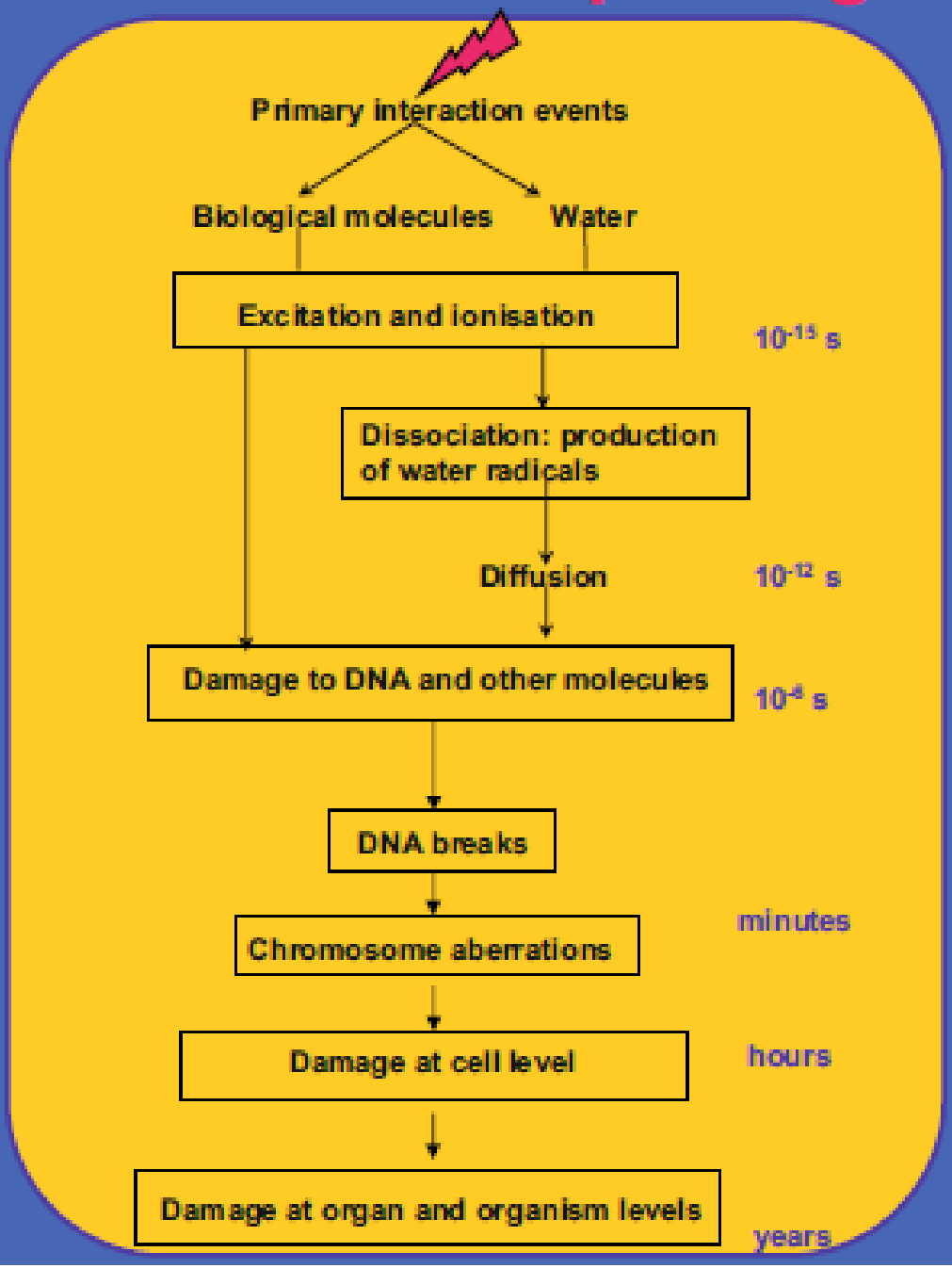
Sugárzás és élő anyag kölcsönhatása

The "standard" paradigm

1 Gy γ-rays in one nucleus:



≈ 100,000 ionizations (≈ 2,000 in the DNA)

≈ 40 DNA DSBs, ≈1 "complex lesion"

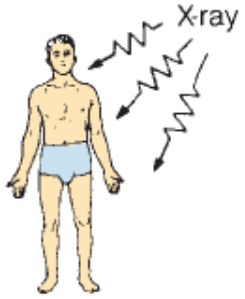
≈ 0.5-1 chromosome aberrations

≈ 0.5-1 lethal lesions
≈ 10^{-3} HPRT mutations
≈ 10^{-5} neoplastic transformations

<< 10^{-5} cancers

Müller, M., Durante, M., Stöcker, H., Merz, F. & Bechmann, I. Modeling radiation effects at the tissue level. *Eur Phys J D* **60**, 171–176 (201 0).(graphics kindly provided by Dr. Andrea Ottolenghi, University of Pavia, Italy)

Total-Body Irradiation



Mass = 70 kg
$LD_{50/60}$ = 4 Gy
Energy absorbed =

$$70 \times 4 = 280 \text{ joules}$$
$$= \frac{280}{4.18} = 67 \text{ calories}$$

A

Drinking Hot Coffee

Excess temperature (°C) = 60° − 37° = 23°
Volume of coffee consumed to equal the energy in the $LD_{50/60}$ = $\frac{67}{23}$
= 3 mL
= 1 sip

B

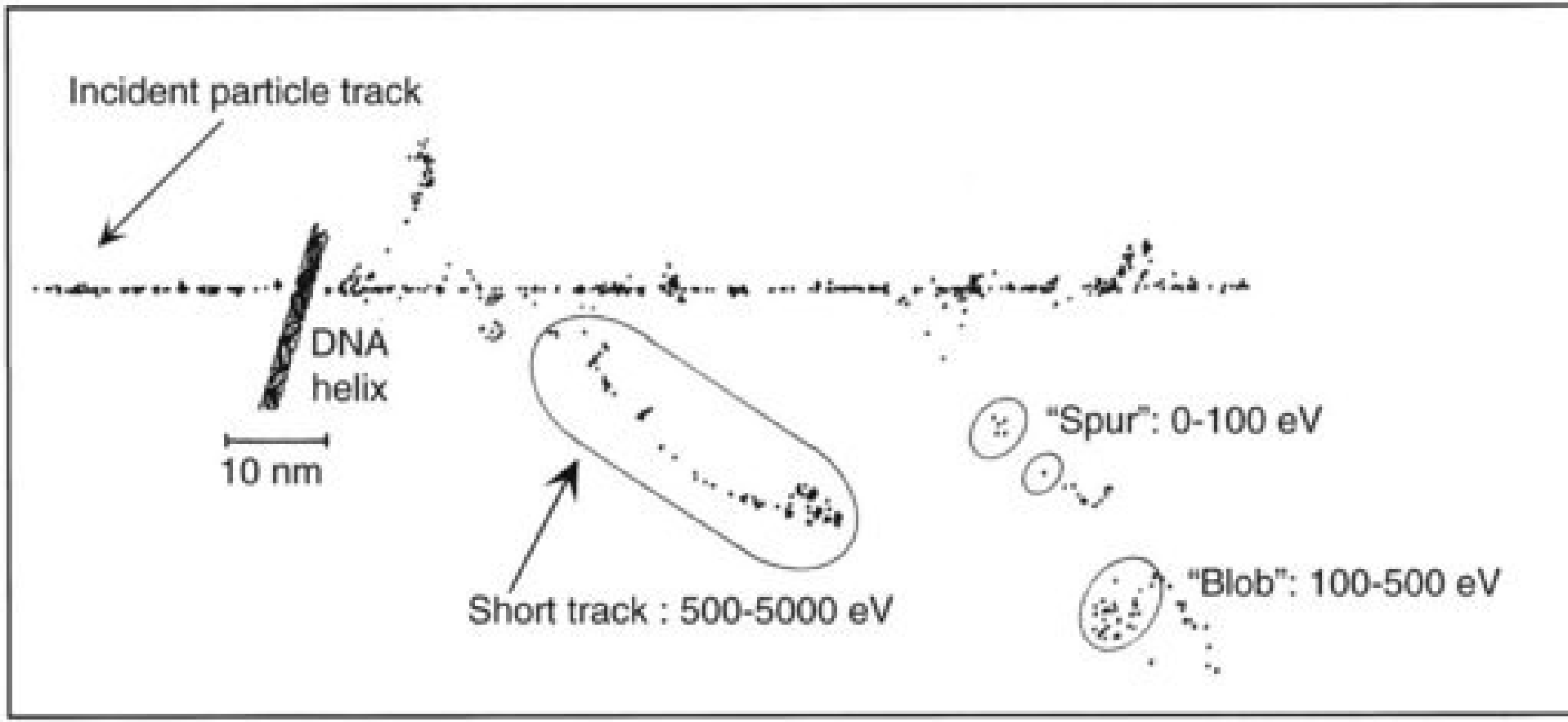
Mechanical Energy: Lifting a Person

Mass = 70 kg
Height lifted to equal the energy in the

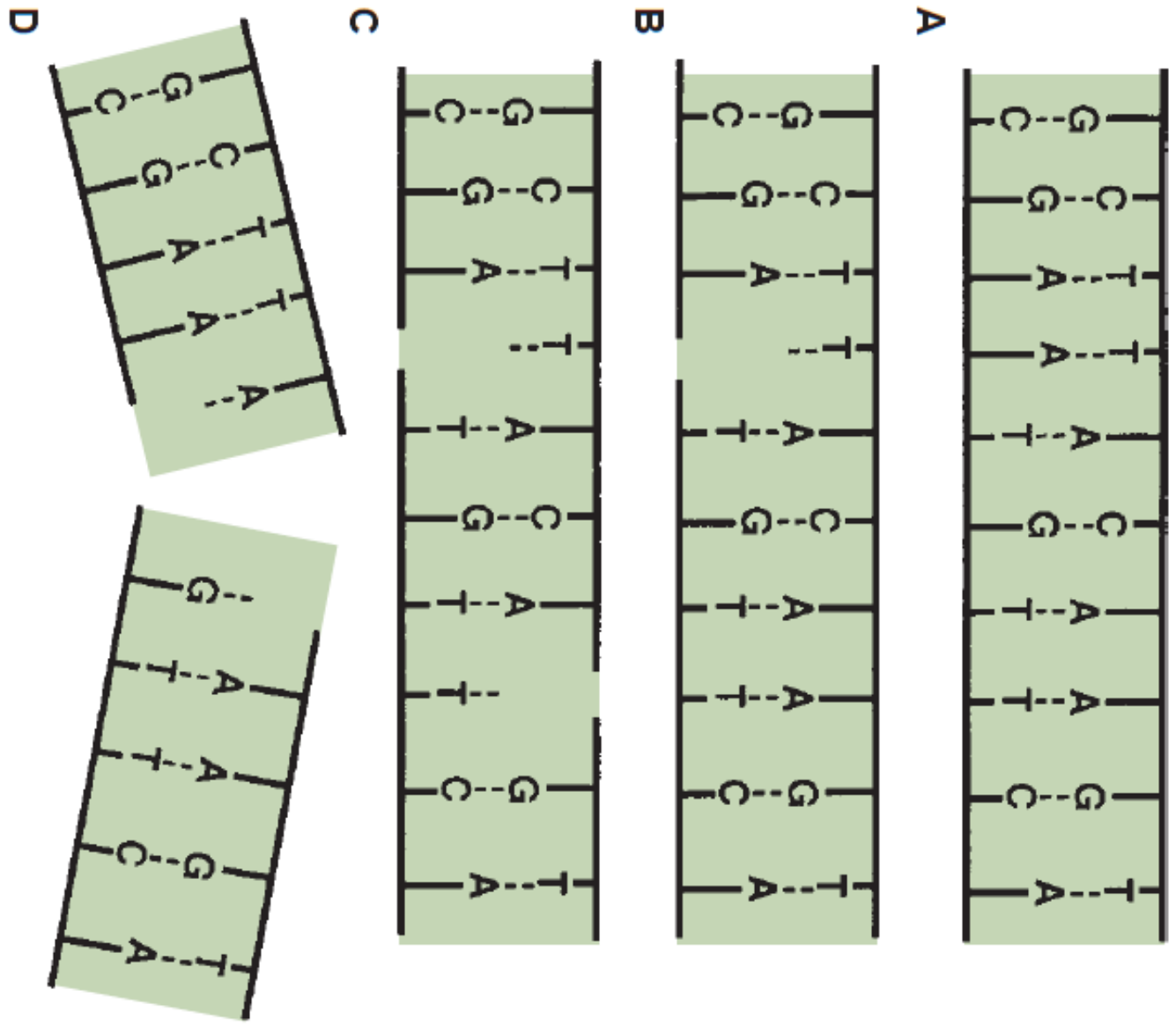
$$LD_{50/60} = \frac{280}{70 \times 9.81}$$
$$= 0.4 \text{ m (16 inches)}$$

C

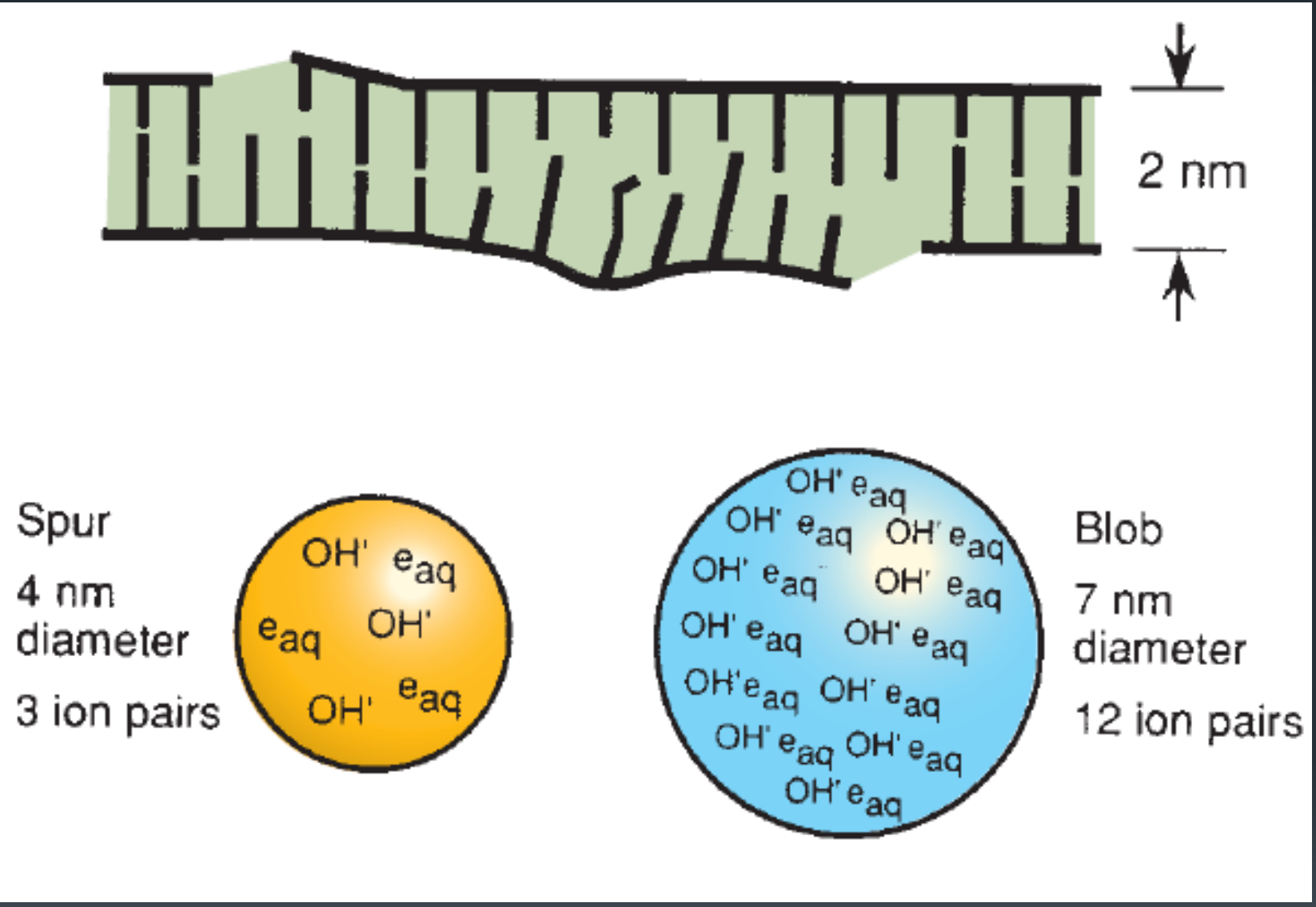
Hall, E. J. & Giaccia, A. J. *Radiobiology for the radiologist.* (Wolters Kluwer Health/Lippincott Williams & Wilkins, 2012). Figure 1.4



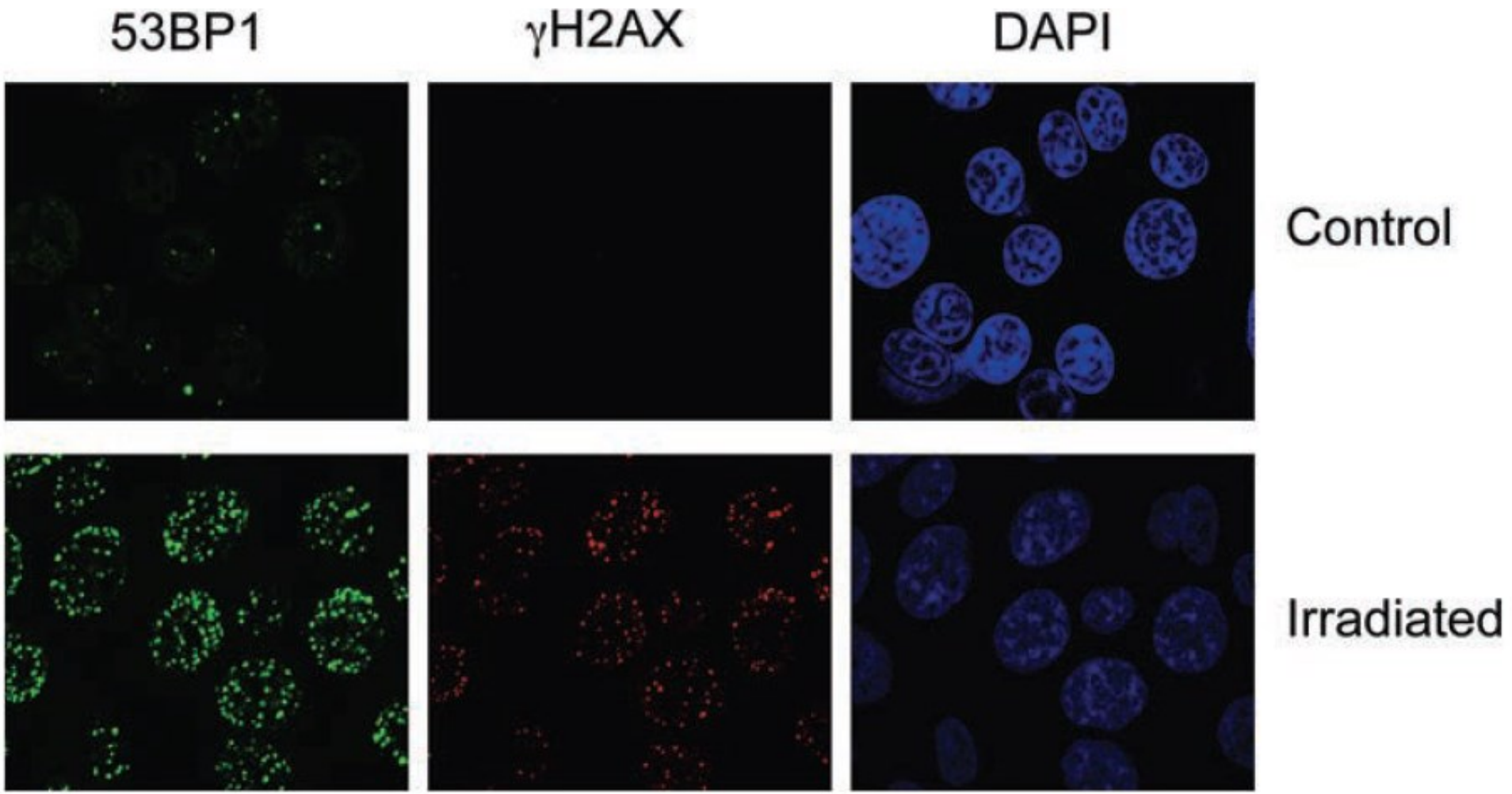
Hall, E. J. & Giaccia, A. J. *Radiobiology for the radiologist*. (Wolters Kluwer Health/Lippincott Williams & Wilkins, 2012). ???
Adapted from Goodhead D: Physics of radiation action: microscopic features that determine biological consequences. In Hagen U, Harder D, Jung H, et al, editors: Radiation research 1895-1995, proceedings of the 10th international congress of radiation research, vol. 2. congress lectures, *Wurzburg, 1995, Universitatsdruckerei H Sturtz, p 43.*



Hall, E. J. & Giaccia, A. J. *Radiobiology for the radiologist*. (Wolters Kluwer Health/Lippincott Williams & Wilkins, 2012). Figure 2-2. p 13 (Courtesy of Dr. John Ward.)

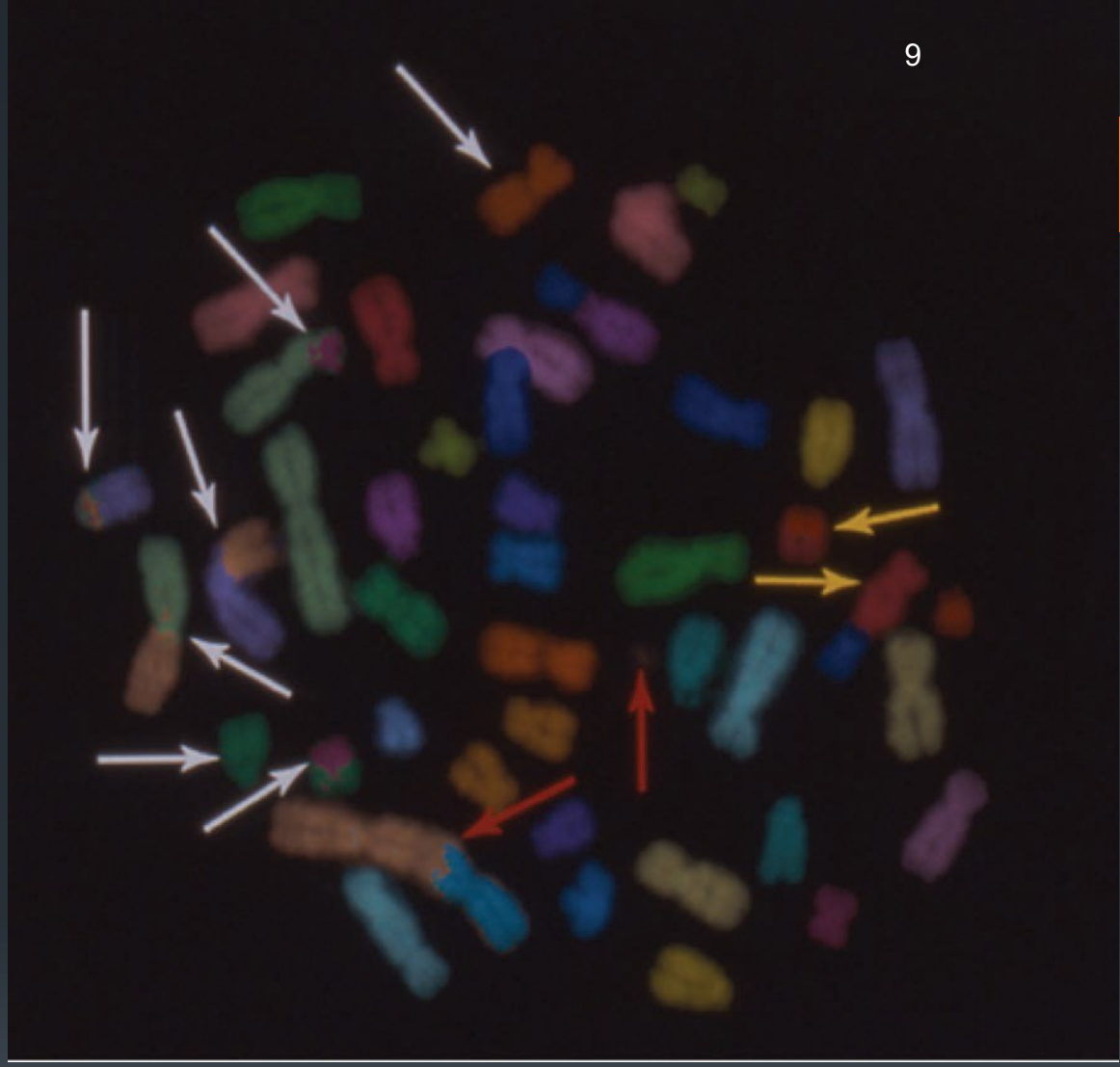


Hall, E. J. & Giaccia, A. J. *Radiobiology for the radiologist*. (Wolters Kluwer Health/Lippincott Williams & Wilkins, 2012). Figure 2.3



Hall, E. J. & Giaccia, A. J. *Radiobiology for the radiologist*. (Wolters Kluwer Health/Lippincott Williams & Wilkins, 2012). Figure 2.5 (Courtesy of Dr. Ester Hammond)

Hall, E. J. & Giaccia, A. J. *Radiobiology for the radiologist*. (Wolters Kluwer Health/Lippincott Williams & Wilkins, 2012). Figure 2.15 (Courtesy of Drs. Brewen, Luippold,and Preston.)



Hall, E. J. & Giaccia, A. J. *Radiobiology for the radiologist*. (Wolters Kluwer Health/Lippincott Williams & Wilkins, 2012). Figure 2.18 (Courtesy of Dr. Michael Cornforth.)

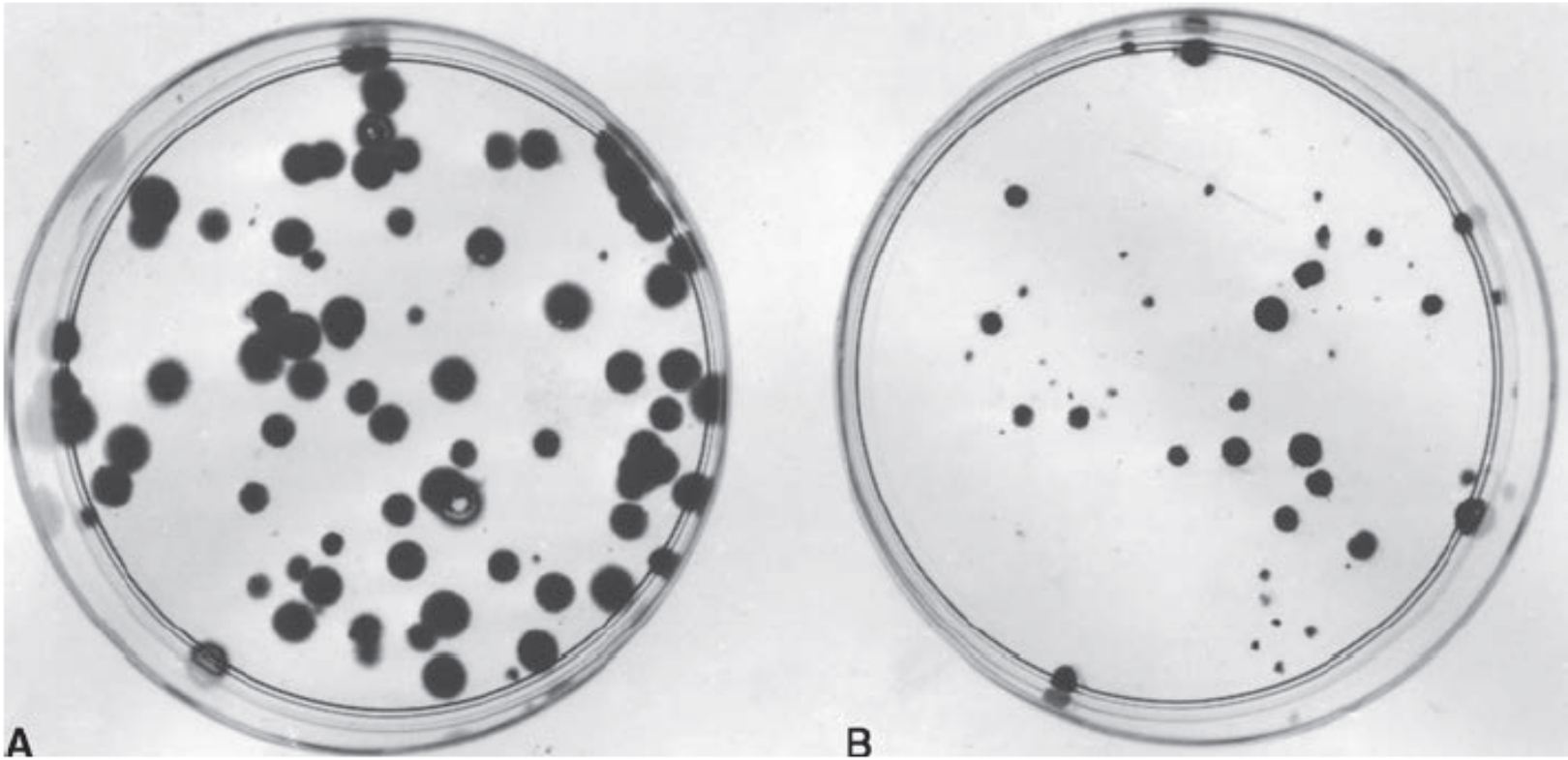
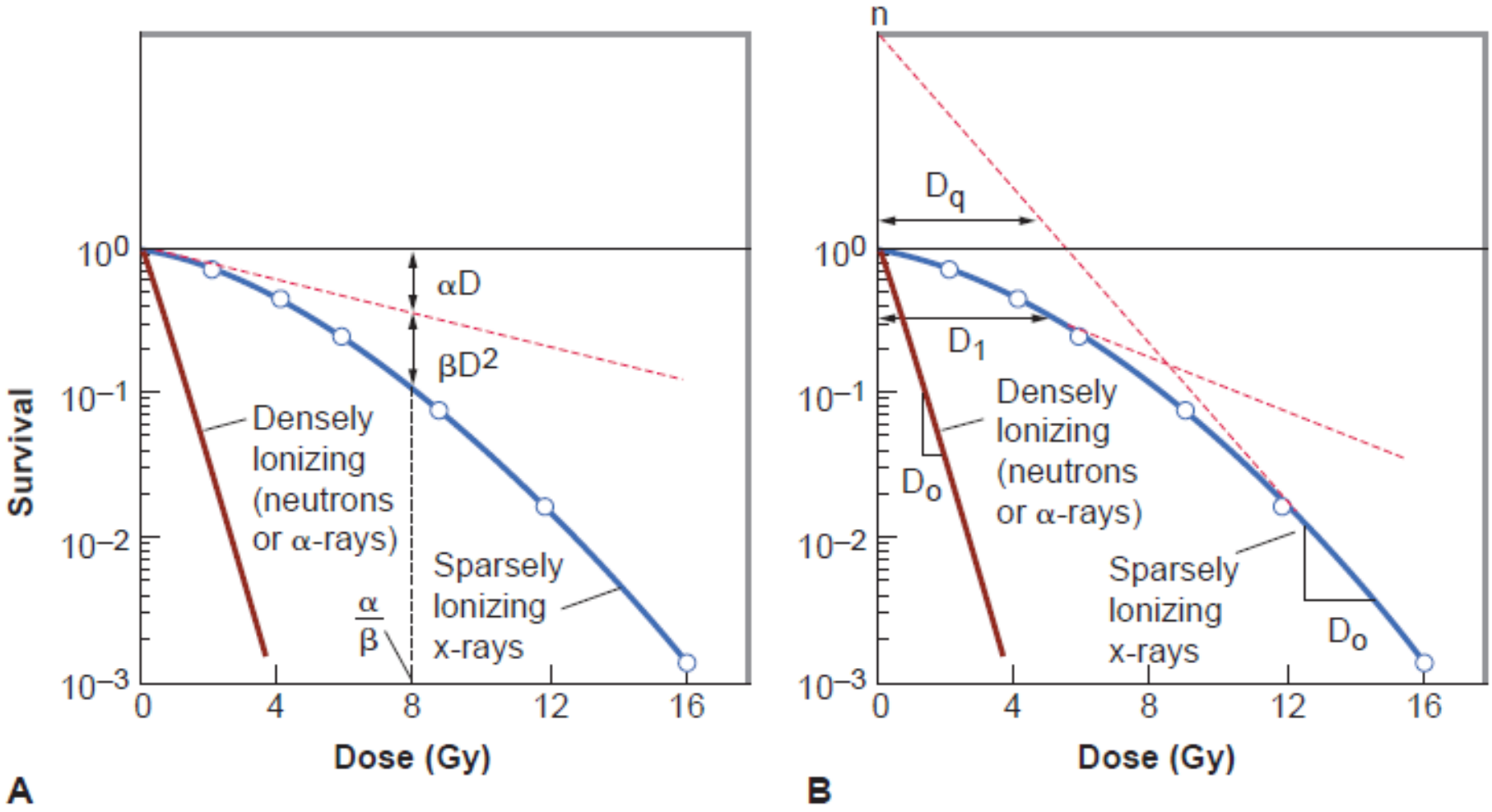


FIGURE 3.1 Colonies obtained with Chinese hamster cells cultured *in vitro*. **A:** In this unirradiated control dish, 100 cells were seeded and allowed to grow for 7 days before being stained. There are 70 colonies; therefore, the plating efficiency is 70/100 or 70%. **B:** Two thousand cells were seeded and then exposed to 8 Gy of x-rays. There are 32 colonies on the dish. Thus,

$$\begin{aligned}\text{Surviving fraction} &= \text{Colonies counted}/[\text{Cells seeded} \times (\text{PE}/100)] \\ &= 32/(2{,}000 \times 0.7) \\ &= 0.023\end{aligned}$$

Hall, E. J. & Giaccia, A. J. *Radiobiology for the radiologist*. (Wolters Kluwer Health/Lippincott Williams & Wilkins, 2012). Figure 3.1



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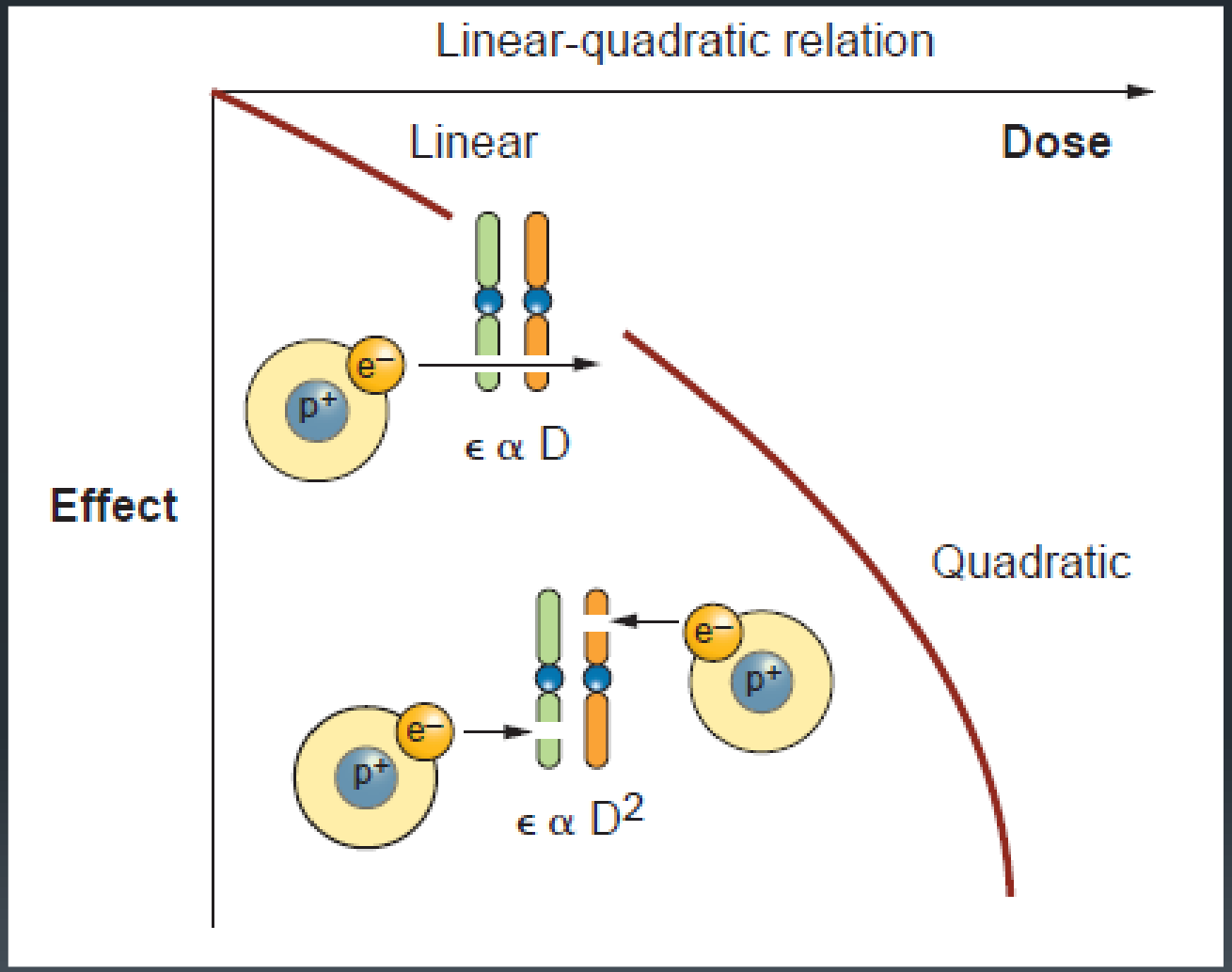

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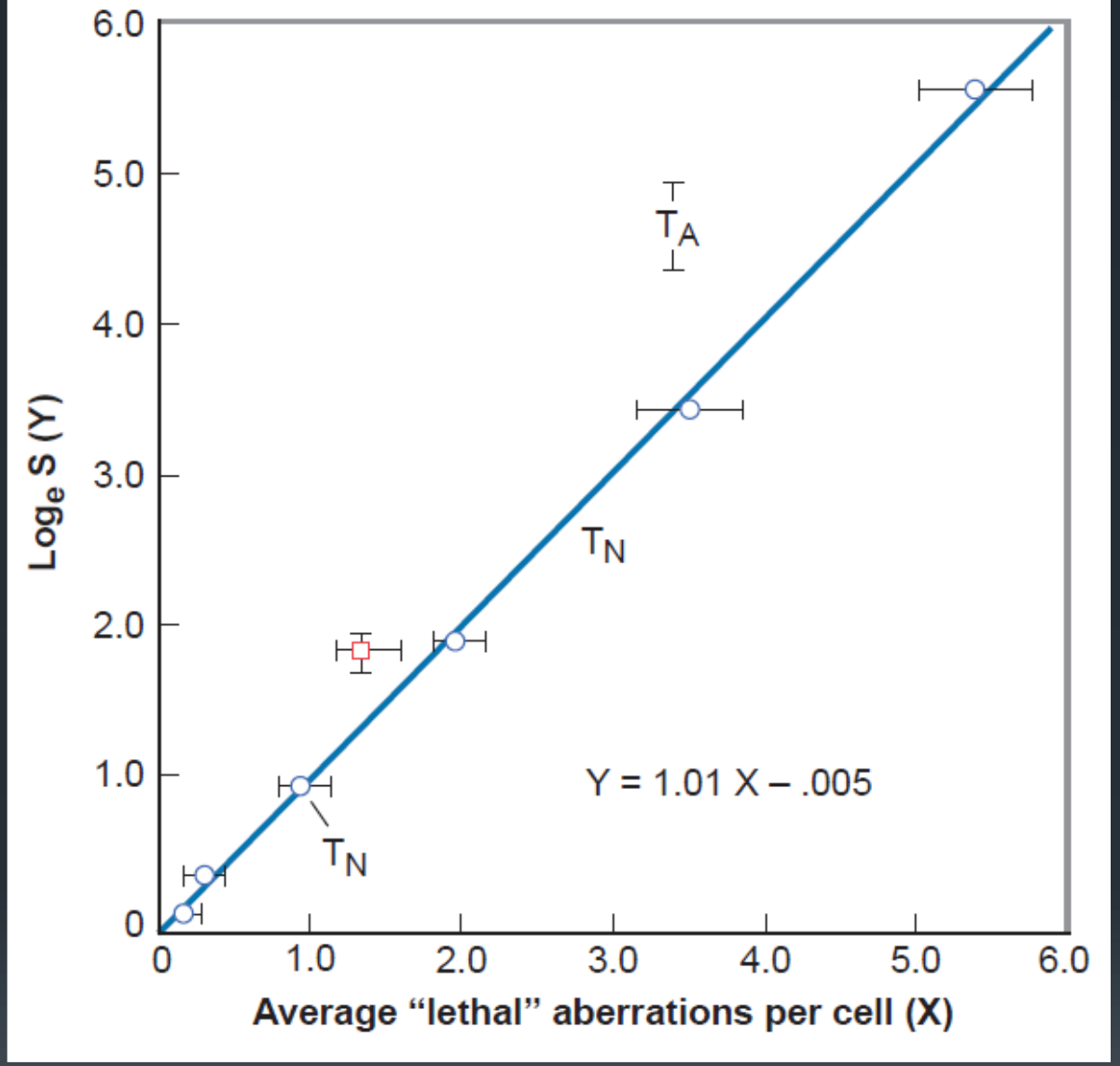
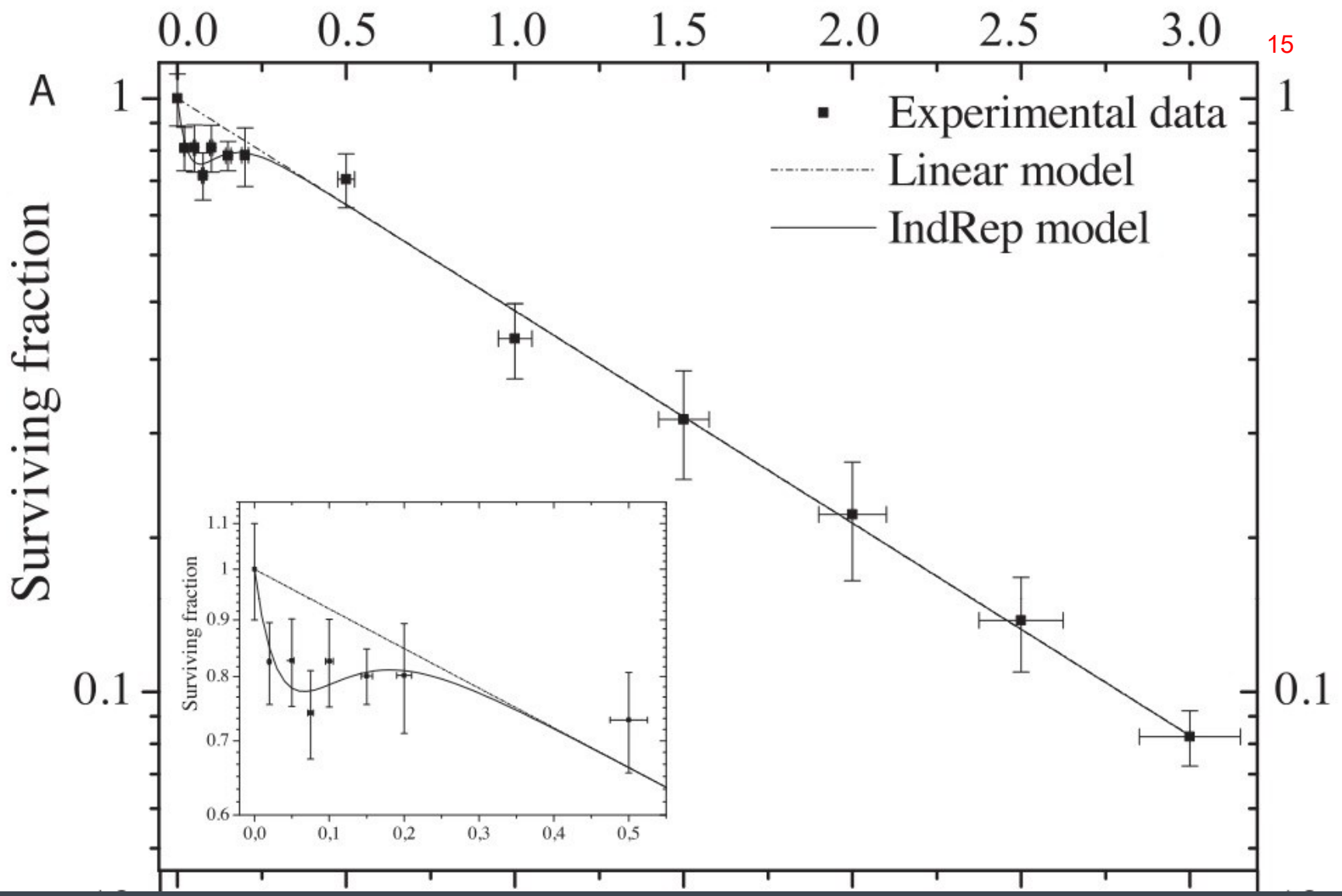


Hall, E. J. & Giaccia, A. J. *Radiobiology for the radiologist*. (Wolters Kluwer Health/Lippincott Williams & Wilkins, 2012). Figure 3.4 (From Cornforth MN, Bedford JS. A quantitative comparison of potentially lethal damage repair and the rejoining of interphase chromosome breaks in low passage normal human fi broblasts. *Radiat Res.* 1987;111:385–405, with permission.)



Wéra, Anne-Catherine, Anne-Catherine Heuskin, Hélène Riquier, Carine Michiels, and Stéphane Lucas. "Low-LET Proton Irradiation of A549 Non-Small Cell Lung Adenocarcinoma Cells: Dose Response and RBE Determination." *Radiation Research* 179, no. 3 (March 2013): 273–81. FIG 1.A

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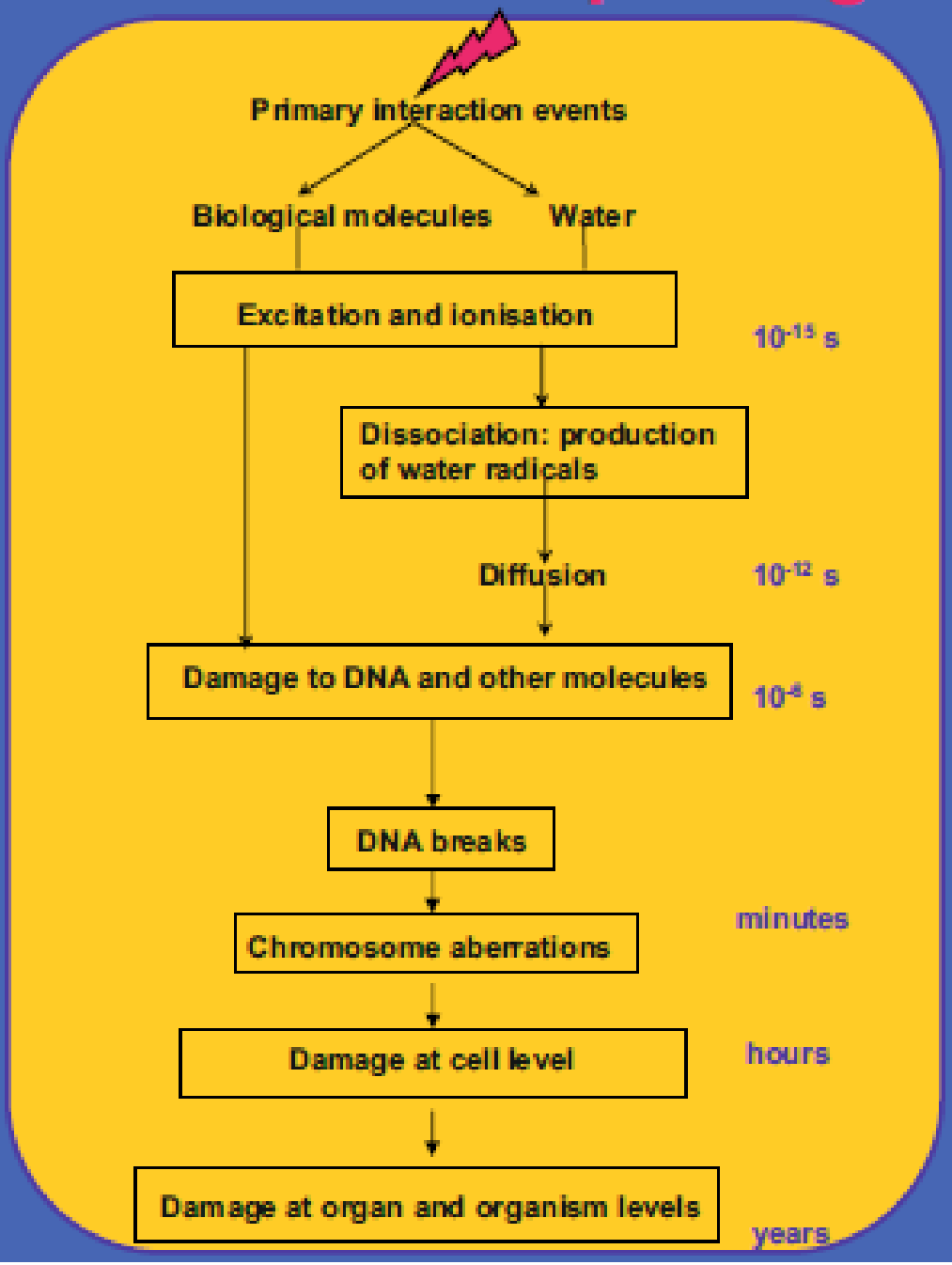

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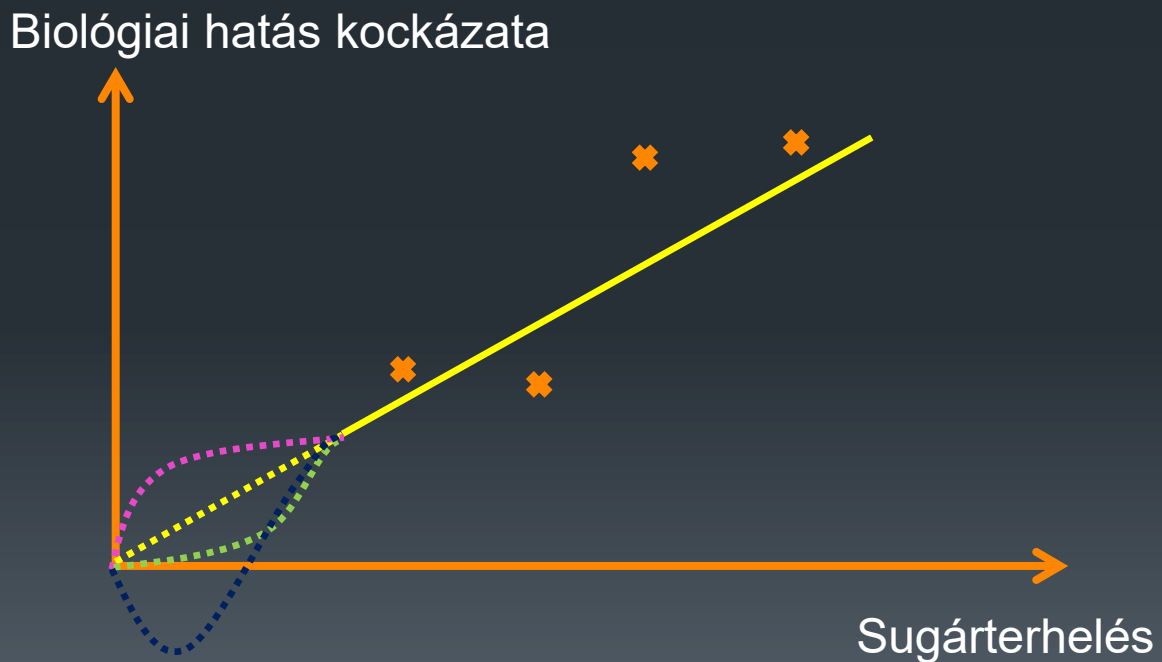
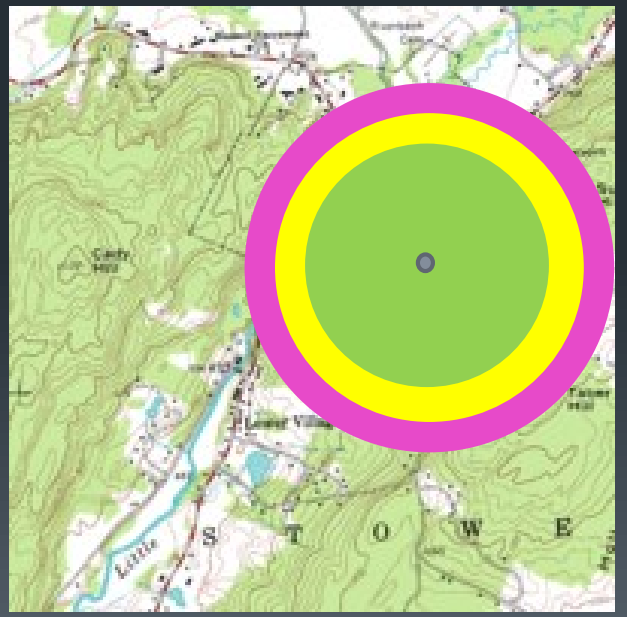
LNT-modell és jelentősége





Néhány optimalizációs kérdés

- Milyen gyakran végezzünk röntgen/CT-vizsgálatokat dohányzóknál?

- Hogyan tervezzünk meg egy besugárzást?
  - konvencionális sugárterápia
  - 3D-CRT
  - IMRT