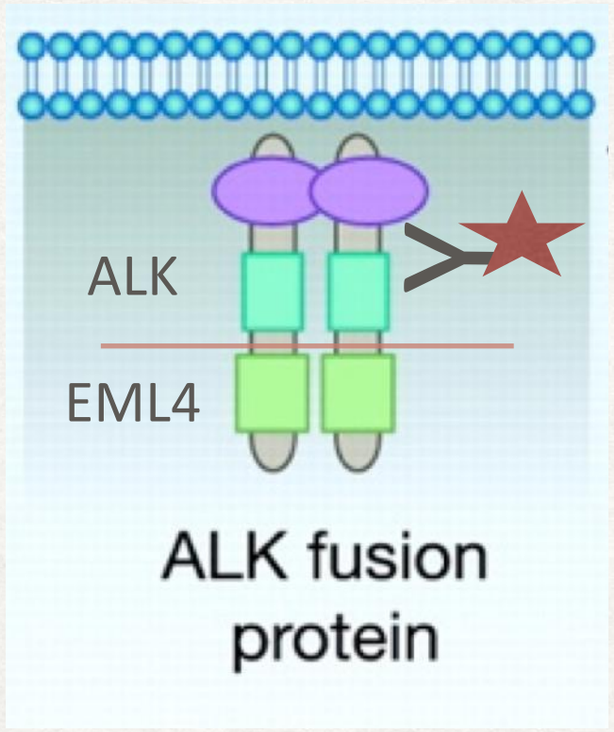
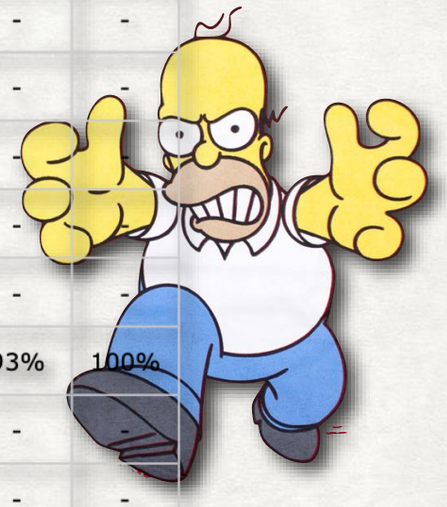


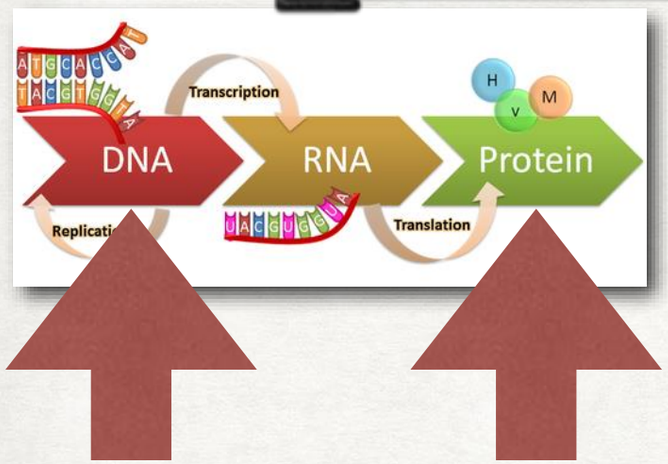
Table 1. **Antibodies and assessment marks for lu-ALK, run 51**

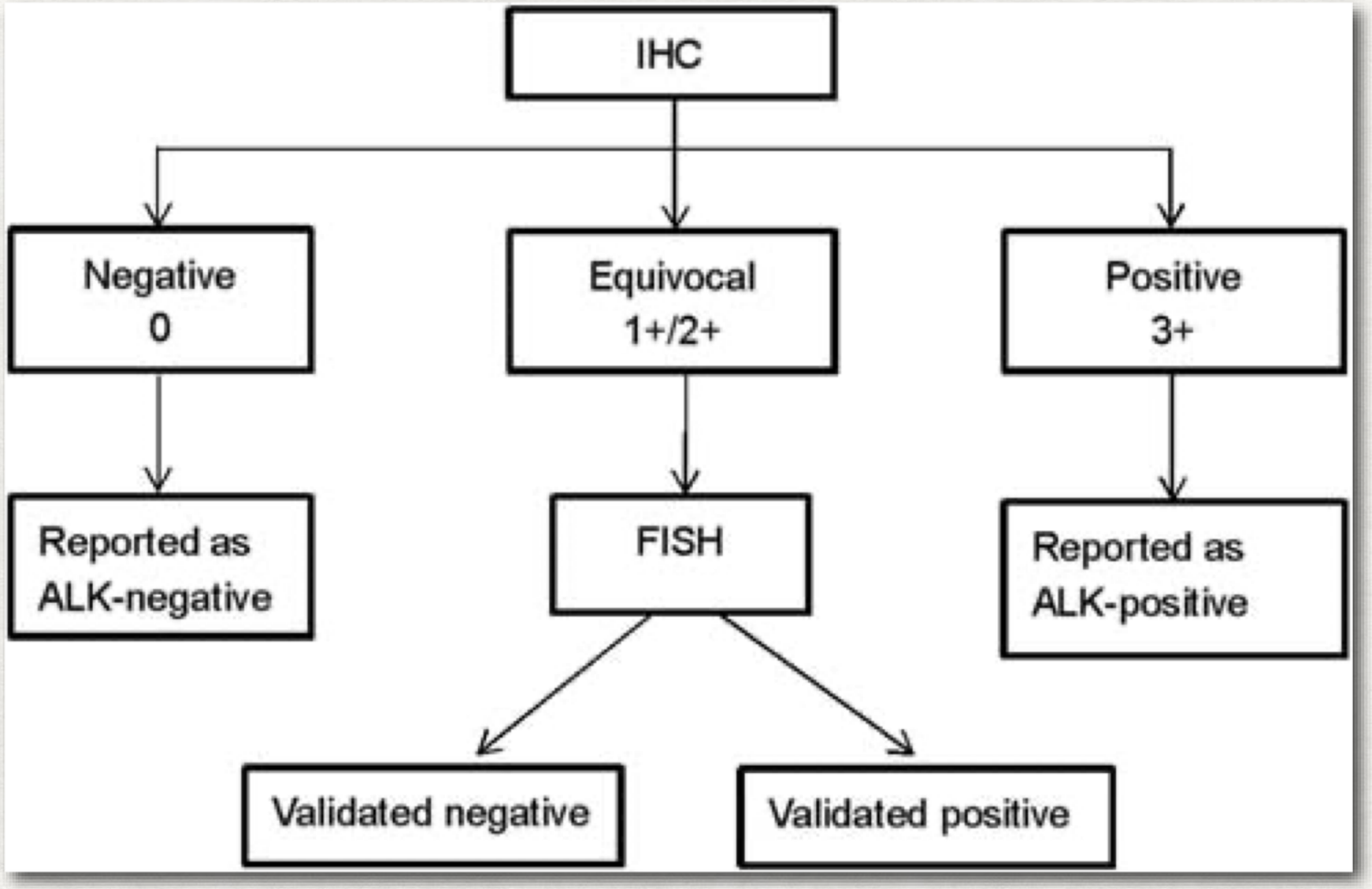
Concentrated antibodies	n	Vendor	Optimal	Good	Borderline	Poor	Suff.[1]	Suff. OPS[2]
mAb clone **5A4**	43 1 1 1 1	Leica/Novocastra Abcam Biocare Monosan ThermoFisher	1	15	24	7	34%	22%
mAb clone **ALK1**	2 1	Dako Cell Marque	0	0	0	3	-	-
rmAb clone **D5F3**	23	Cell Signaling	6	12	3	2	78%	94%
mAb clone **OTI1A4**	13	ORIGENE	10	3	0	0	100%	100%
Ready-To-Use antibodies								
mAb clone **5A4 PA0306**	6	Leica/Novocatra	0	0	6	0	-	-
mAb clone **5A4 MAB-0281**	1	Maixin	0	0	1	0	-	-
mAb **5A4 MAD-001720QD**	1	Master Diagnostica	0	0	1	0	-	-
mAb clone **5A4 MS-1104-R7**	1	ThermoFisher	0	1	0	0	-	-
mAb **ALK1 IR641**	9	Dako	0	0	1	8	-	-
mAb clone **ALK1 GA641**	4	Dako	0	0	0	4	-	-
mAb clone **ALK1 790/800-2918**	7	Ventana	0	0	2	5	-	-
rmAb clone **SP8 AN770**	1	BioGenex	0	0	0	1	-	-
rmAb clone **D5F3 790-4796**	70	Ventana	53	12	4	1	93%	100%
rmAb clone **D5F3 790-4796**[3]	2	Ventana	1	0	1	0	-	-
mAb clone **OTI1A4 8344-C010**	1	Sakura Finetek	1	0	0	0	-	-
Total	189		72	43	43	31	-	
Proportion			38%	23%	23%	16%	61%	

1) Proportion of sufficient stains (optimal or good).
2) Proportion of sufficient stains with optimal protocol settings only, see below. . 3) RTU system developed for the Ventana BenchMark systems (Ultra/XT) but used by laboratories on different platforms (e.g Dako Autostainer)



Predictive, diagnostic and prognostic markers



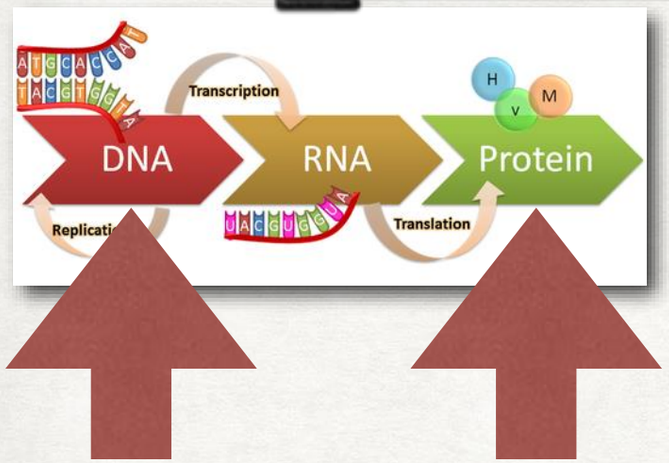


Improving Selection Criteria for *ALK* Inhibitor Therapy in Non–Small Cell Lung Cancer

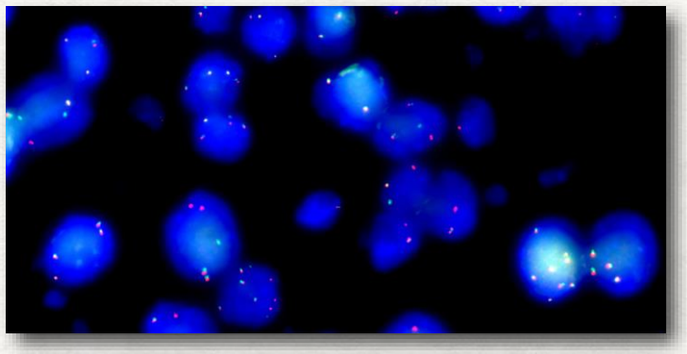
A Pooled-Data Analysis on Diagnostic Operating Characteristics of Immunohistochemistry

Long Jiang, MD, PhD,† Haihong Yang, MD, PhD,‡ Ping He, MD, PhD,§ Wenhua Liang, MD, PhD,‡ Jianrong Zhang, MD,*† Jingpei Li, MD,*† Yang Liu, MD,*† and Jianxing He, MD, PhD, FACS*†*

Predictive, diagnostic and prognostic markers

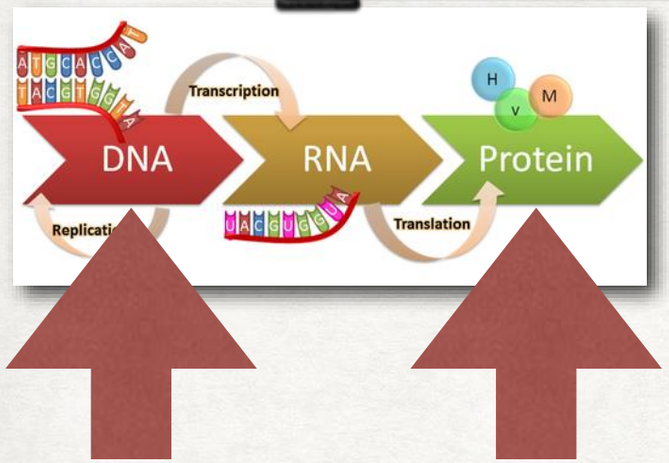


Immunohistochemistry of ALK



Fusions RNA analysis (PCR), NGS or FISH

Predictive, diagnostic and prognostic markers



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Translocation	Absence of protein
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Amplification	Over expression
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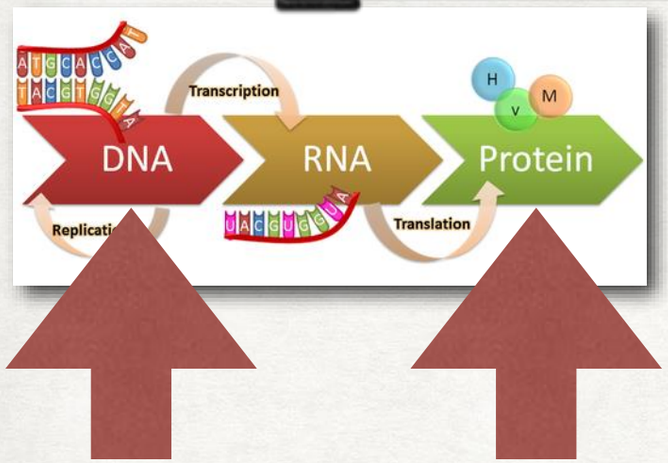
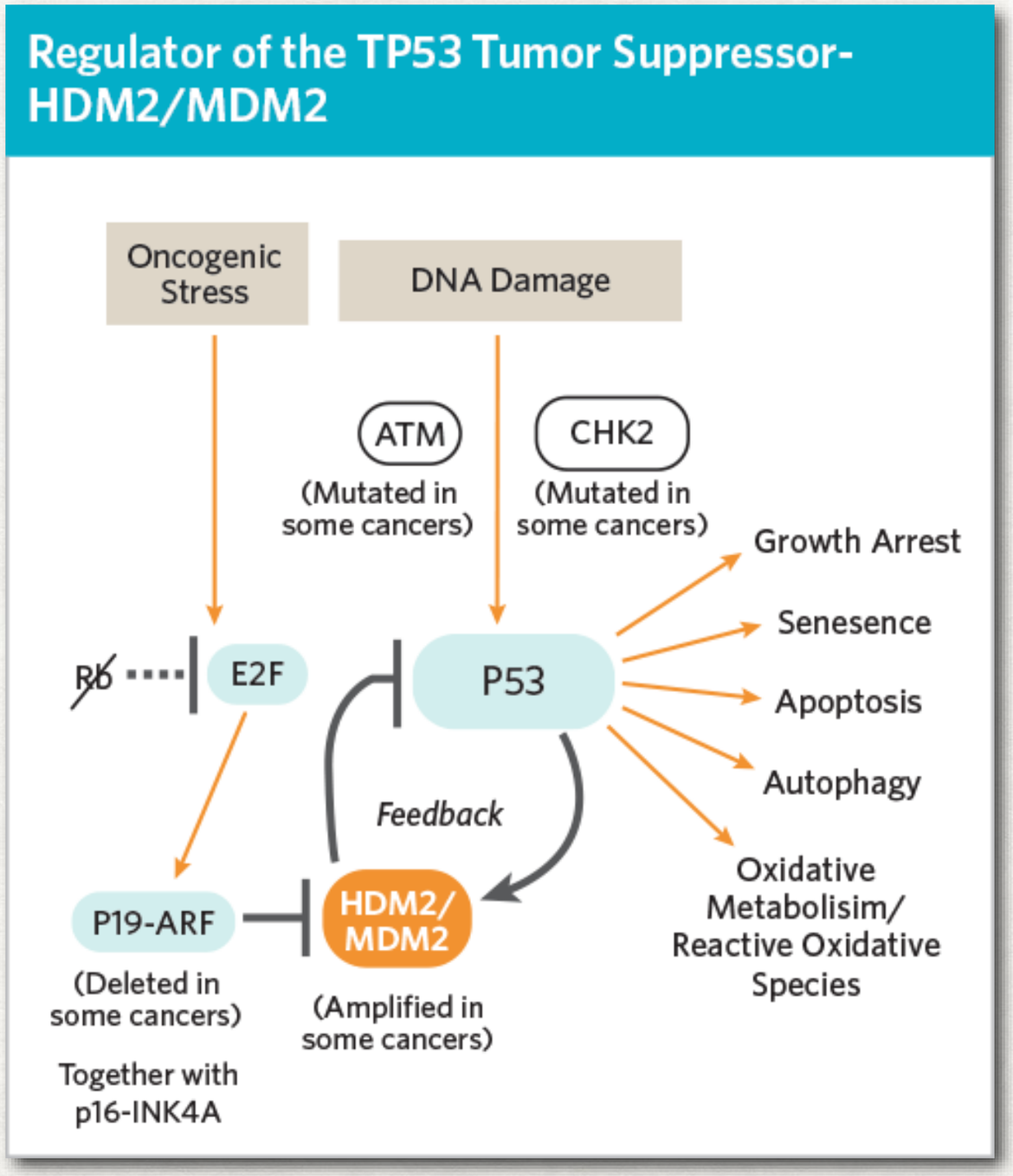
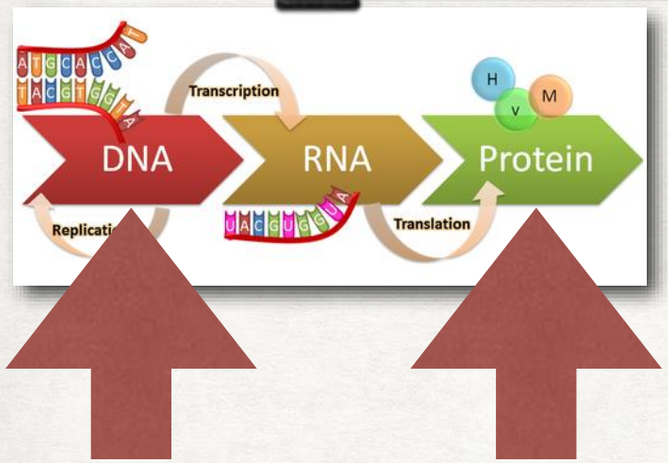
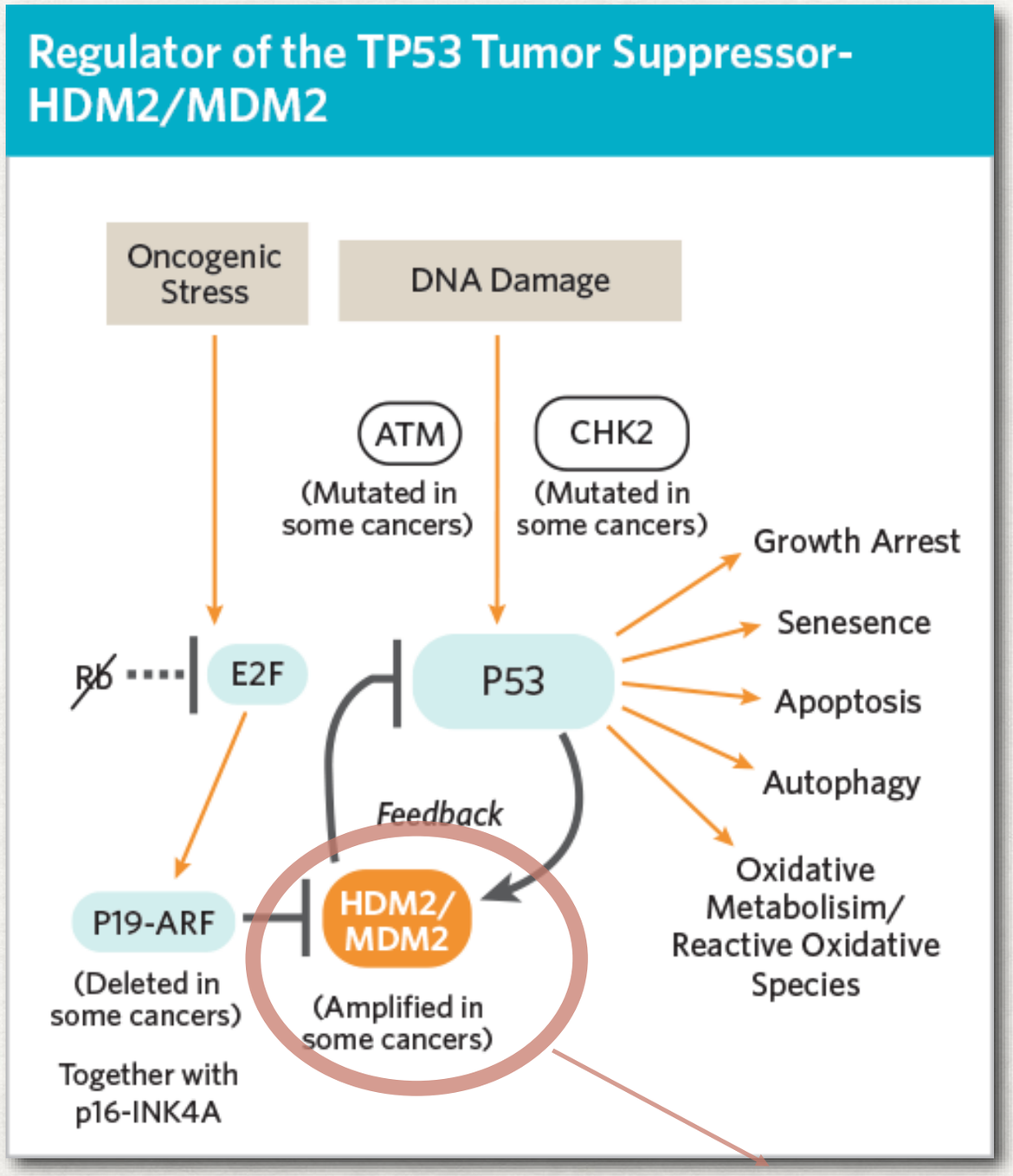
Predictive, diagnostic and prognostic markers





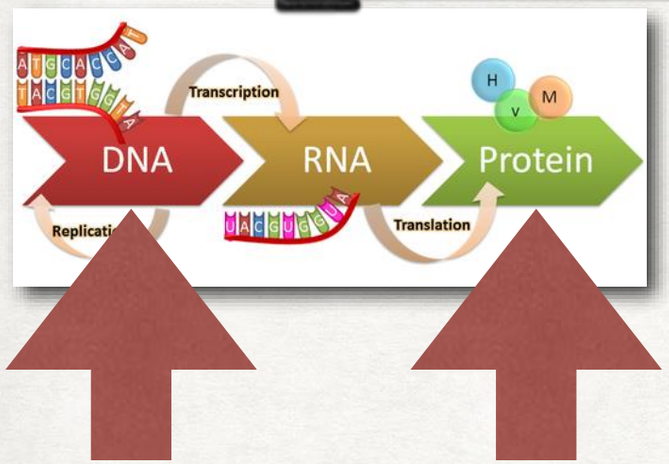
Predictive, diagnostic and prognostic markers



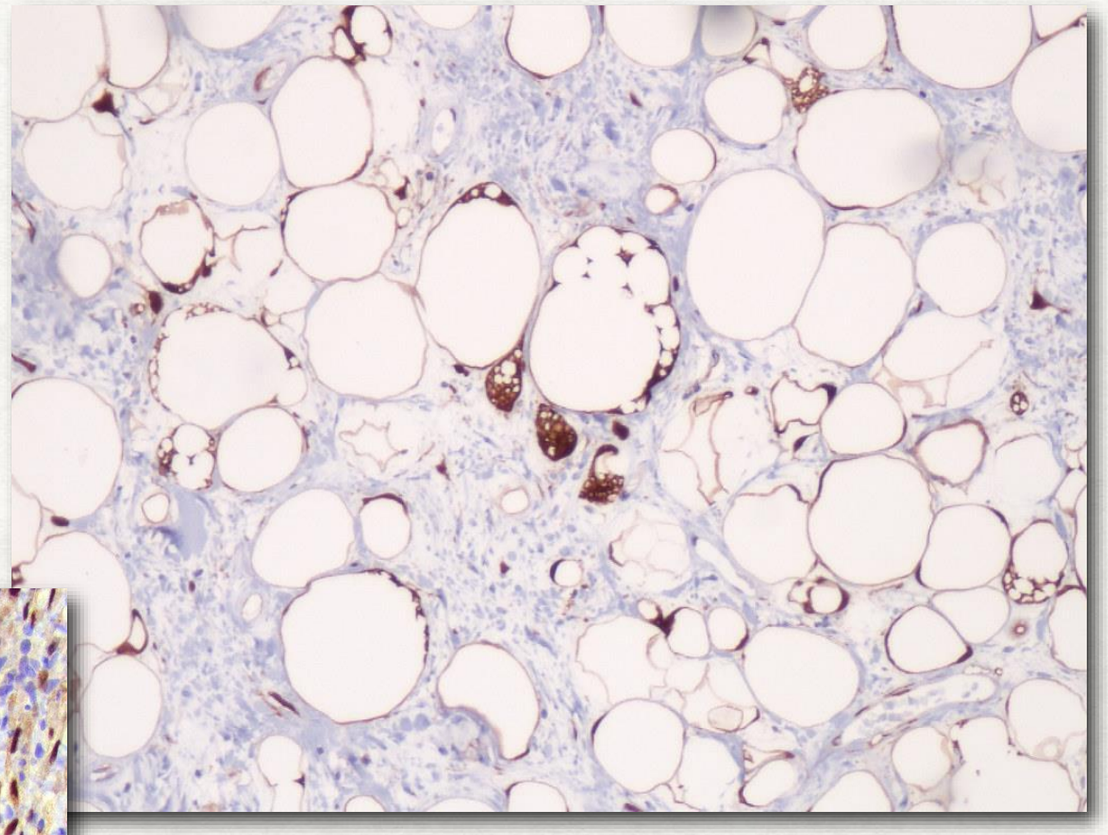


E.g. liposarcoma

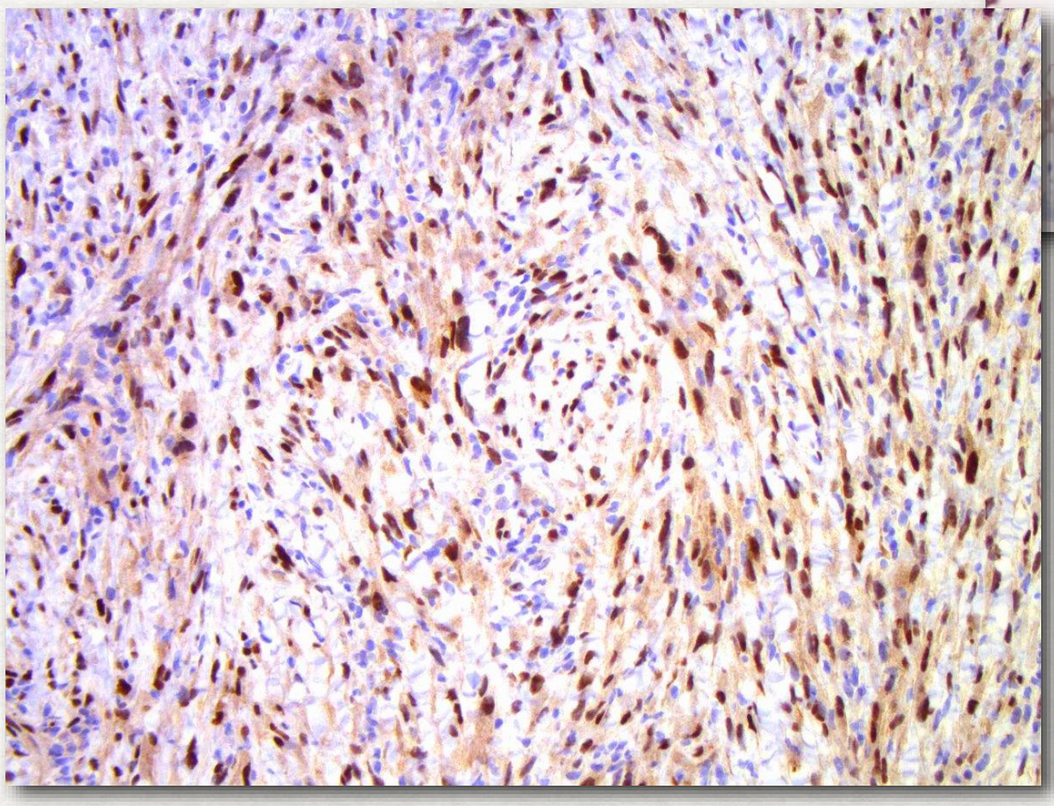
Predictive, diagnostic and prognostic markers



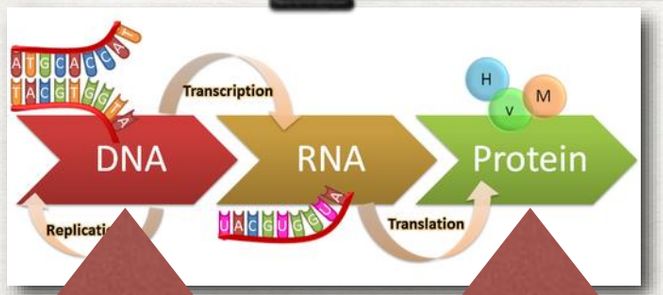
Well differentieret liposarcoma



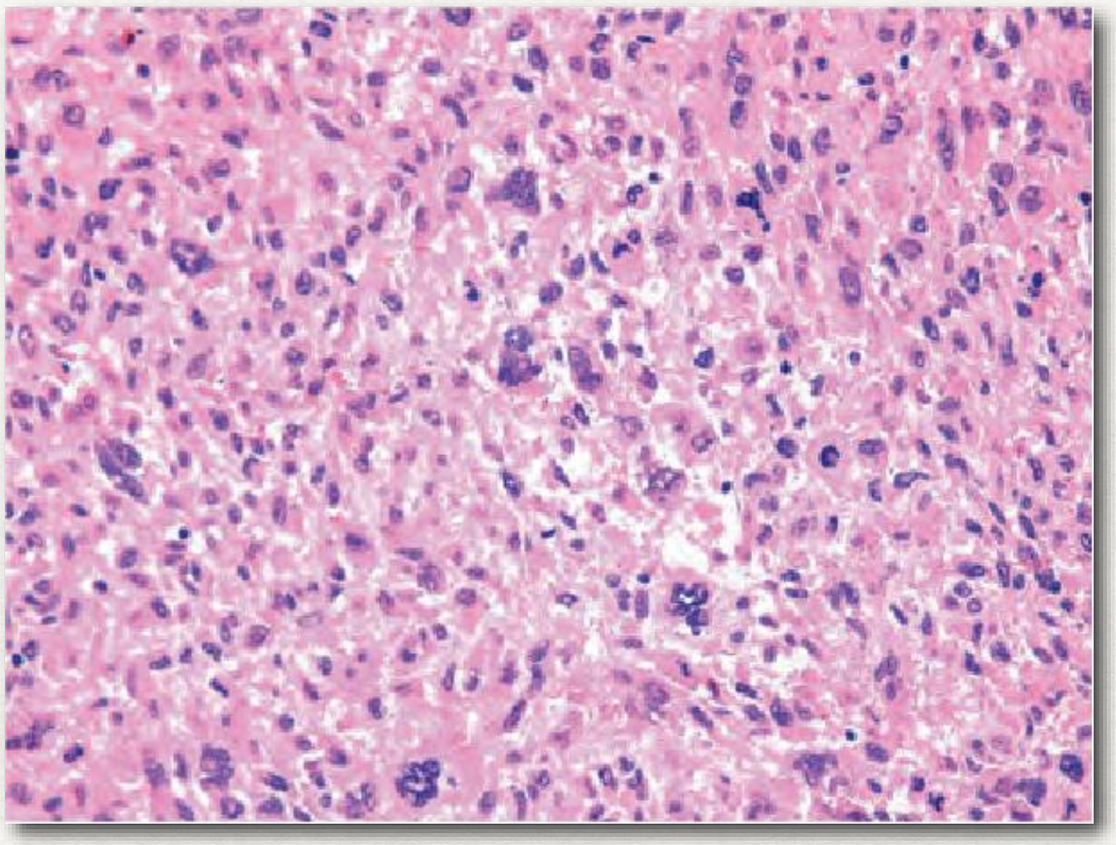
Dedifferentiated liposarcoma



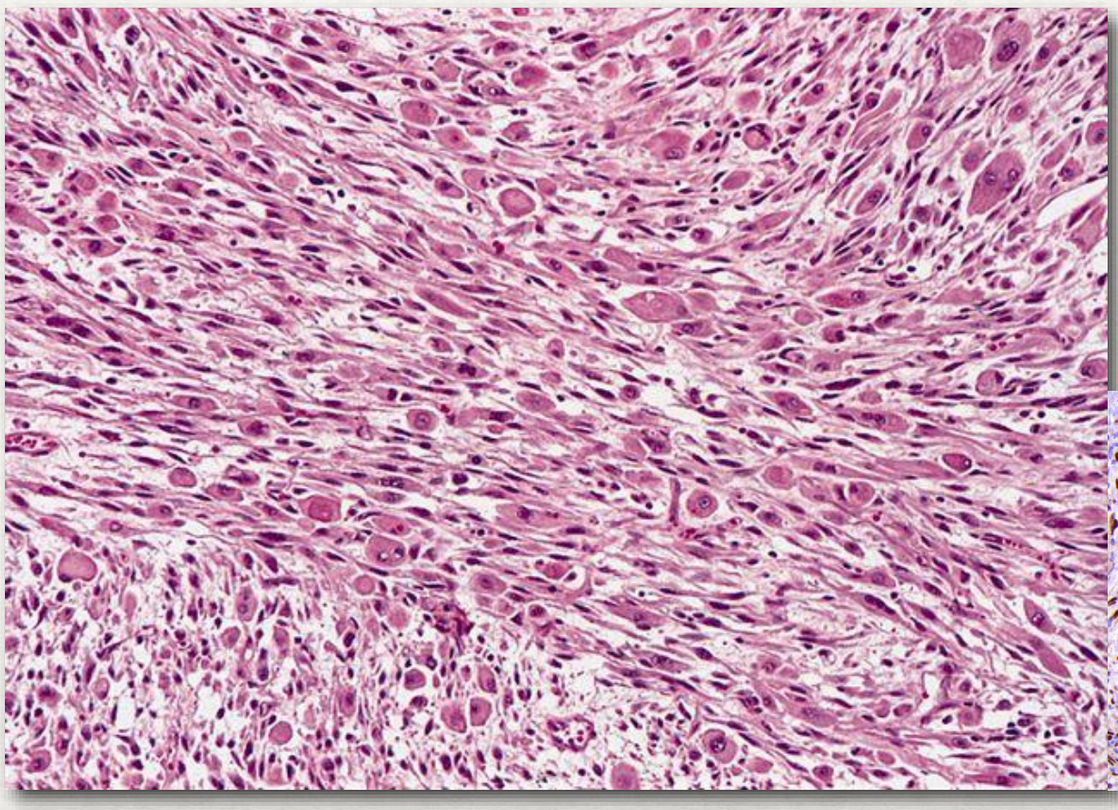
Predictive, diagnostic and prognostic markers



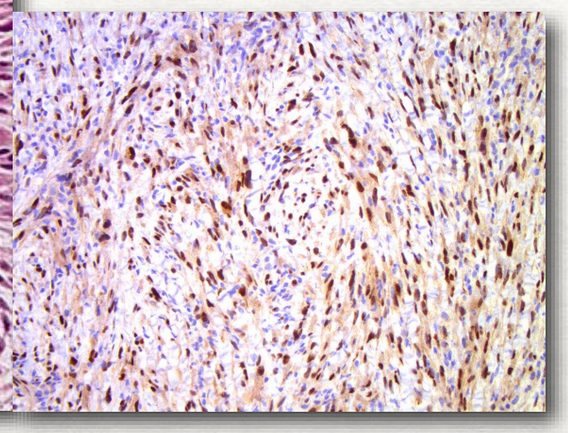
Pleomorph undifferentiated sarcoma



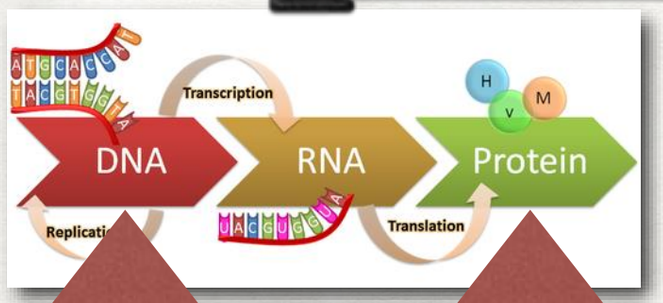
Dedifferentieret liposarcoma



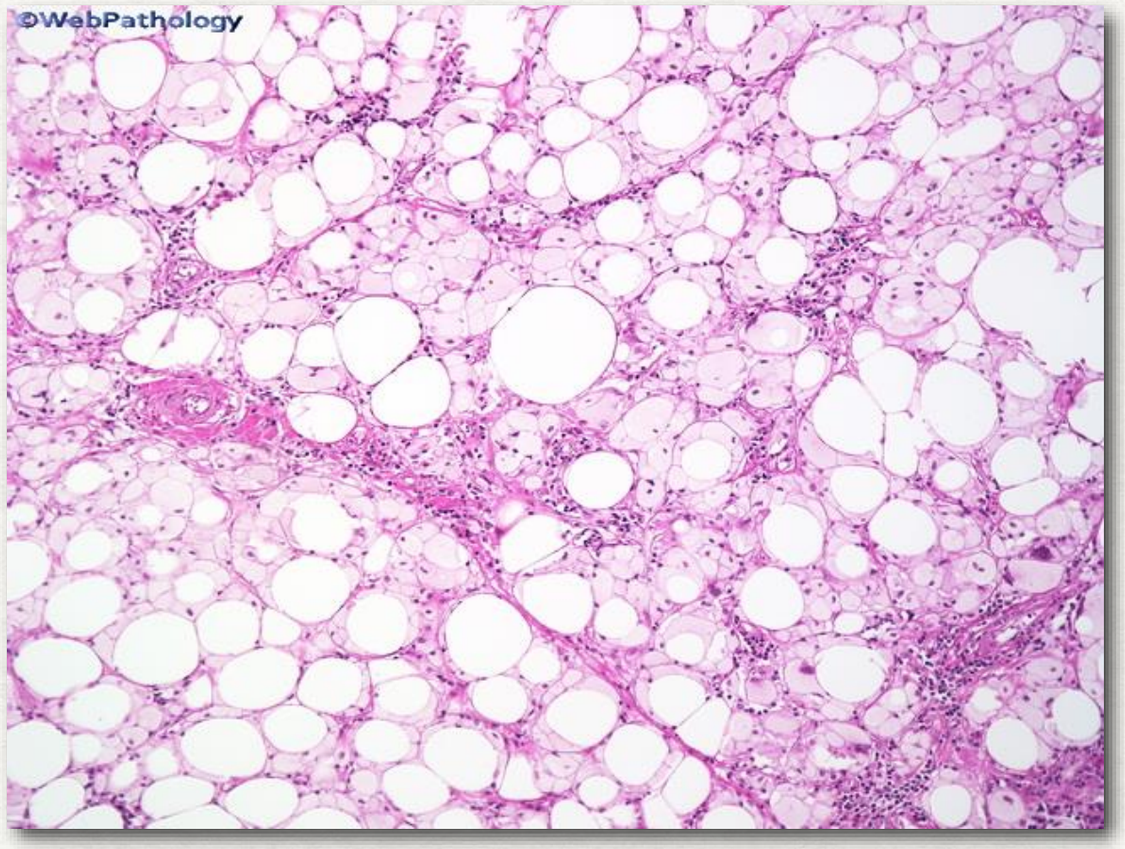
MDM2



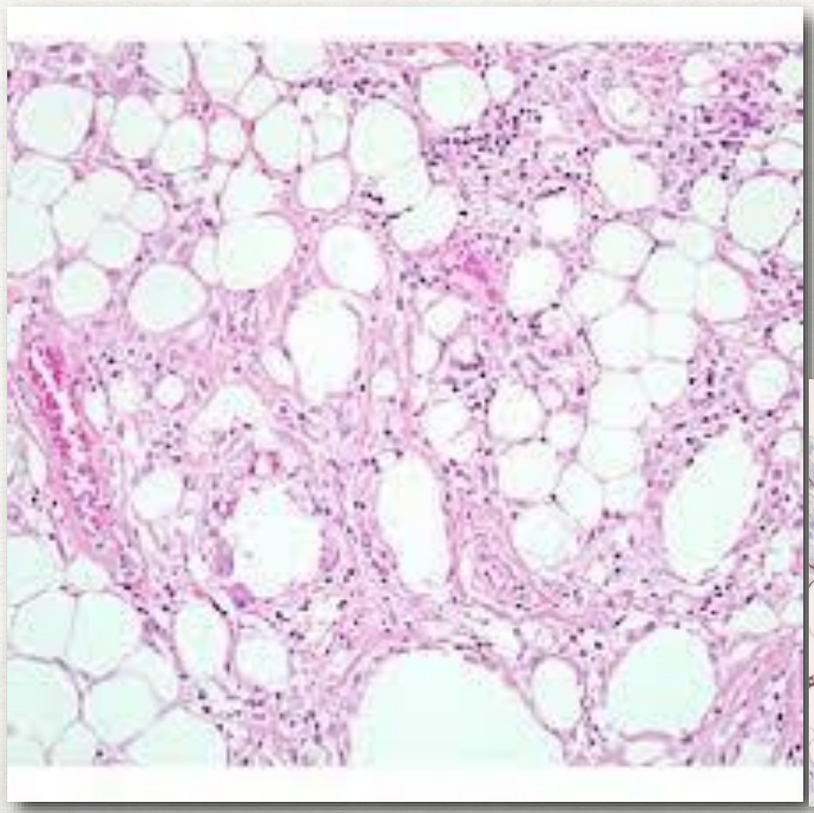
Predictive, diagnostic and prognostic markers



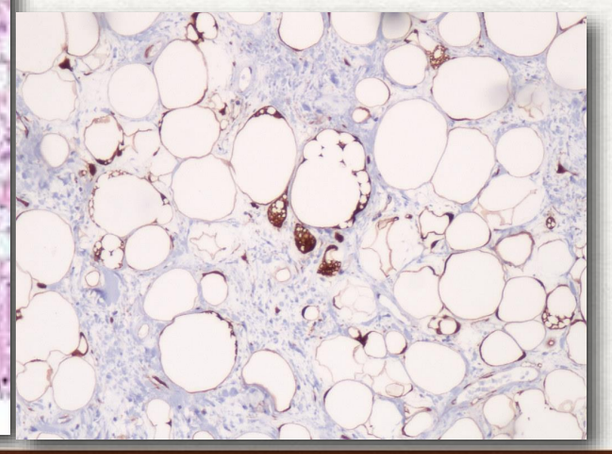
Lipoma



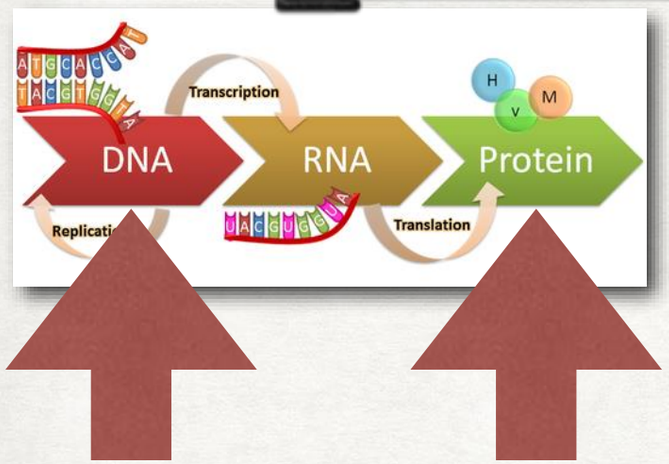
Well differentiated liposarcoma



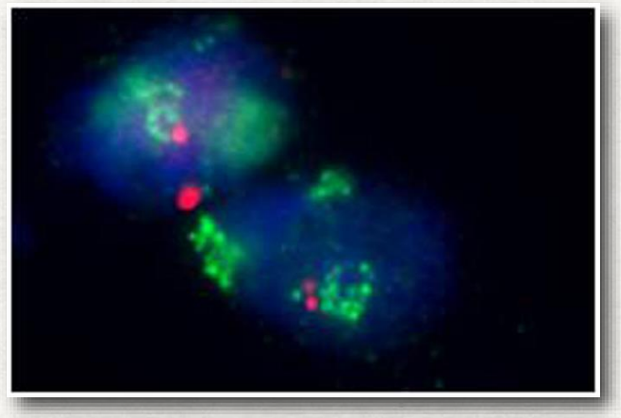
MDM2



Predictive, diagnostic and prognostic markers

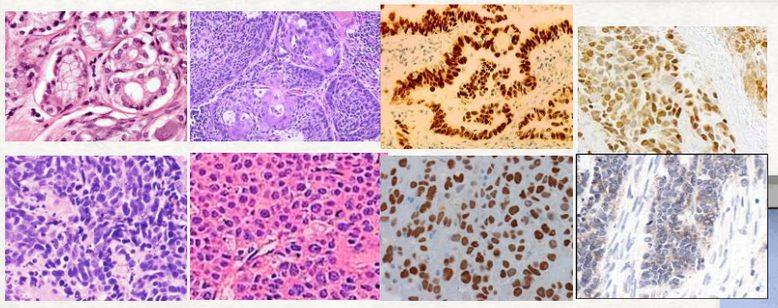


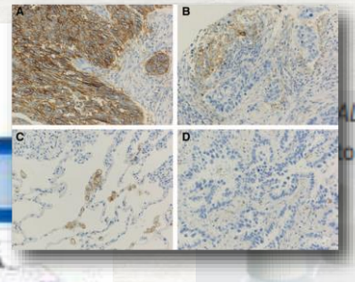
Immunohistochemistry of MDM2



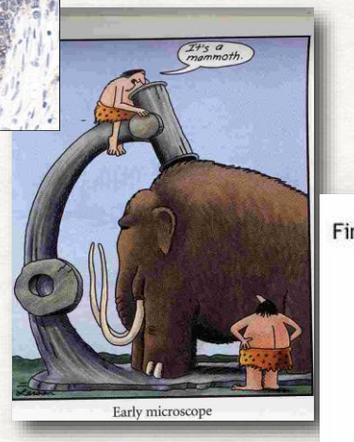
NGS or FISH analysis of amplification of MDM2 gene.

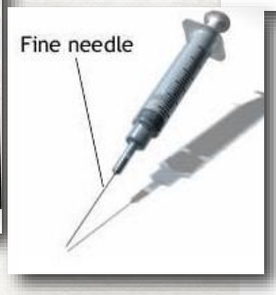
Mutation	Changed protein
Translocation	Absence of protein
Deletion	Abnormal localisation
Amplification	Over expression
Methylation	Fussion protein





ALK, *RET*, *ROS1*, and *NTRK1* fusion transcripts, in addition to targets designed
to detect 5' and 3' *ALK* gene expression
ALK, *DDR2*, *CTNNB1*, *MET*, *TP53*, *SMAD4*, *FBXW7*, *FGFR3*, *NOTCH1*, *ERBB4*, *FGFR1*, *FGFR2*





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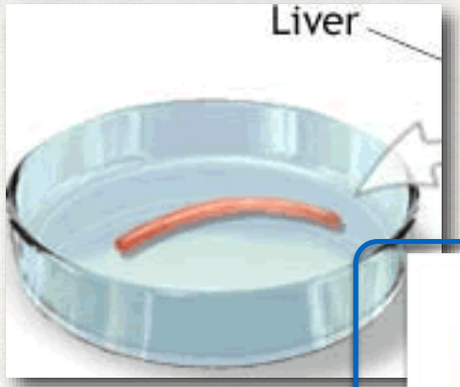
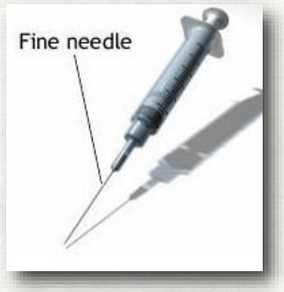
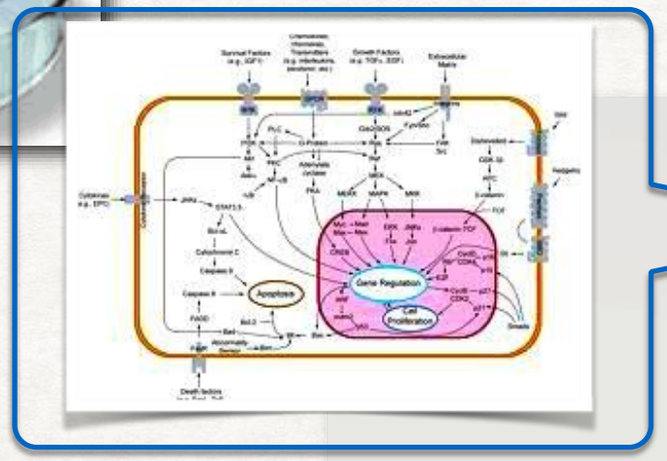
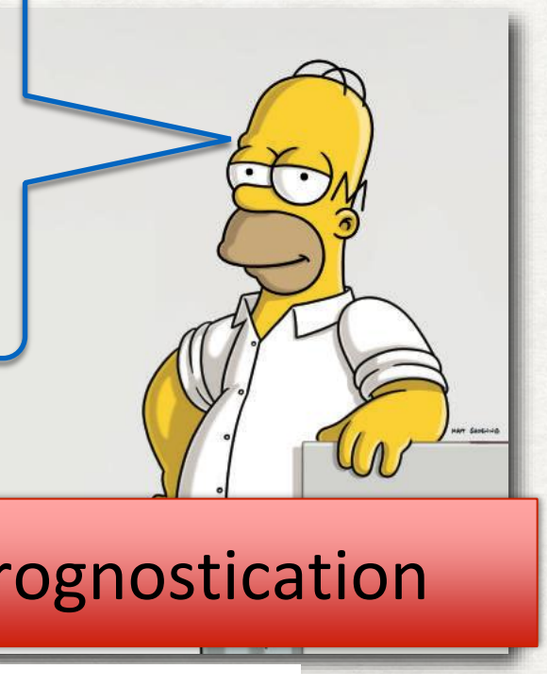
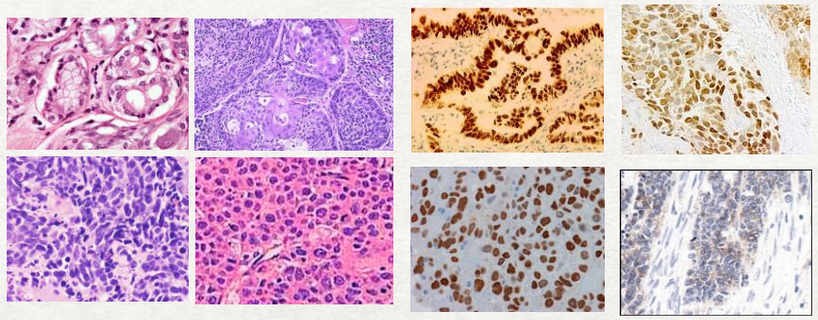


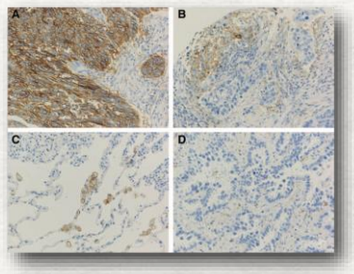






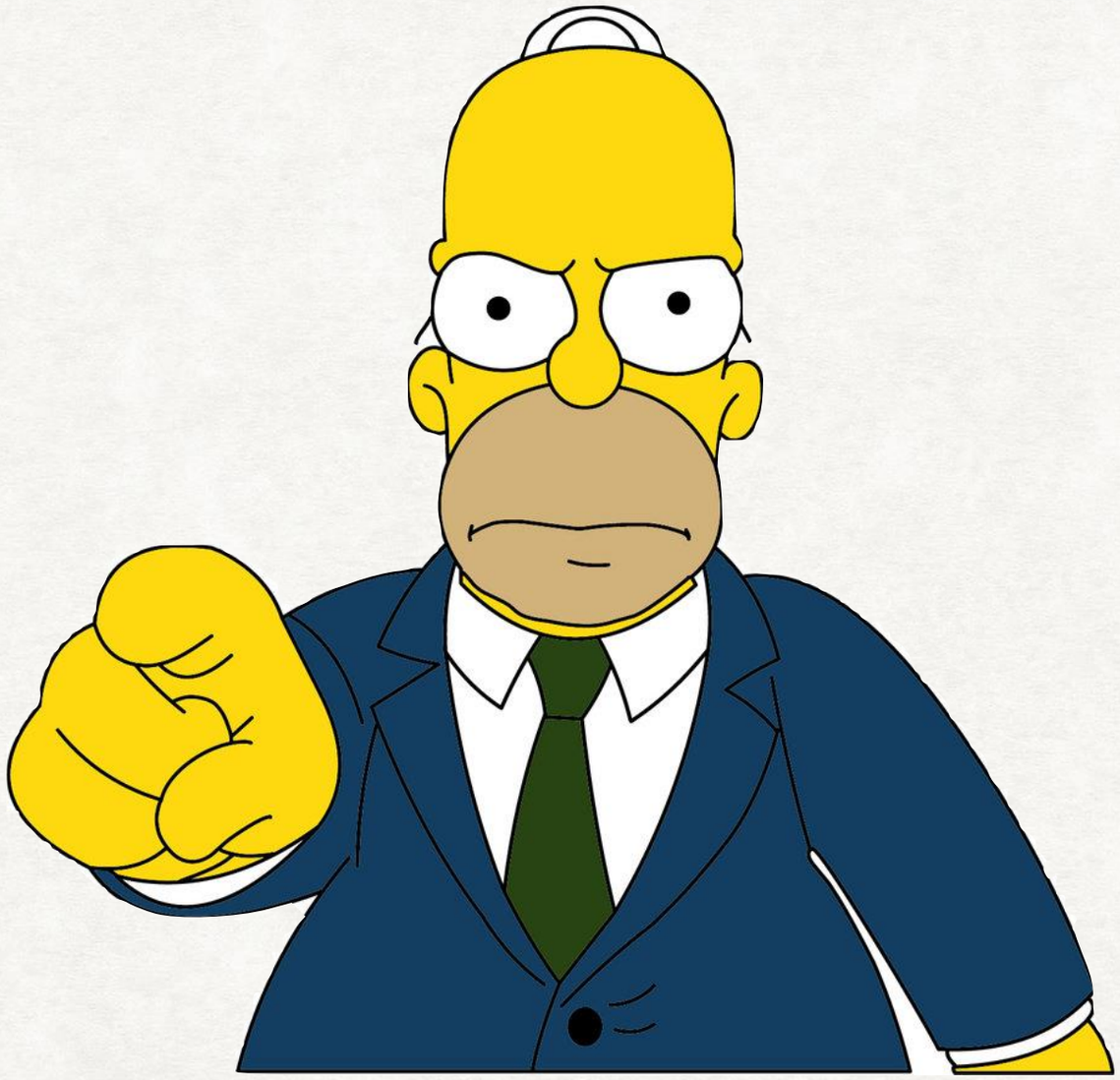
Diagnosis	Prediction	Prognostication



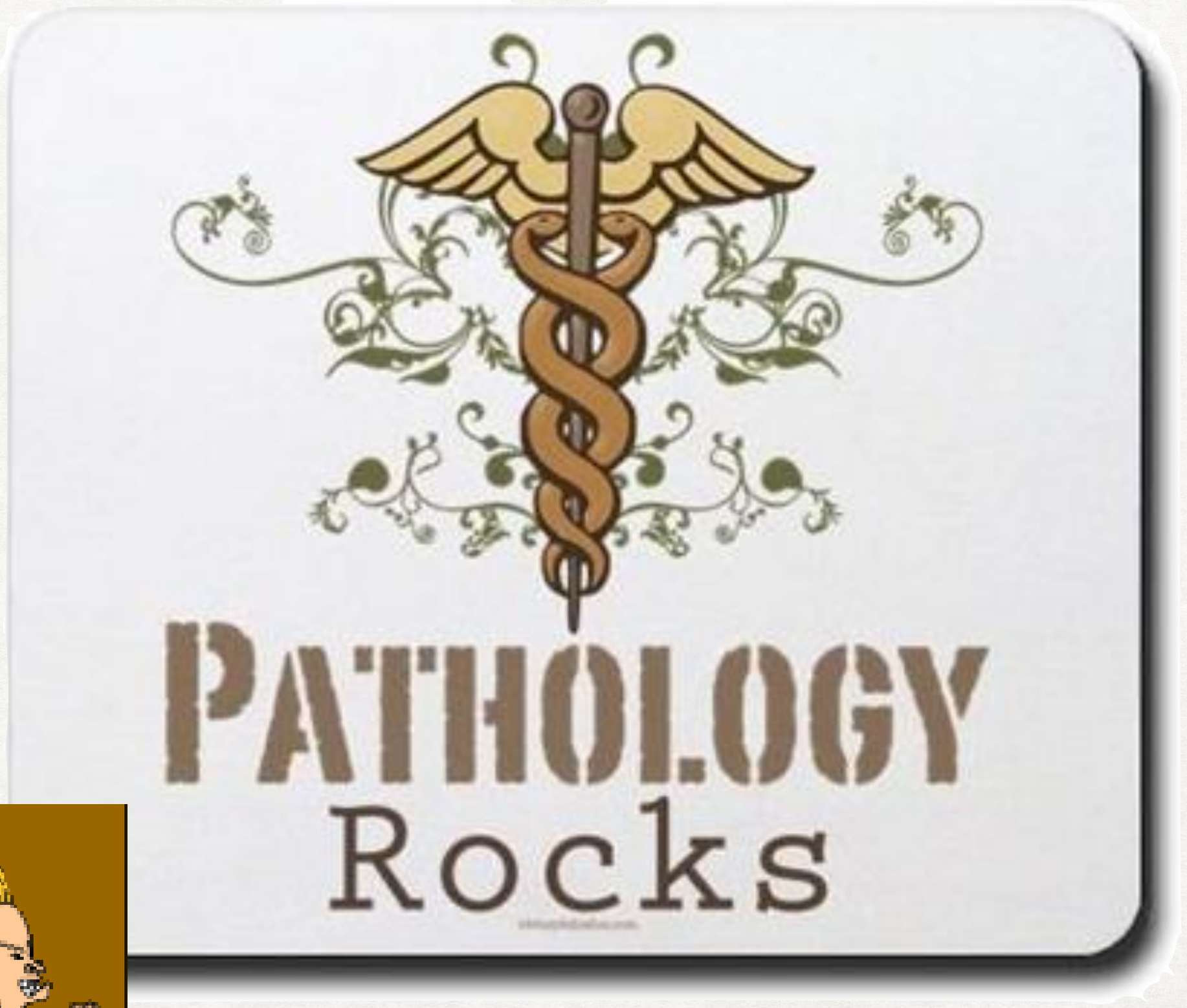


ALK, *RET*, *ROS1*, and *NTRK1* fusion transcripts, in addition to targets designed to detect 5' and 3' *ALK* gene expression

KRAS, *EGFR*, *BRAF*, *PIK3CA*, *AKT1*, *ERBB2*, *PTEN*, *NRAS*, *STK11*, *MAP2K1*, *ALK*, *DDR2*, *CTNNB1*, *MET*, *TP53*, *SMAD4*, *FBX7*, *FGFR3*, *NOTCH1*, *ERBB4*, *FGFR1*, *FGFR2*



Take home message


PATHOLOGY
Rocks