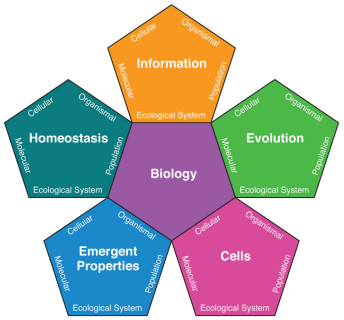
Integrating Concepts in Biology



PowerPoint Slides for Chapter 3:

Reproduction and Cell Division

3.3 How do prokaryotes communicate their identity to the next generation?

by A. Malcolm Campbell, Laurie J. Heyer, & Christopher Paradise

Biology Learning Objective

- Use diagrams to illustrate how prokaryotes reproduce through cellular fission.

Bio-Math Learning Objective

- Predict the distribution of cell volumes in a population of *E. coli* using a time-step model.

How Do Prokaryotes Replicate?

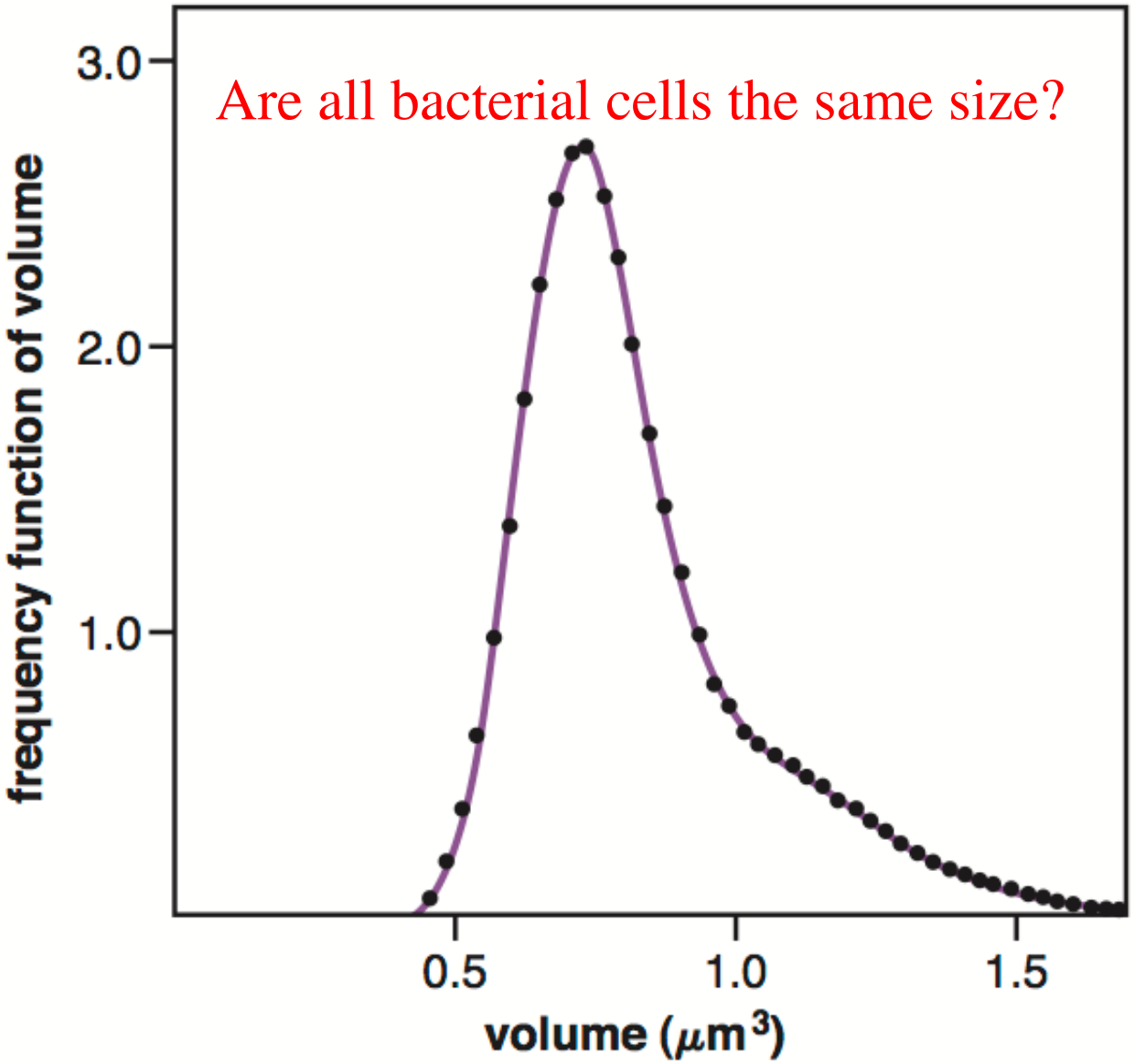


Fig. 3.15

modified from Harvey *et al.*, 1967

E. coli Cell Volumes

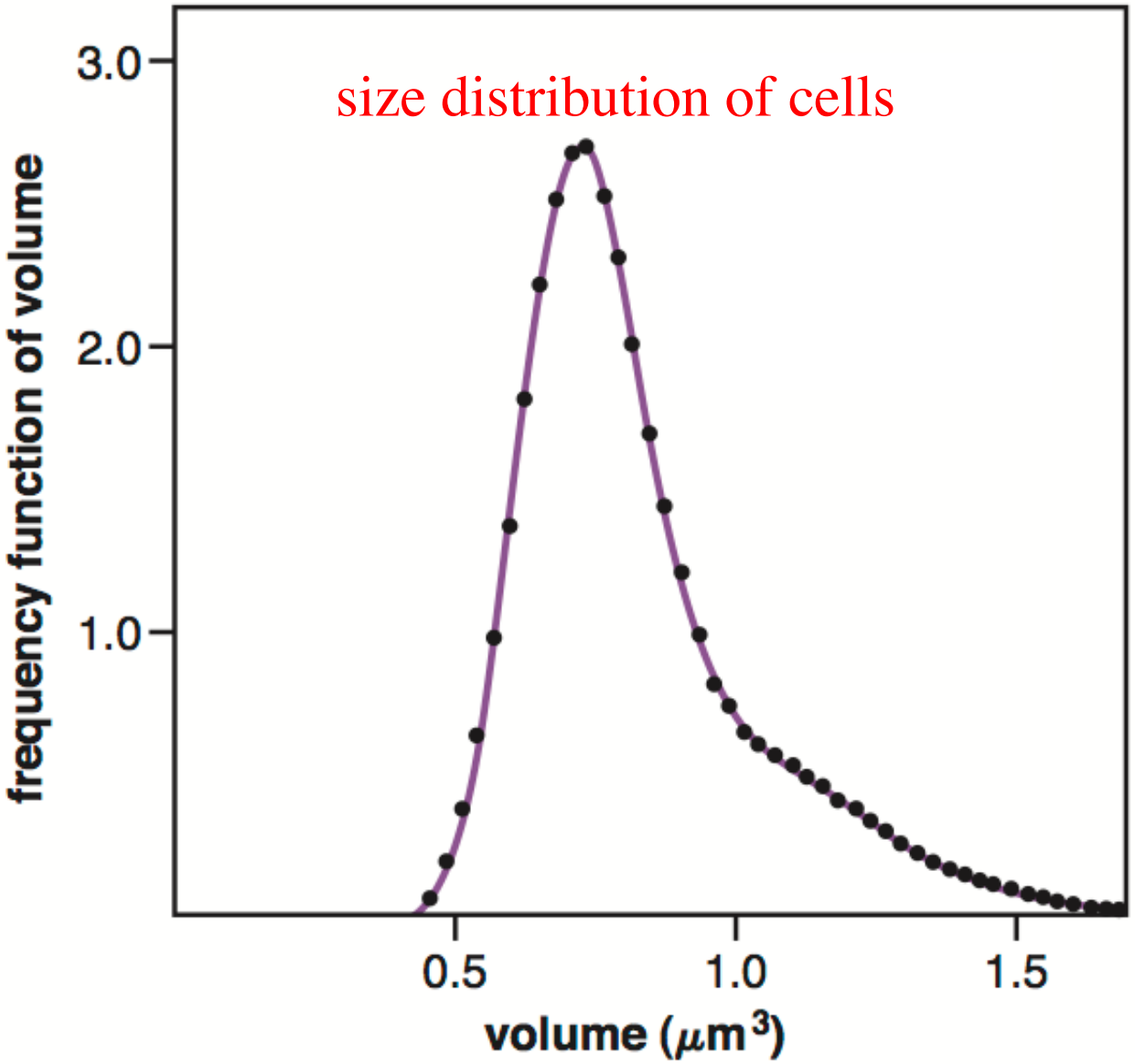


Fig. 3.15

modified from Harvey *et al.*, 1967

E. coli Cell Volumes

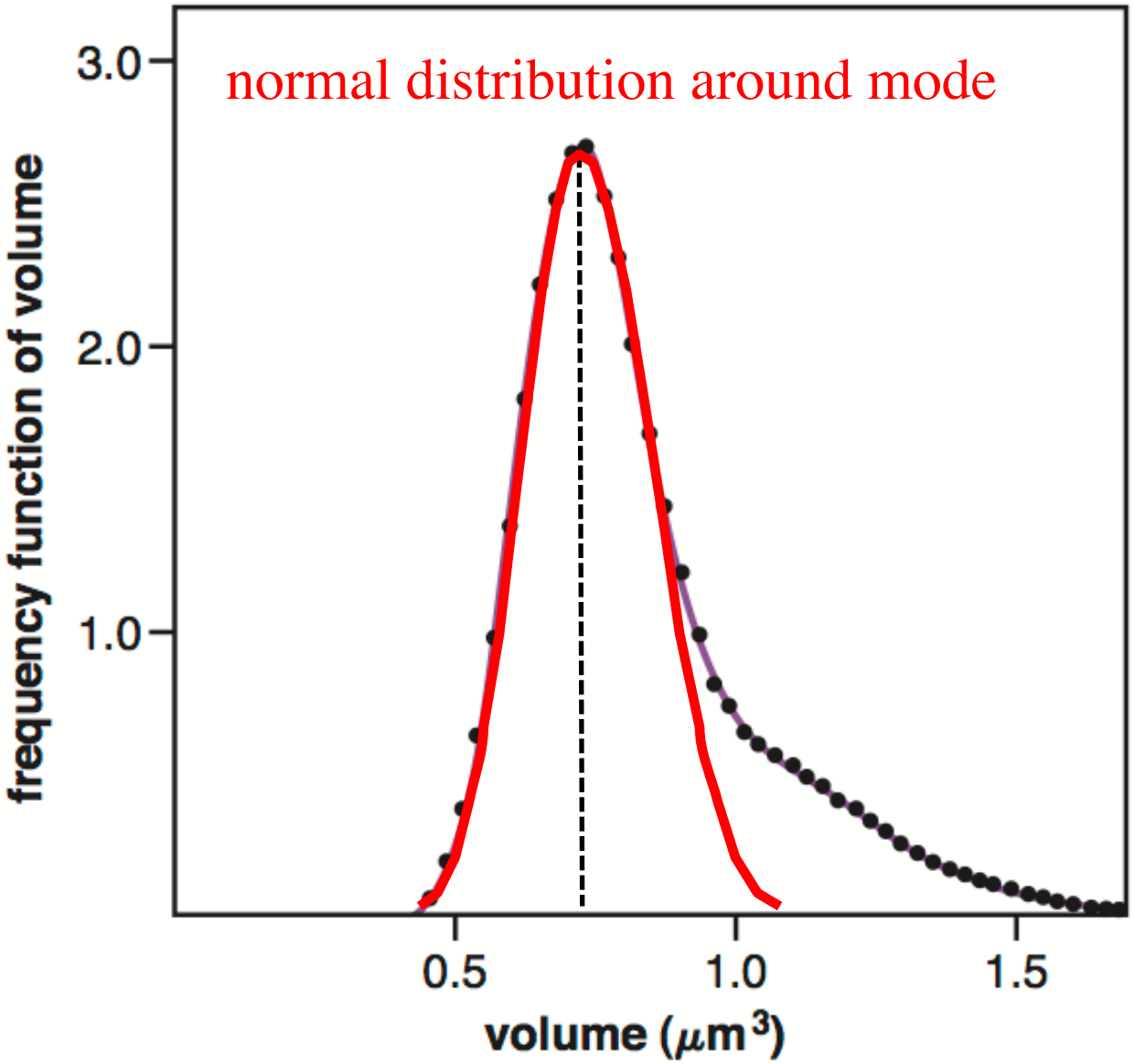


Fig. 3.15

modified from Harvey *et al.*, 1967

How Are Some Cells Much Bigger

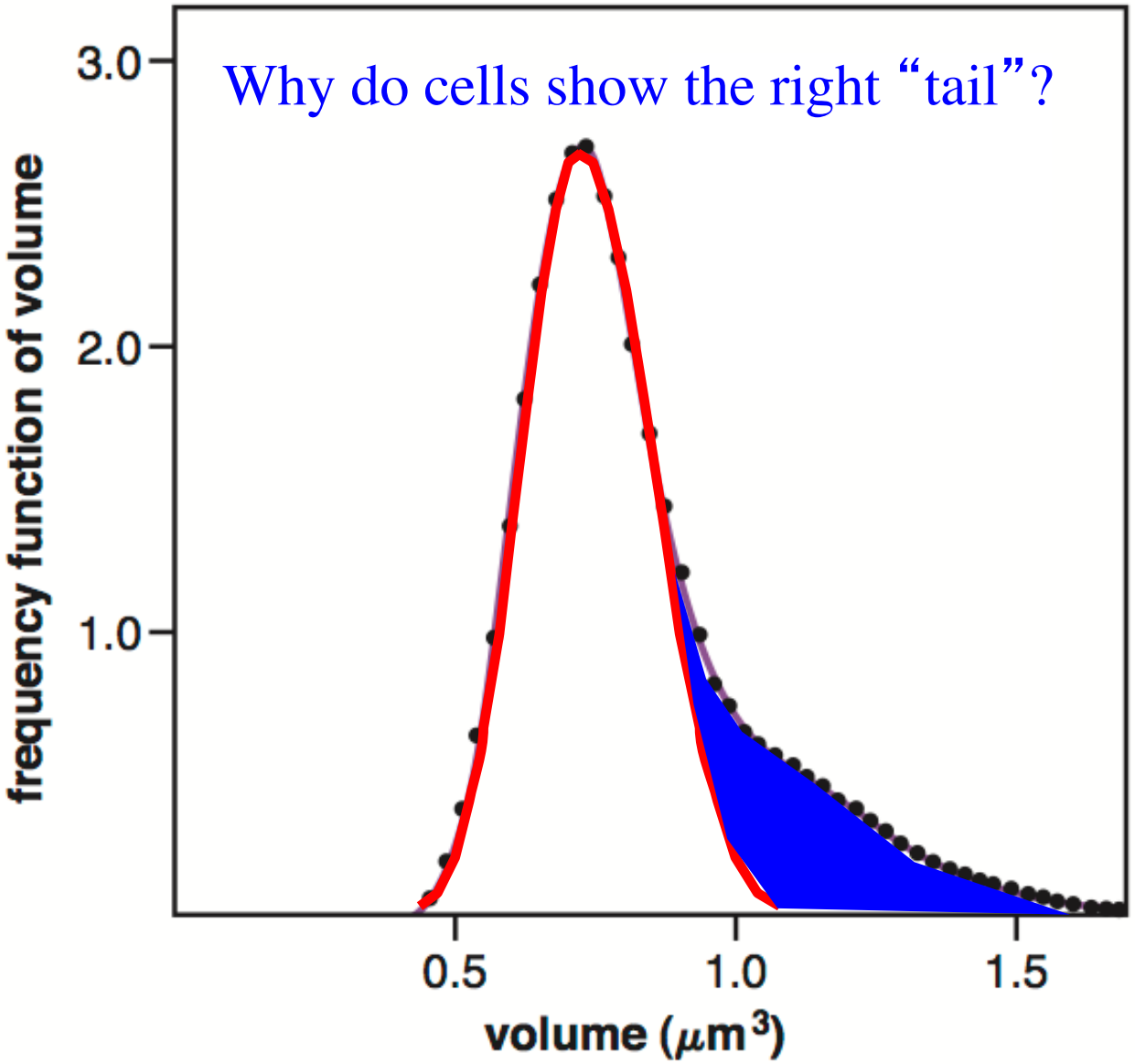


Fig. 3.15

modified from Harvey *et al.*, 1967

E. coli Cell Volumes

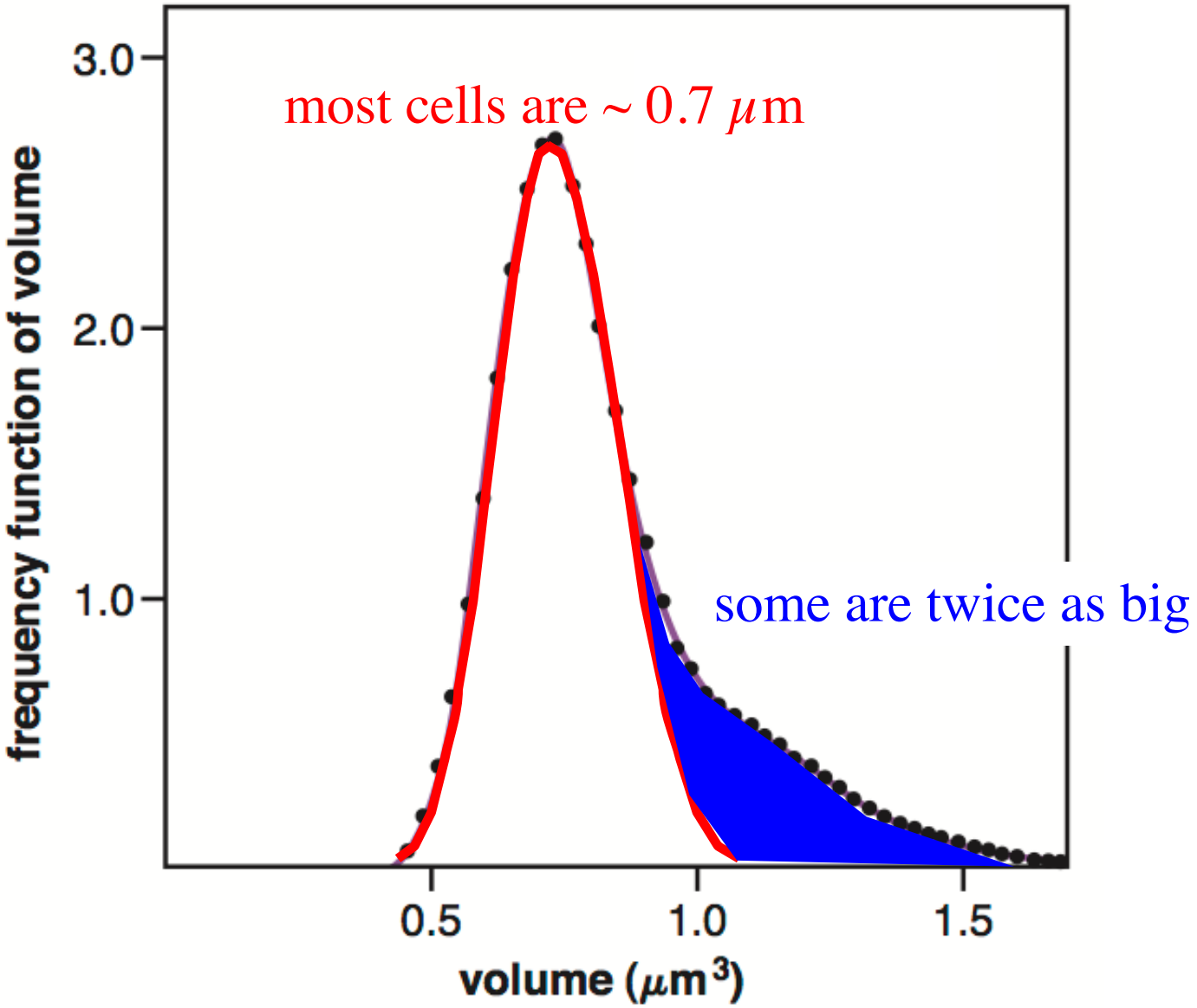


Fig. 3.15

modified from Harvey *et al.*, 1967

E. coli Cell Volumes

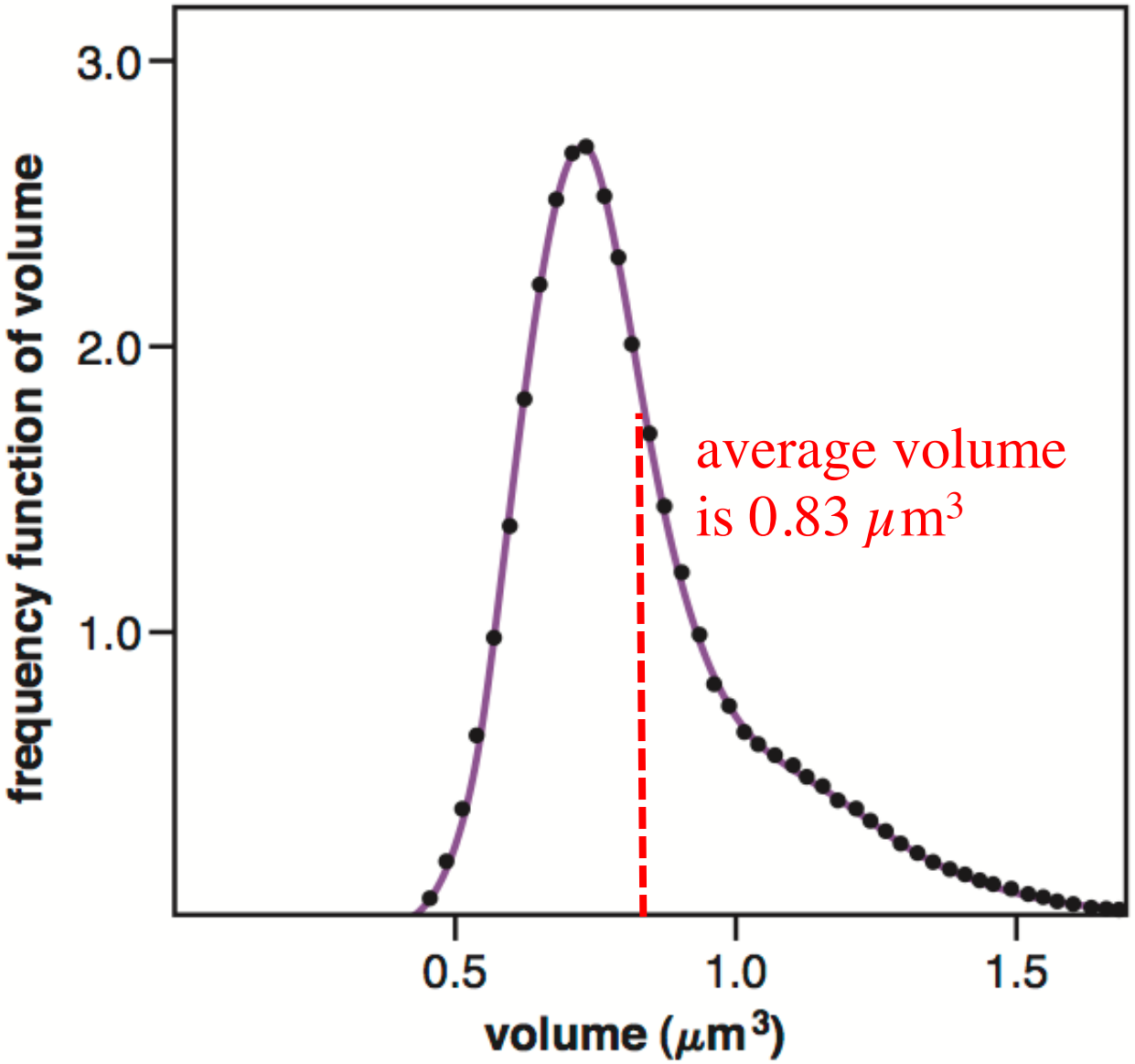


Fig. 3.15

modified from Harvey *et al.*, 1967

Is Growth Rate Genetically Set?

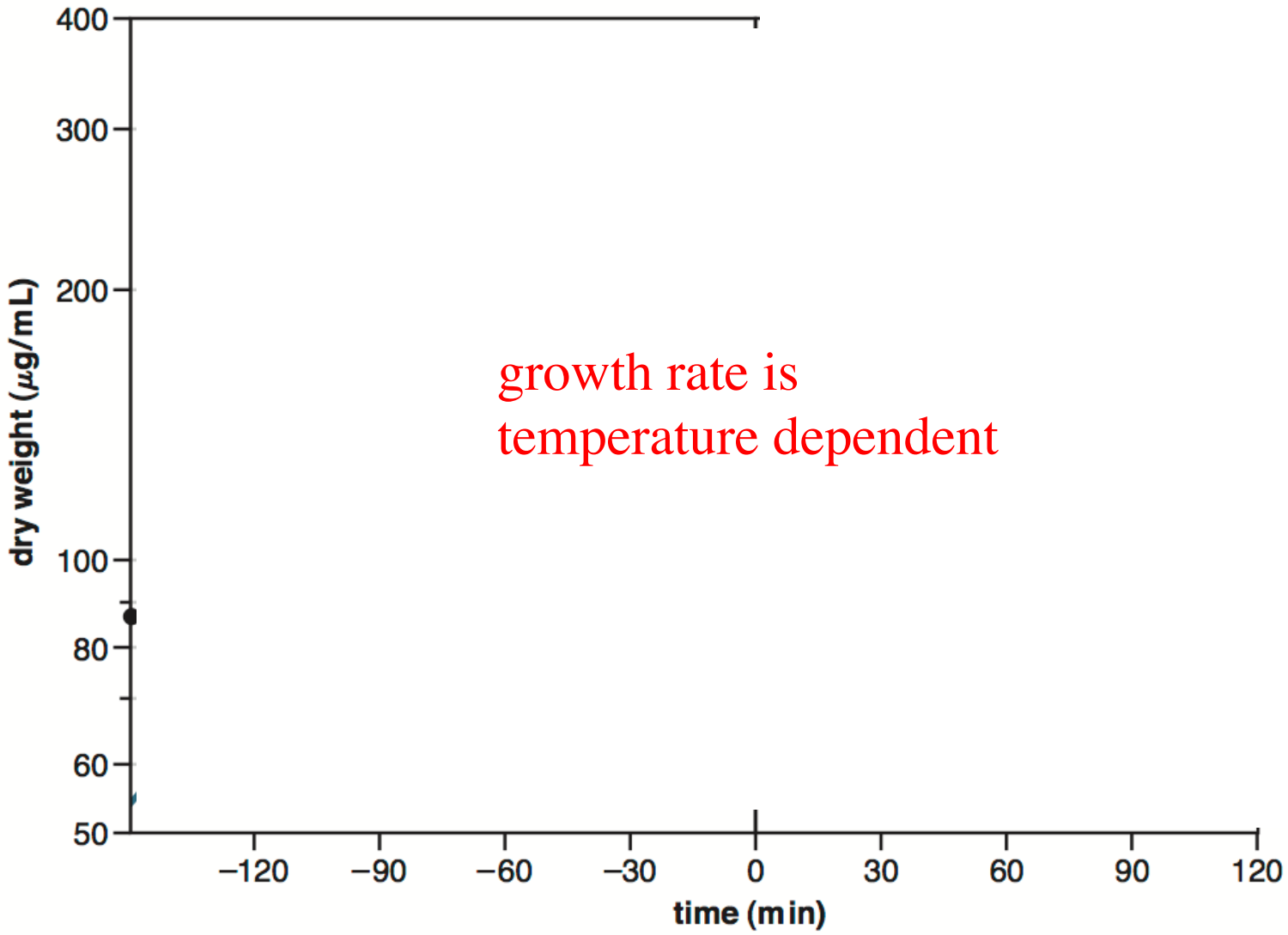
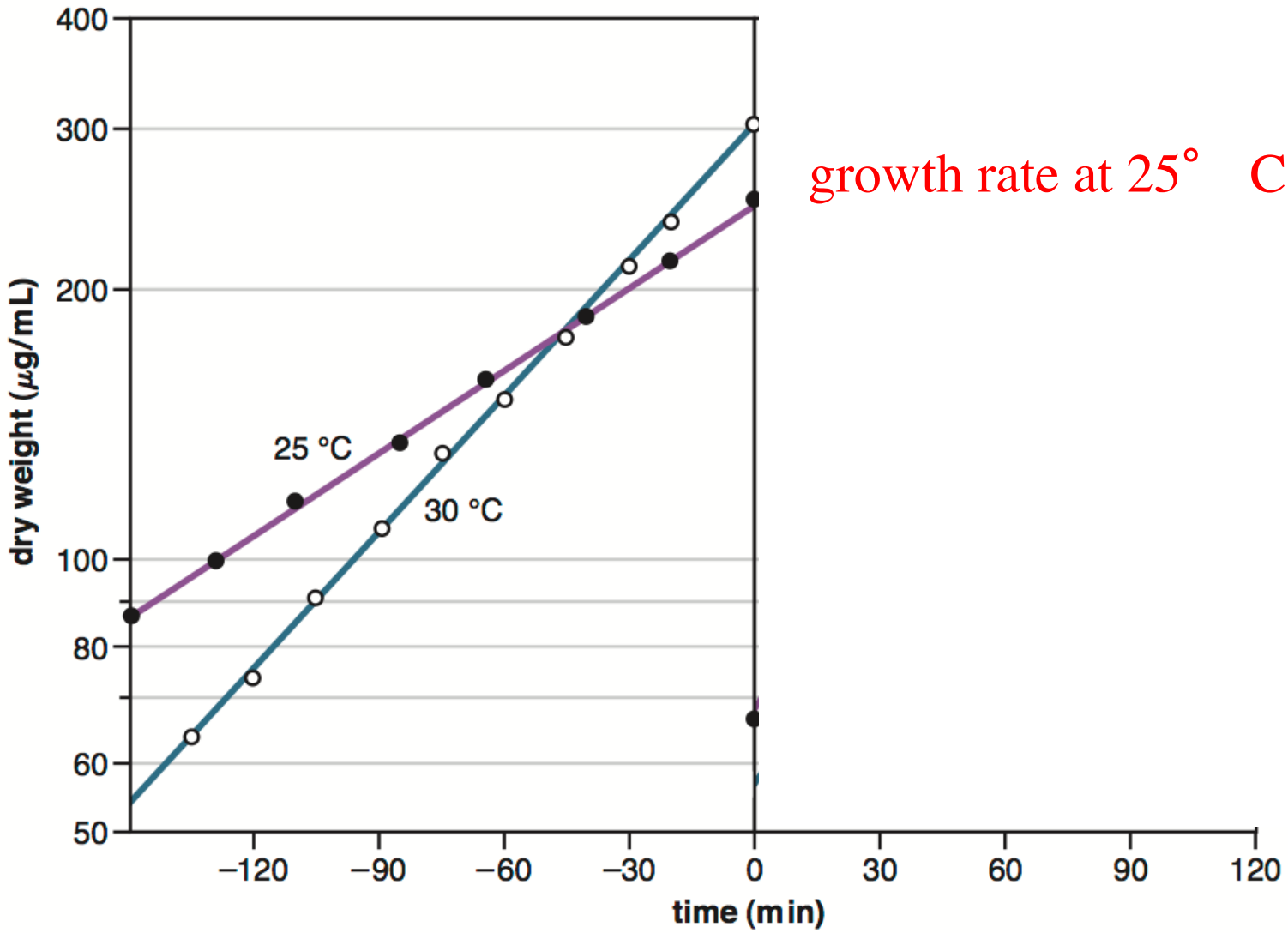


Fig. 3.16

modified from Ng *et al.*, 1962

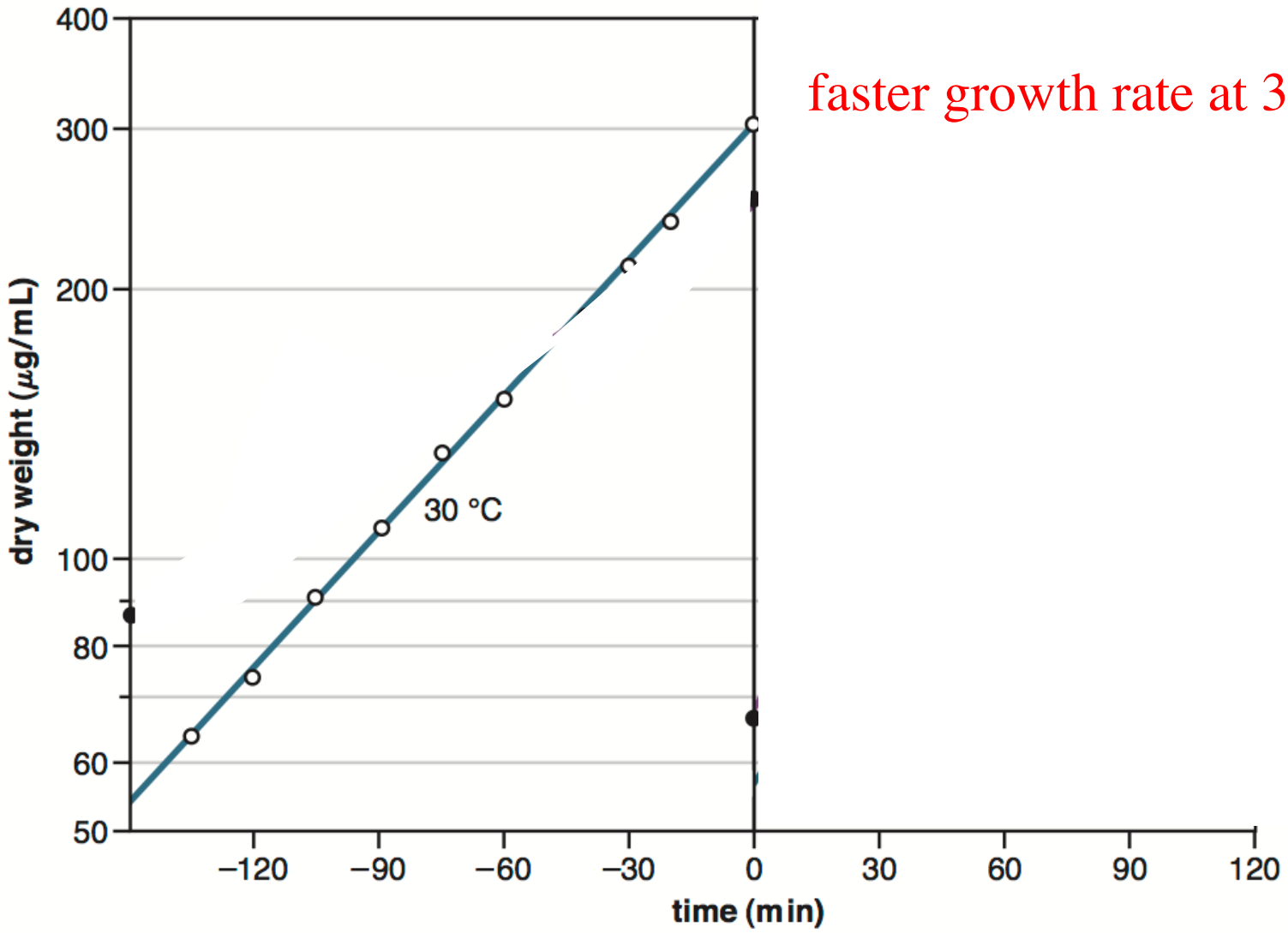
Temperature Affects Cell Growth



growth rate at 25° C

Fig. 3.16

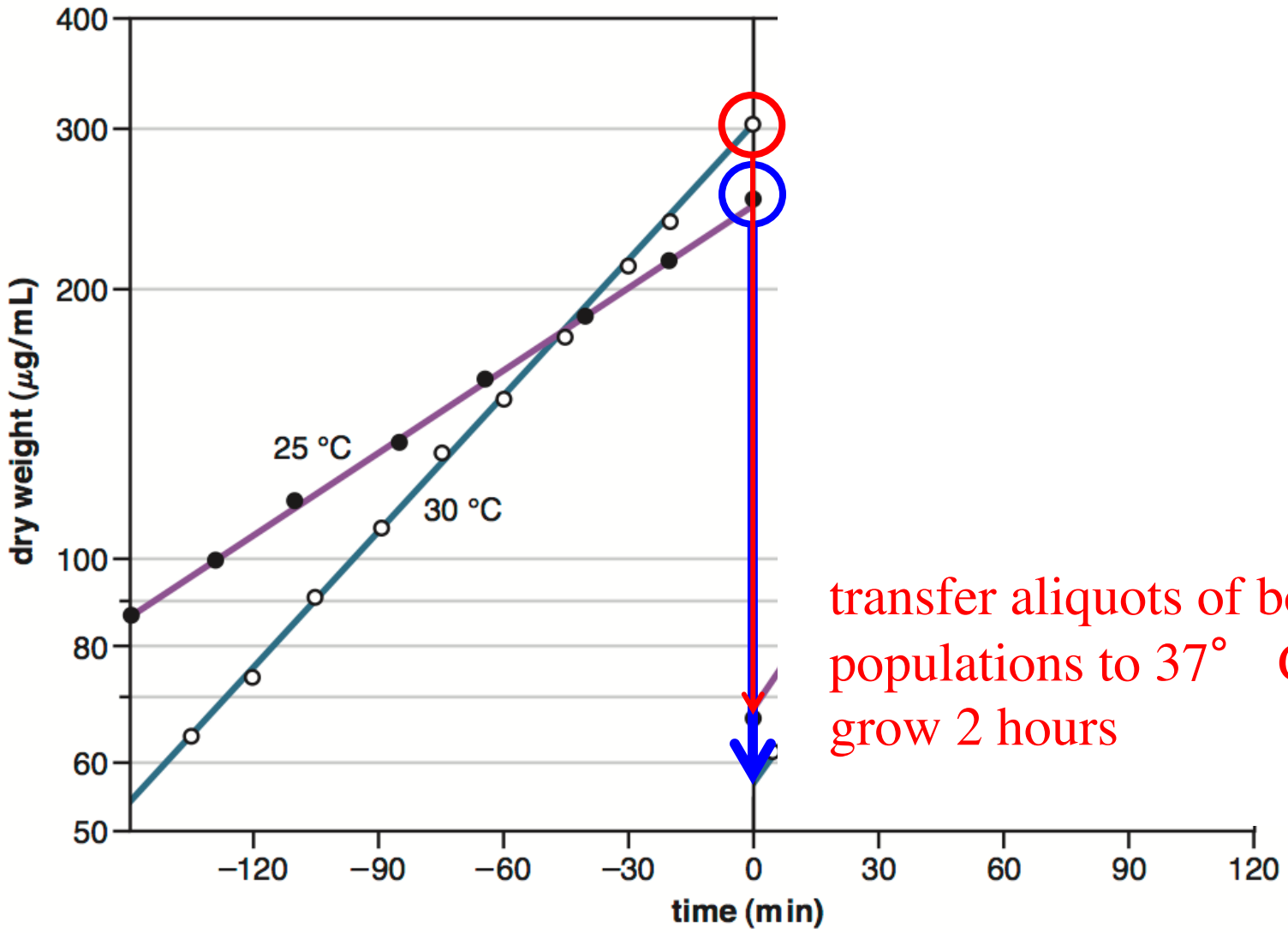
Temperature Affects Cell Growth



faster growth rate at 30° C

Fig. 3.16

Temperature Affects Cell Growth



transfer aliquots of both populations to 37° C; grow 2 hours

Fig. 3.16

Growth: Genetically Confined, Env. Limited

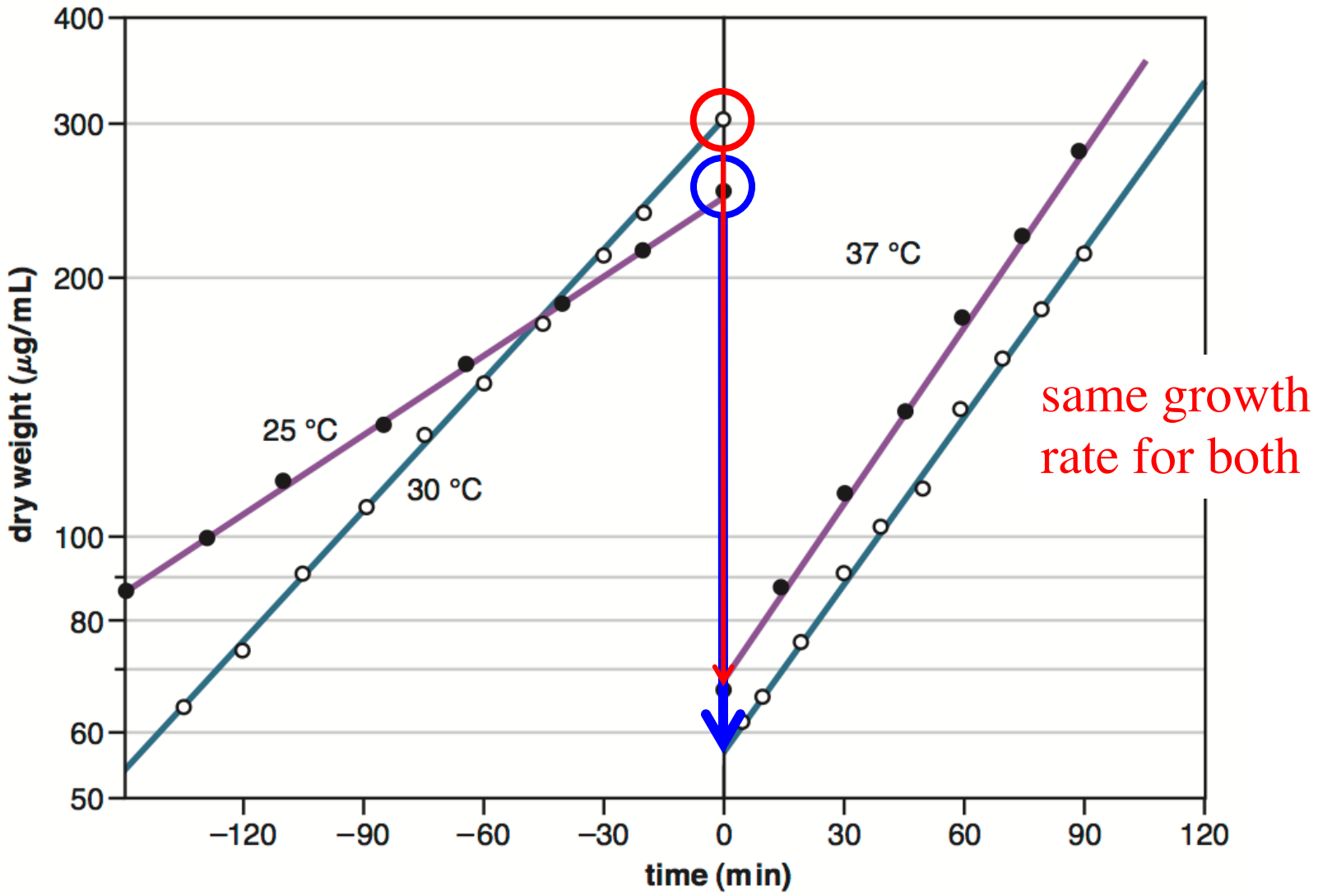
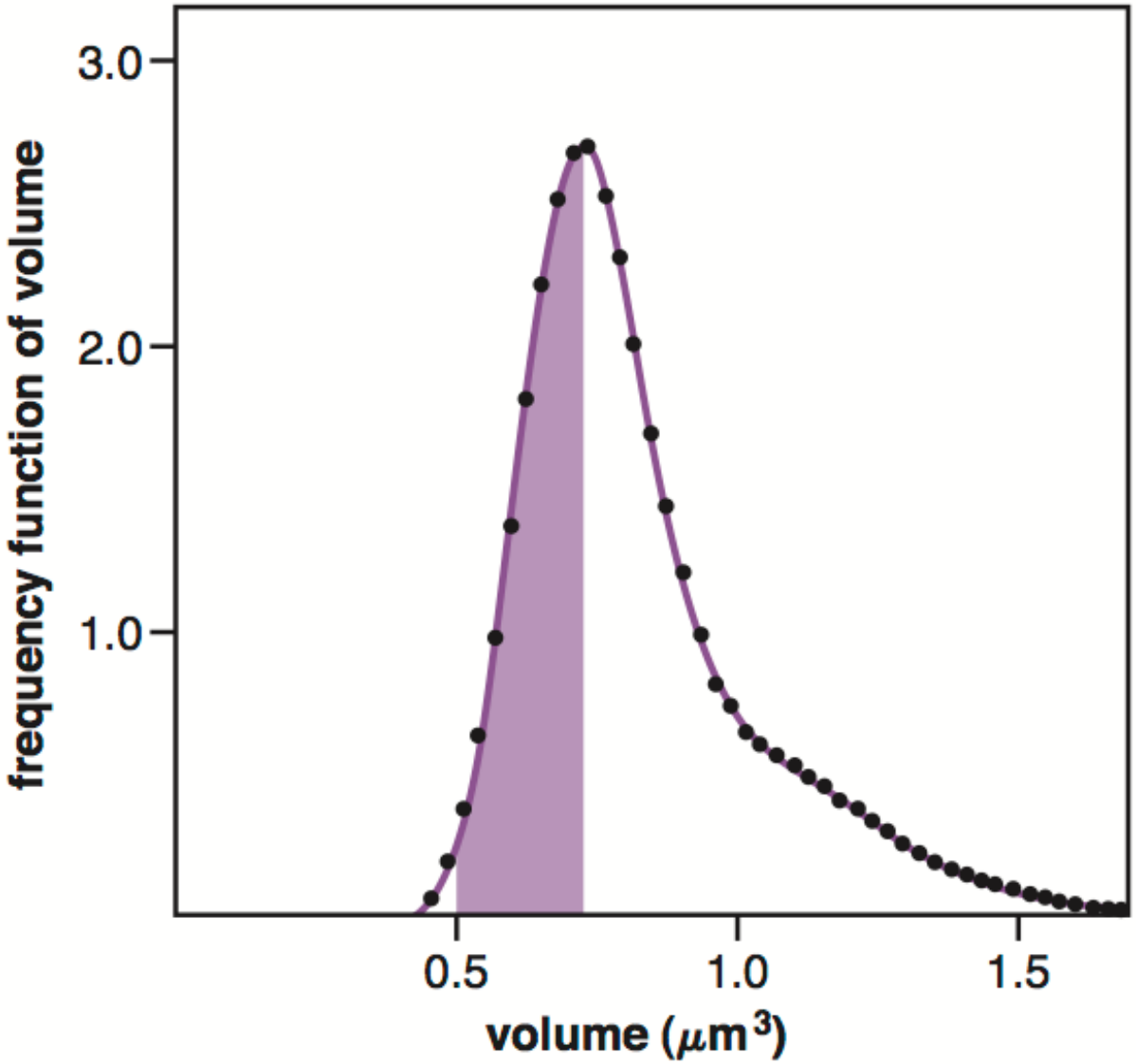


Fig. 3.16

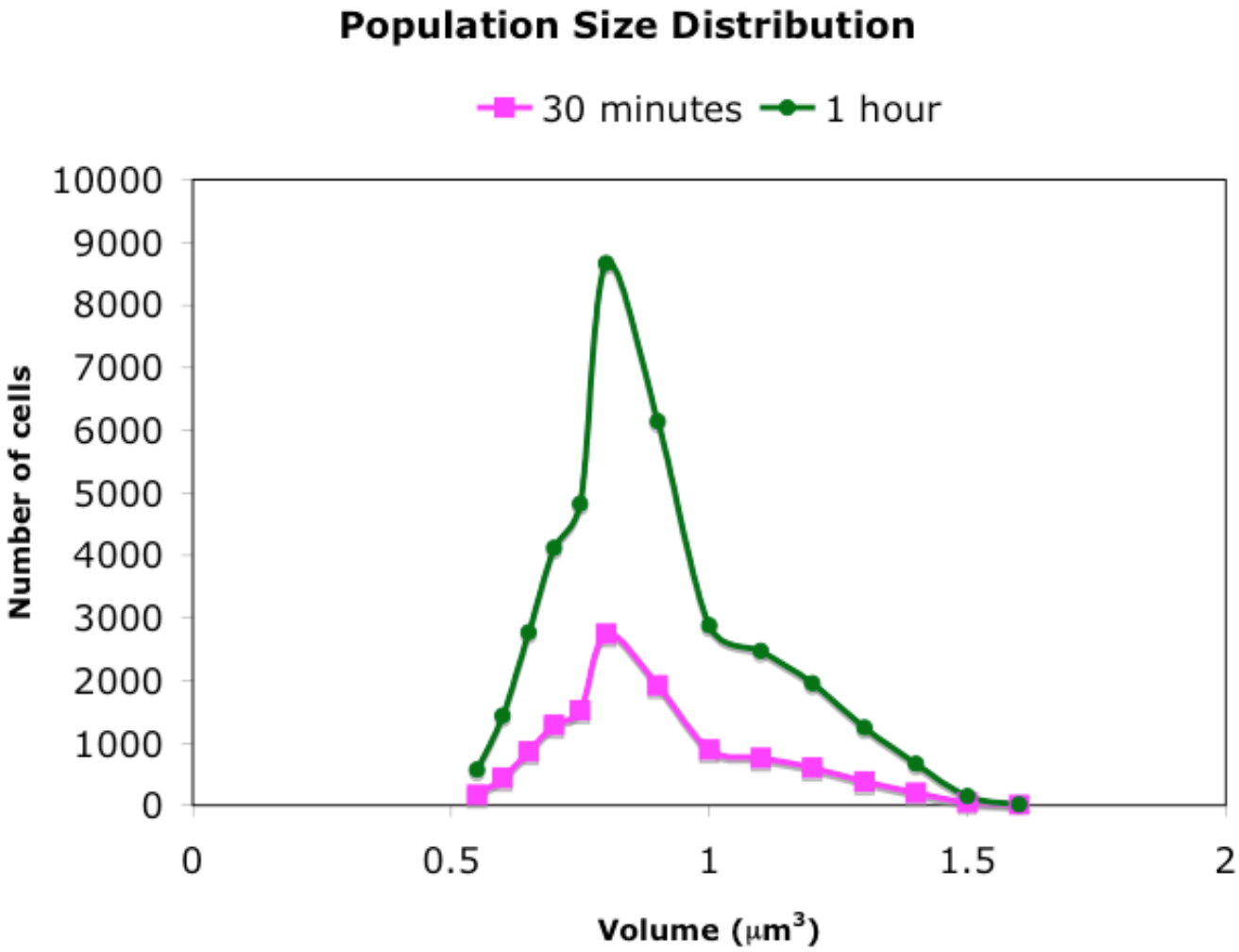
Not All Cells Are the Same Size



BME Fig. 3.1

modified from Harvey *et al.,* 1967.

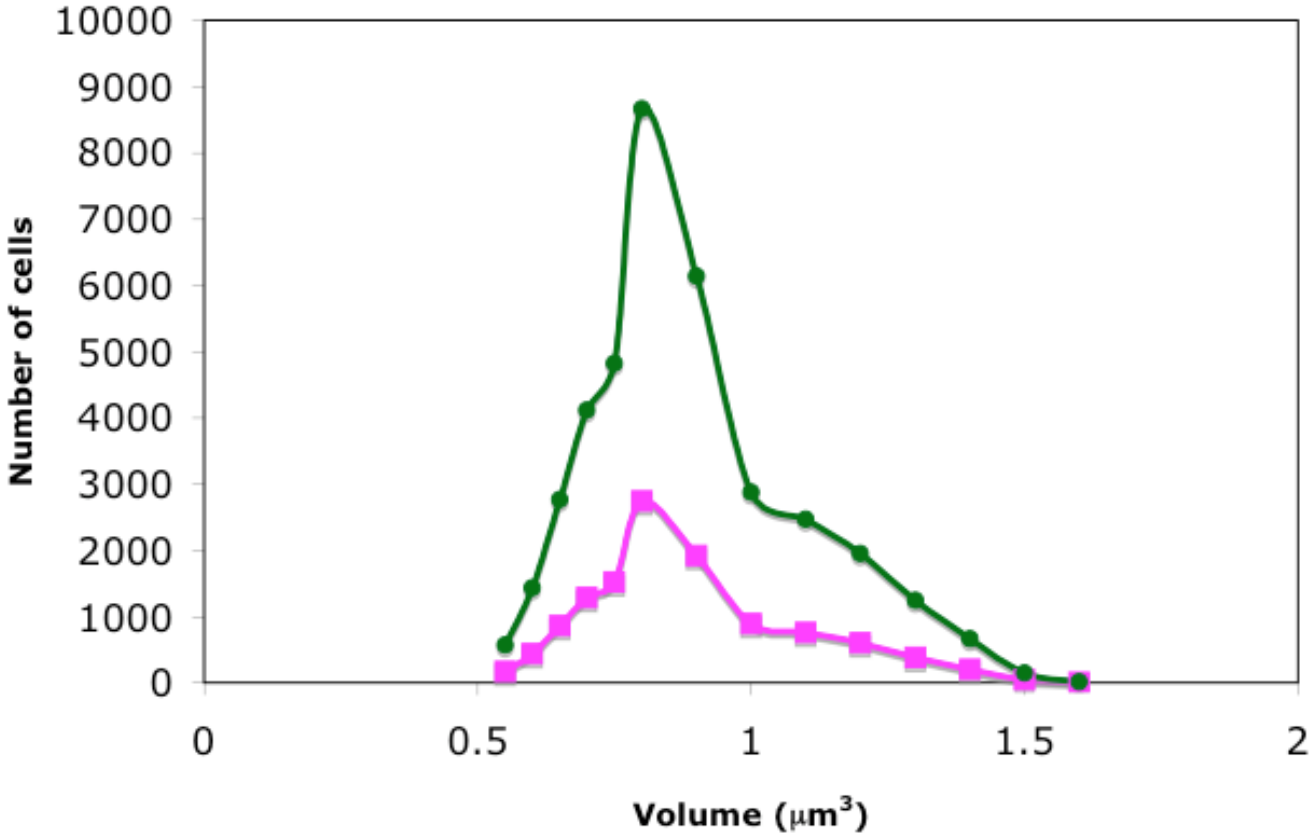
Time Influence Population Sizes



BME Questions

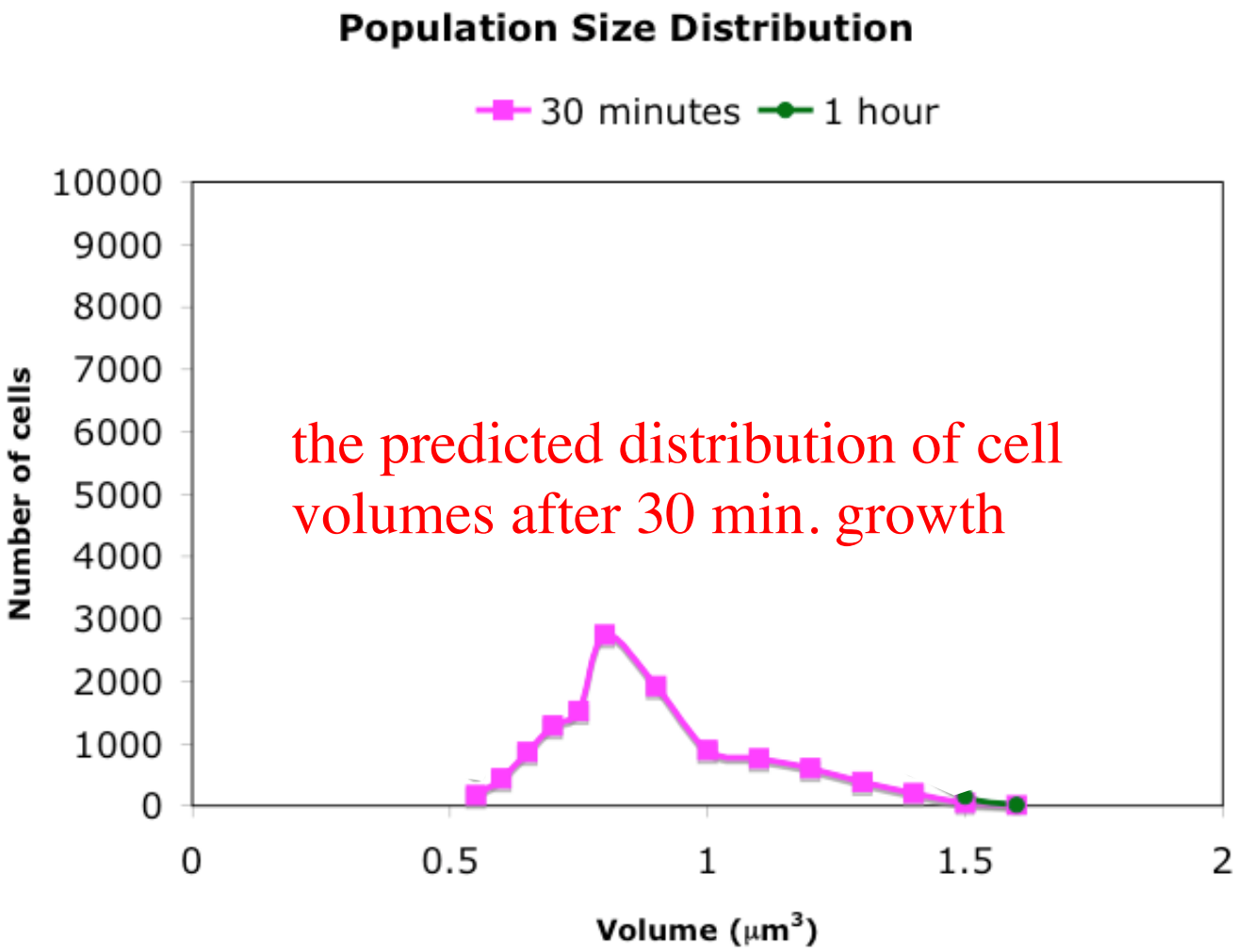
Time Influence Population Sizes

use file cell_division.xls
to model growth rates



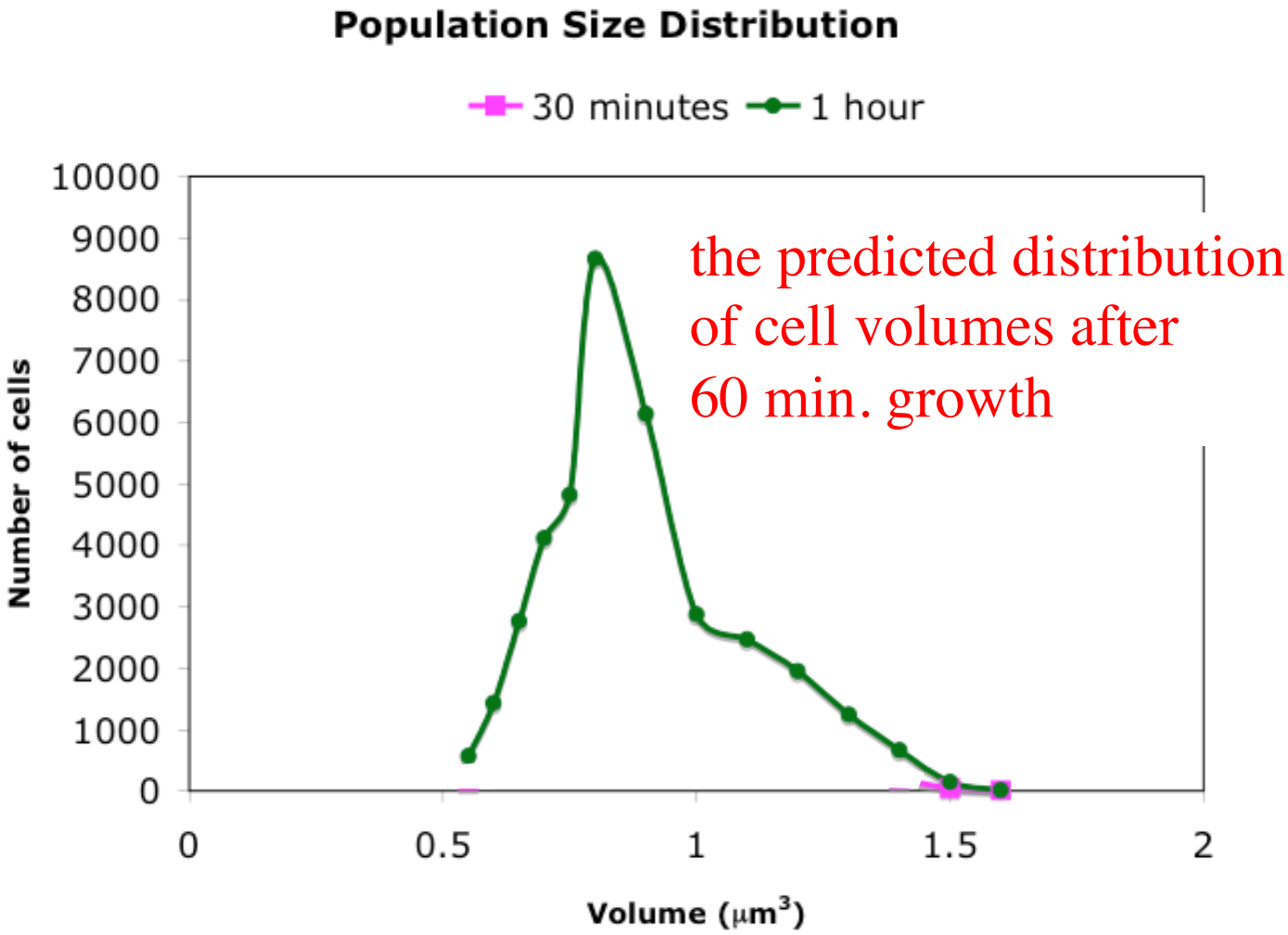
BME Questions

Time Influence Population Sizes



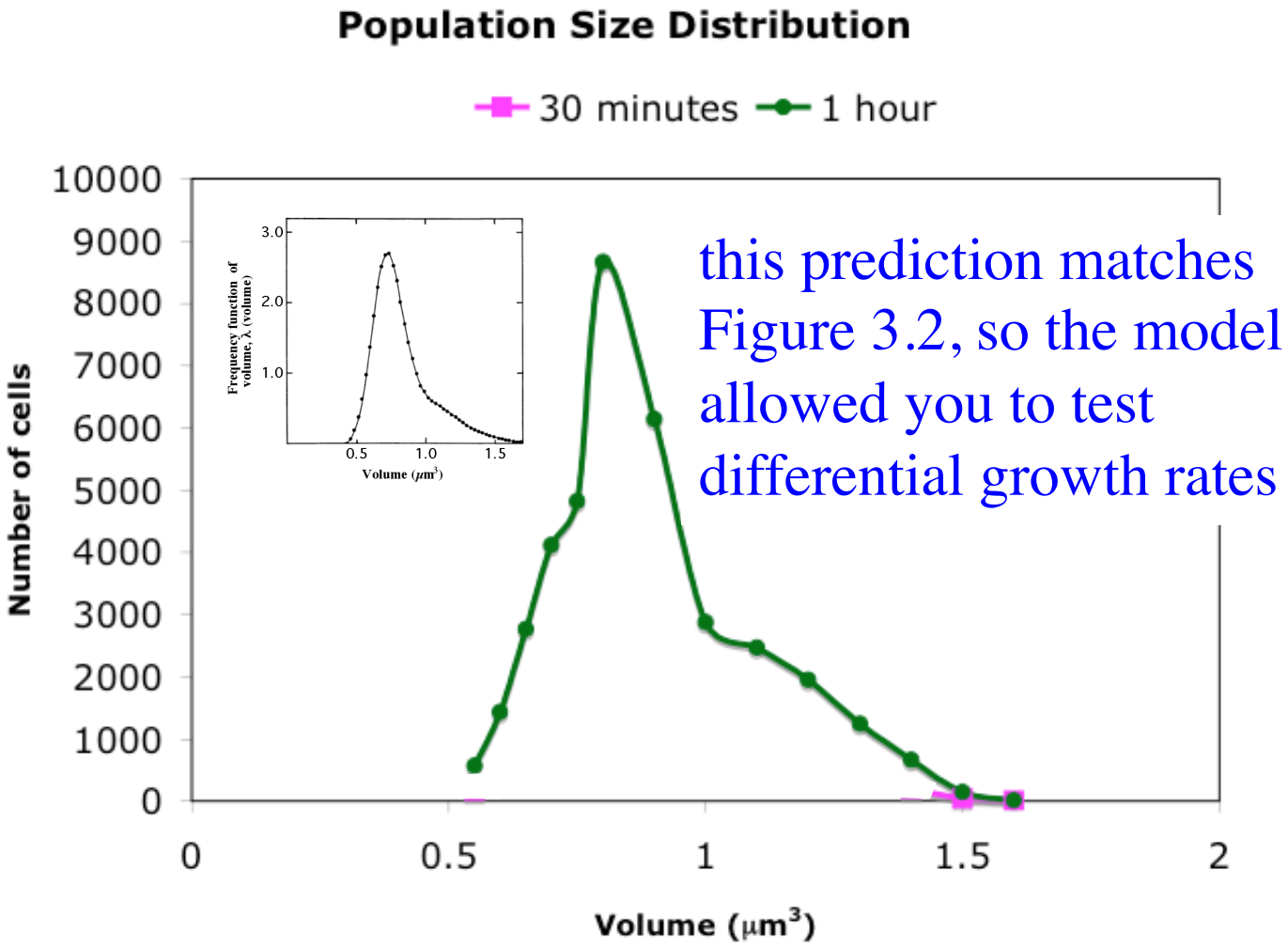
BME Questions

Time Influence Population Sizes



BME Questions

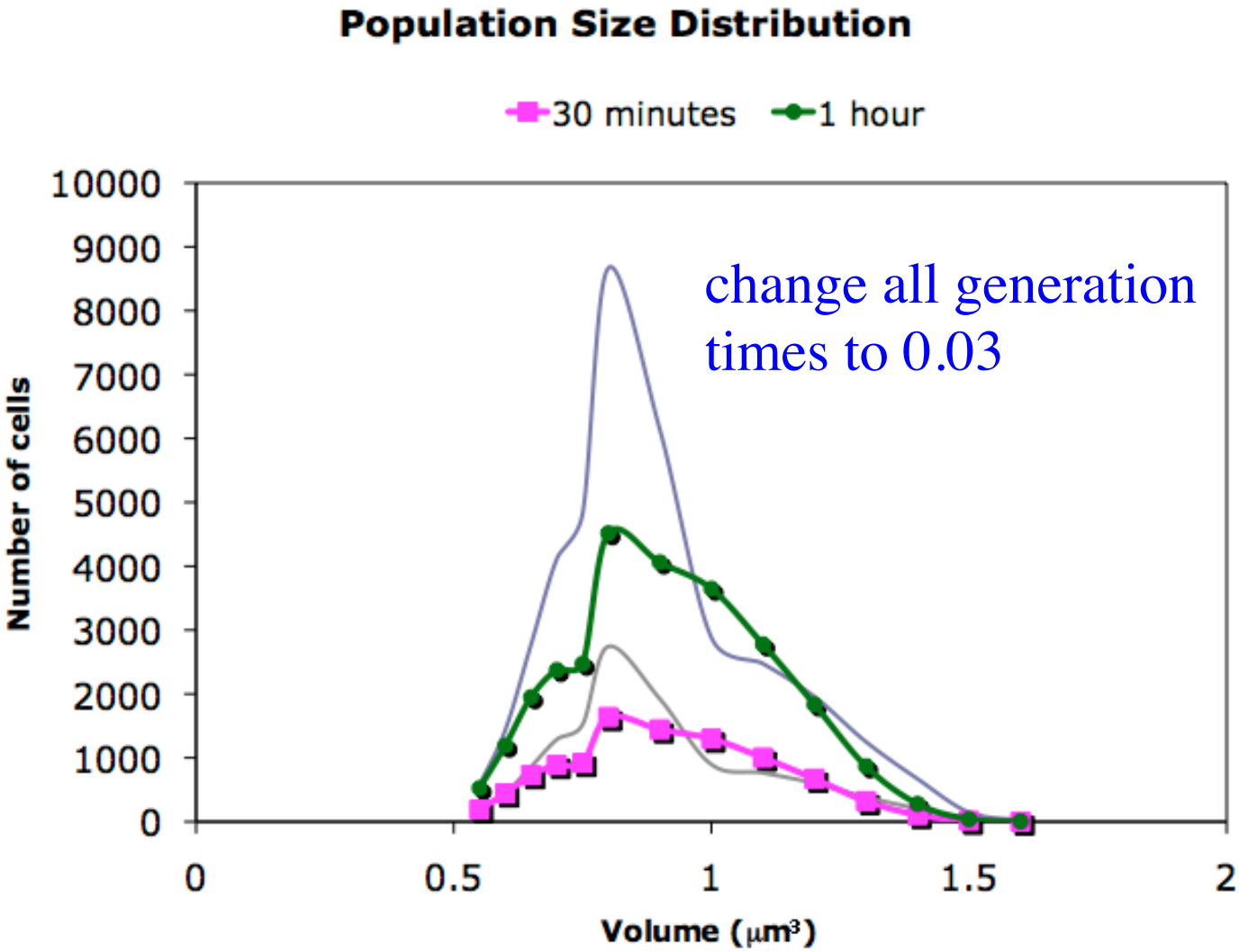
Time Influence Population Sizes



this prediction matches Figure 3.2, so the model allowed you to test differential growth rates

BME Questions

Integrating Question Answer



BME Questions

Do All Cells Grow at the Same Rate?

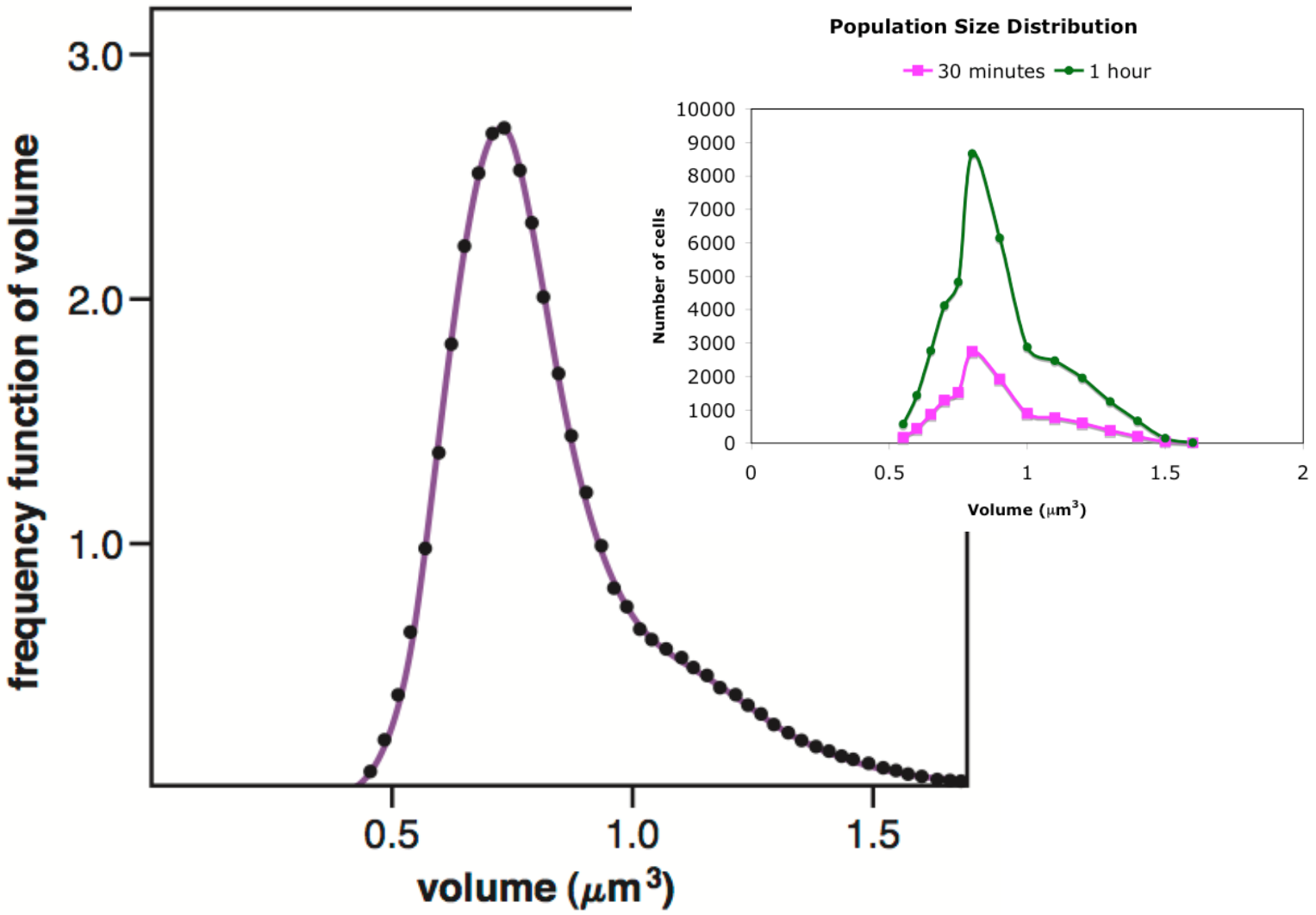


Fig. 3.15

What Signals When to Divide?

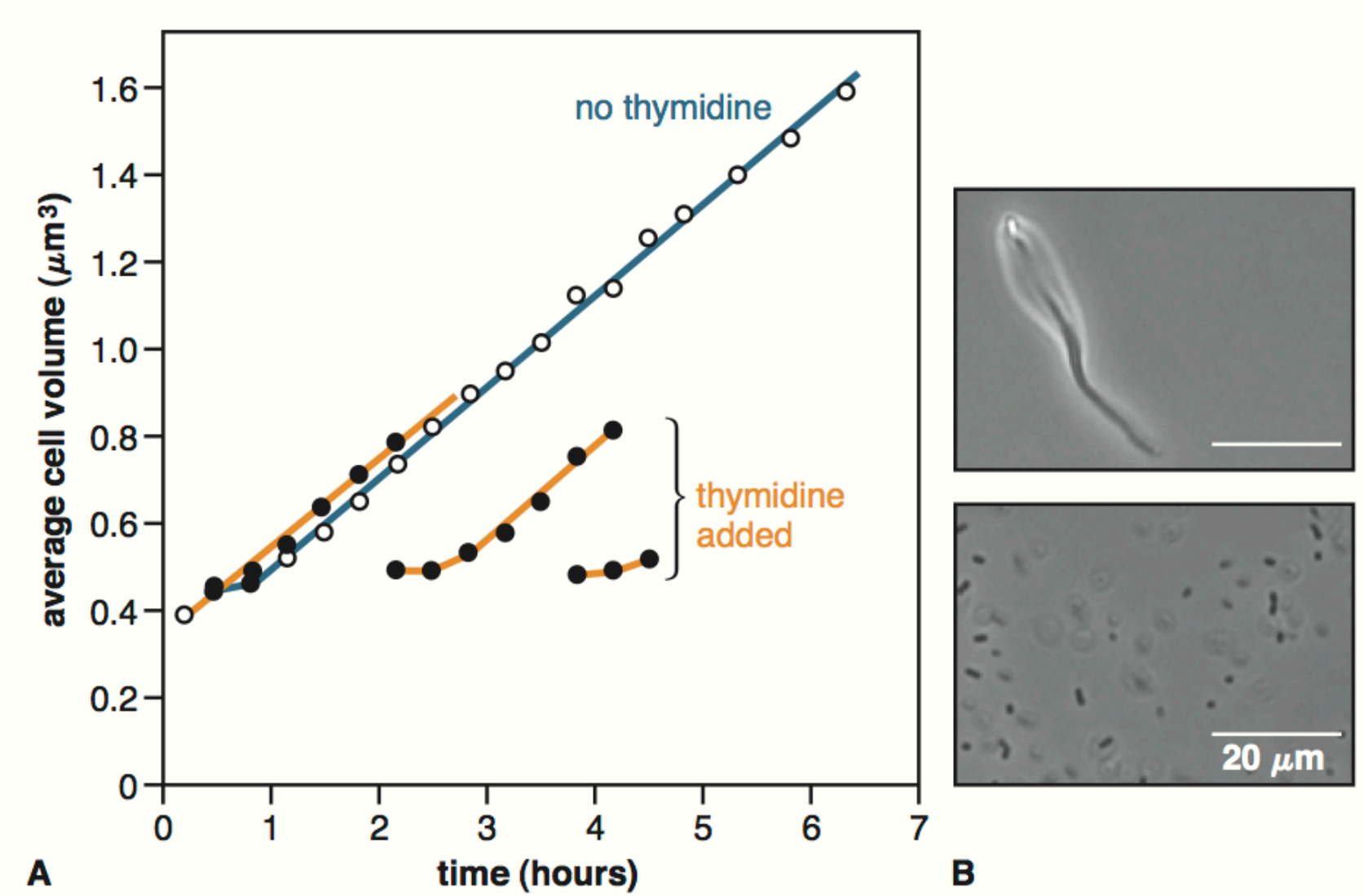
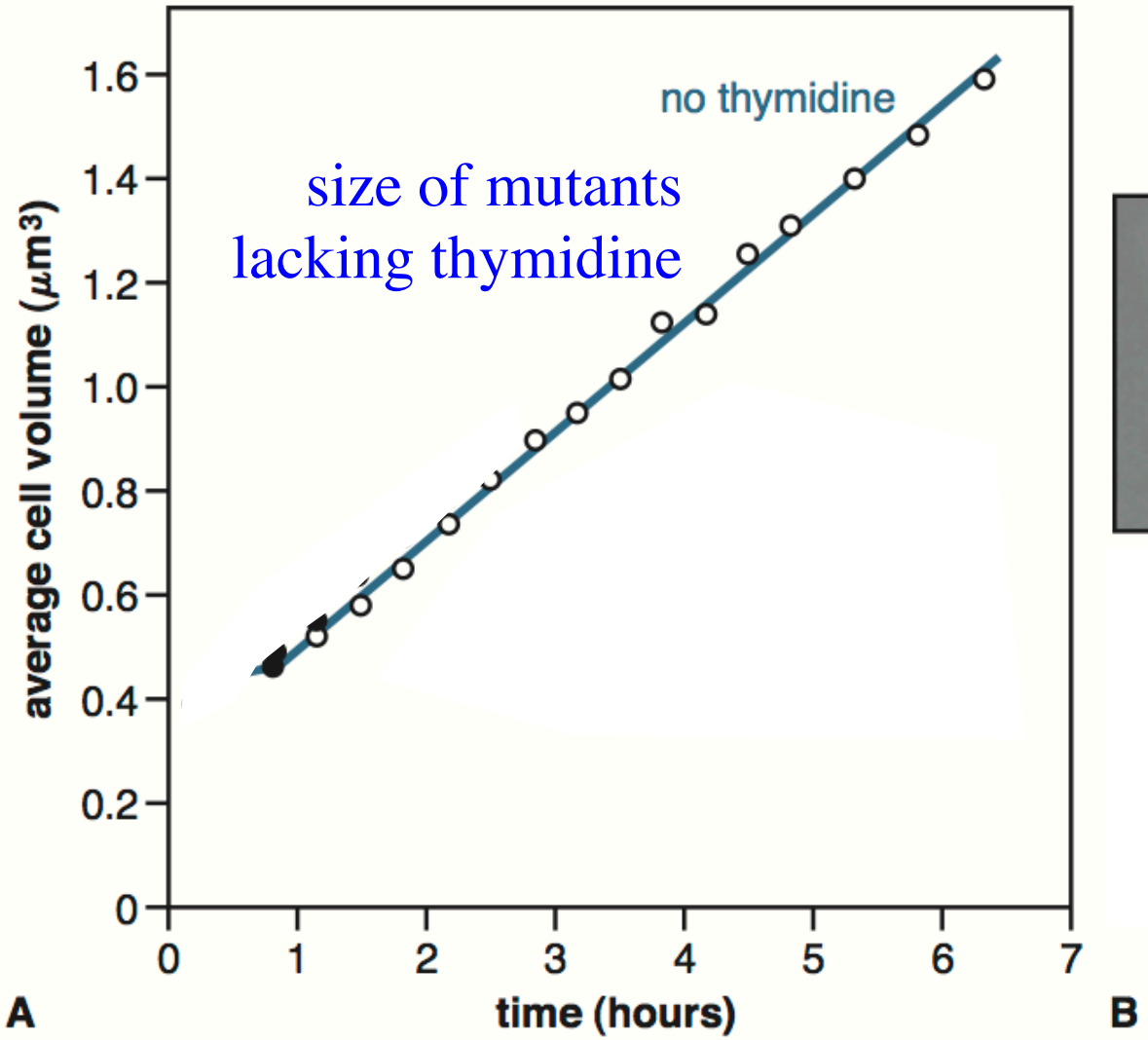


Fig. 3.17

A: Kubitschek. 1971. B Elizabeth Brunner, 2013

What Signals When to Divide?



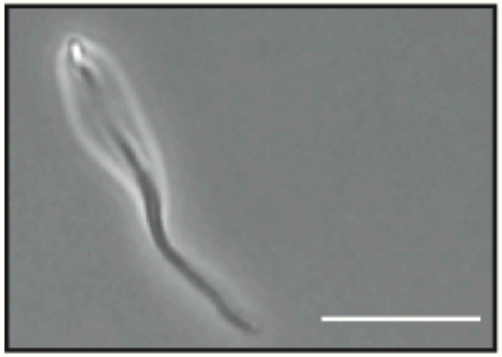


Fig. 3.17

What Signals When to Divide?

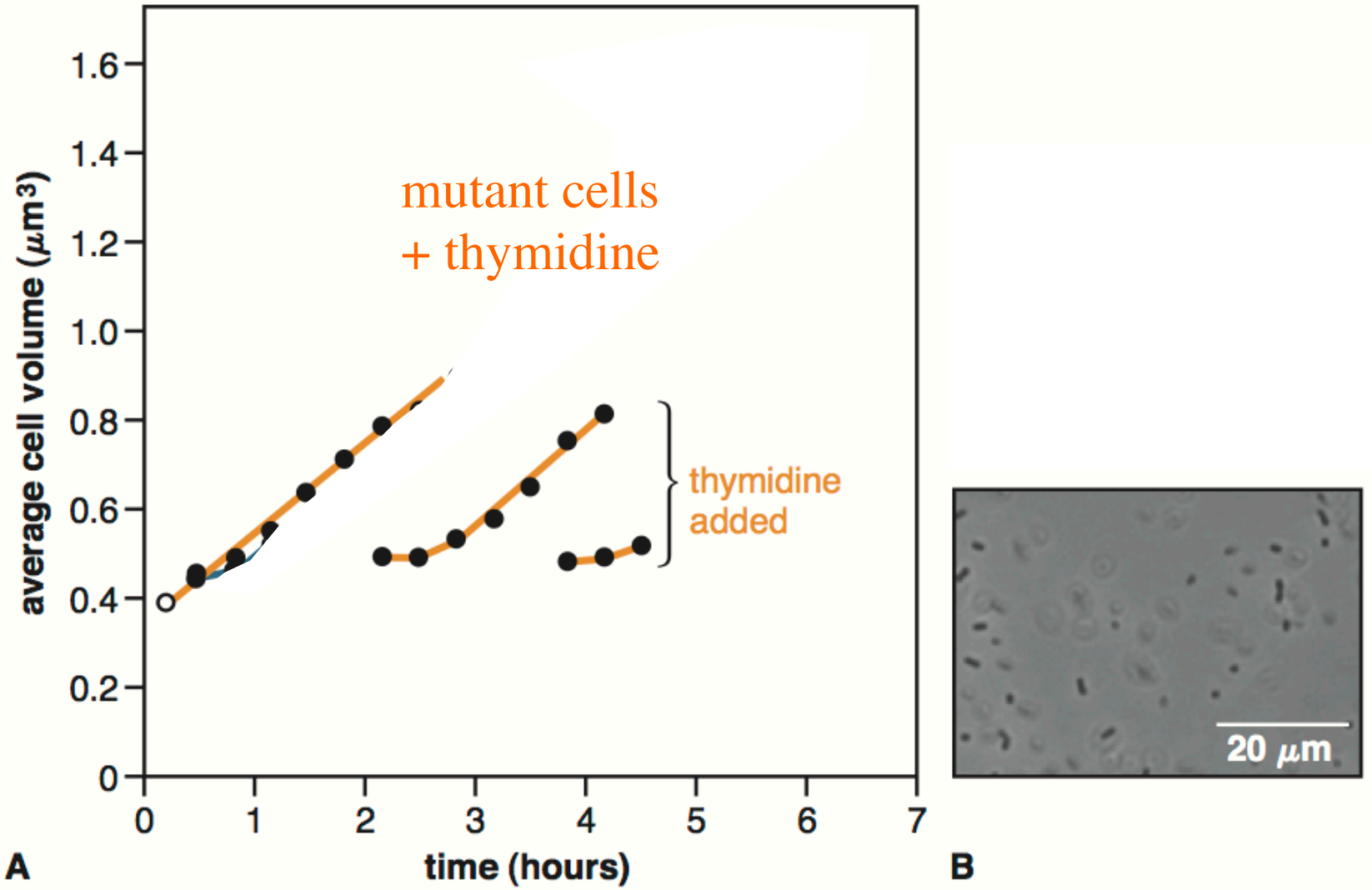


Fig. 3.17

What Signals When to Divide?

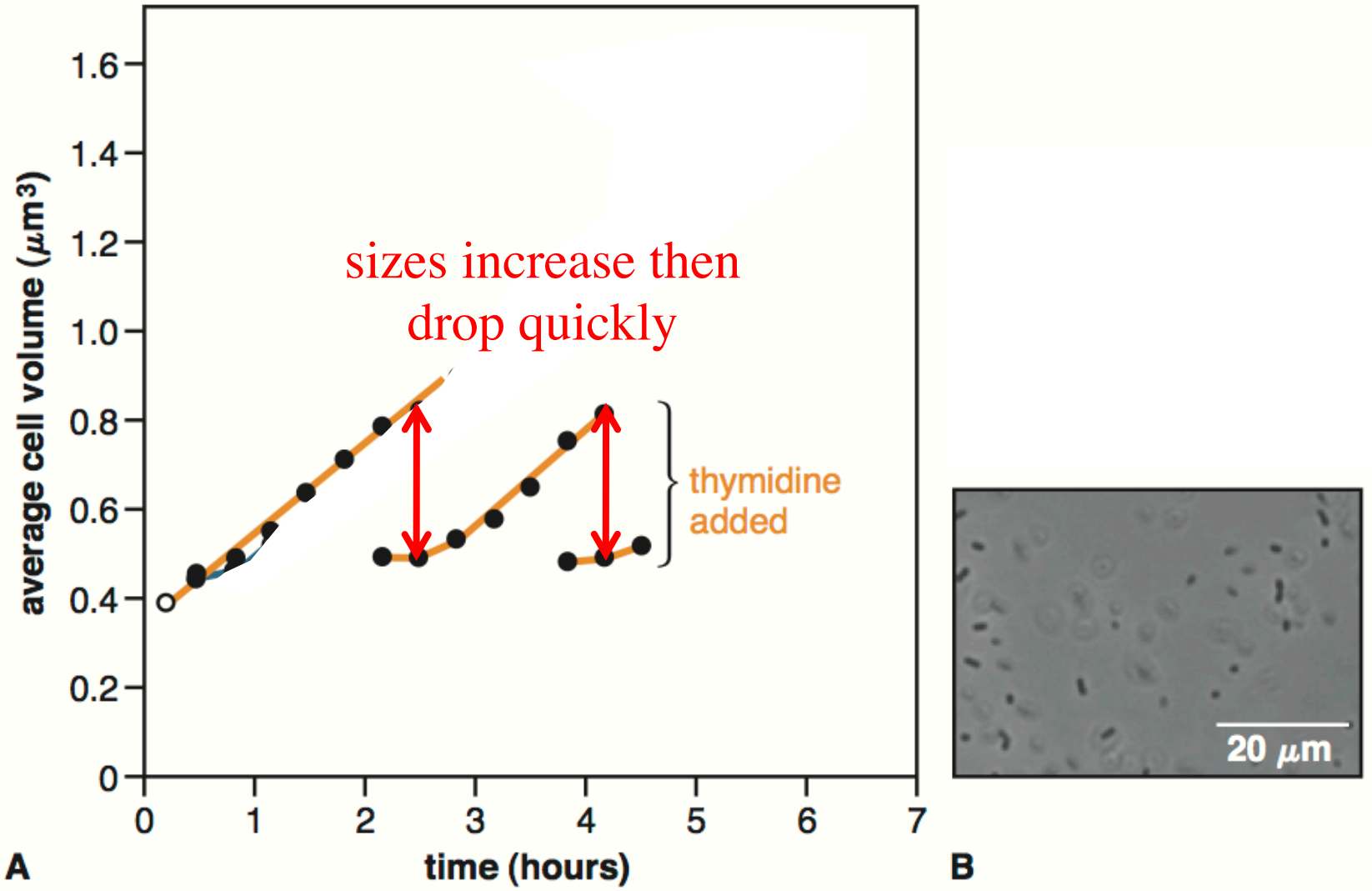


Fig. 3.17

Do Cells Bud, or Pinch?

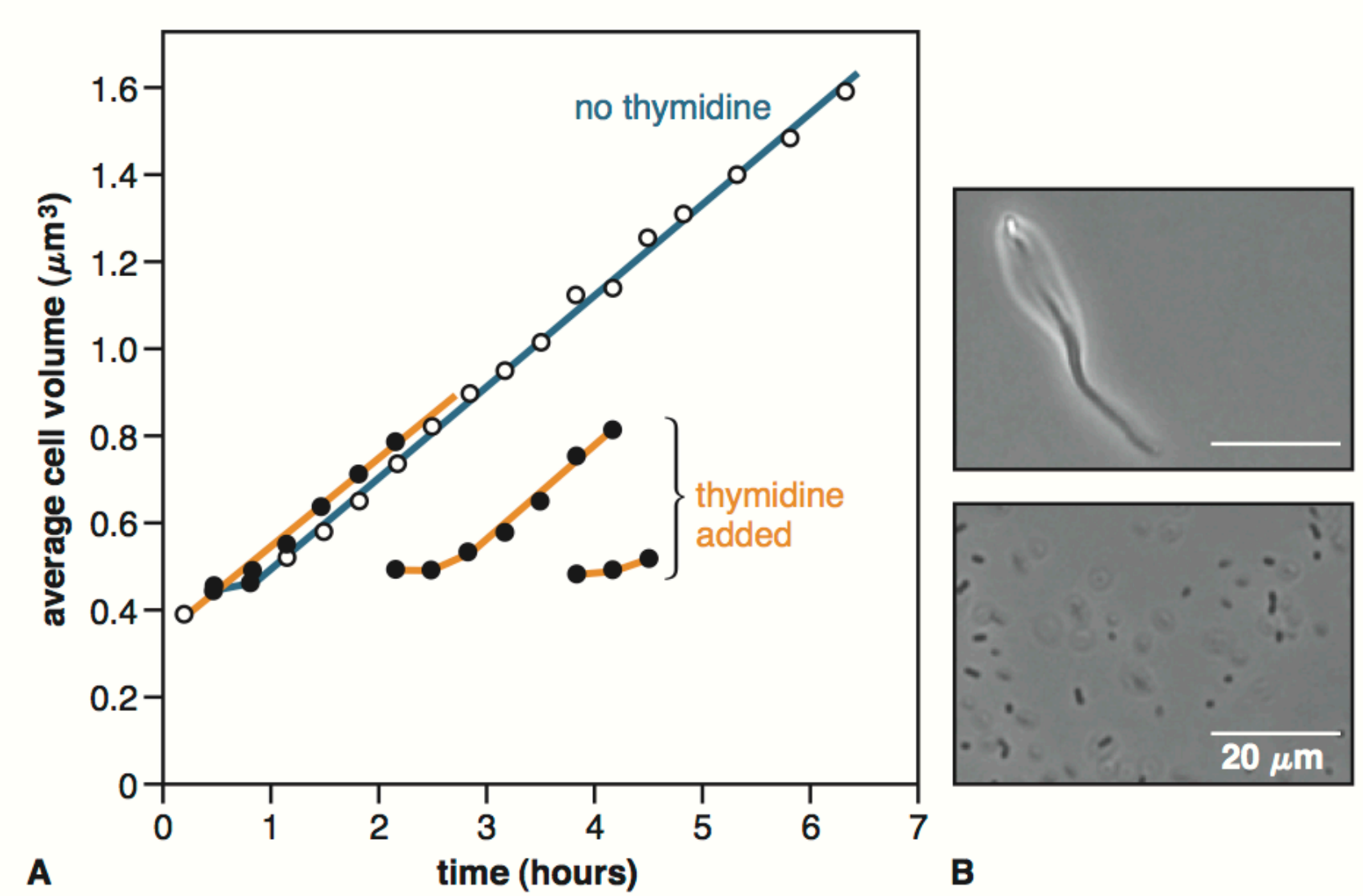
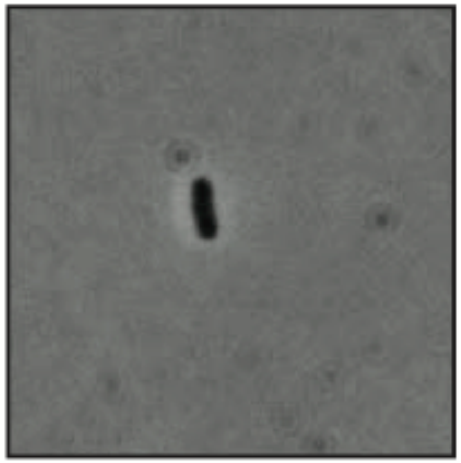


Fig. 3.17

E. coli Cells Dividing



$t = 0$ min

Fig. 3.18

modified from Ducret *et al,* 2009

E. coli Cells Dividing

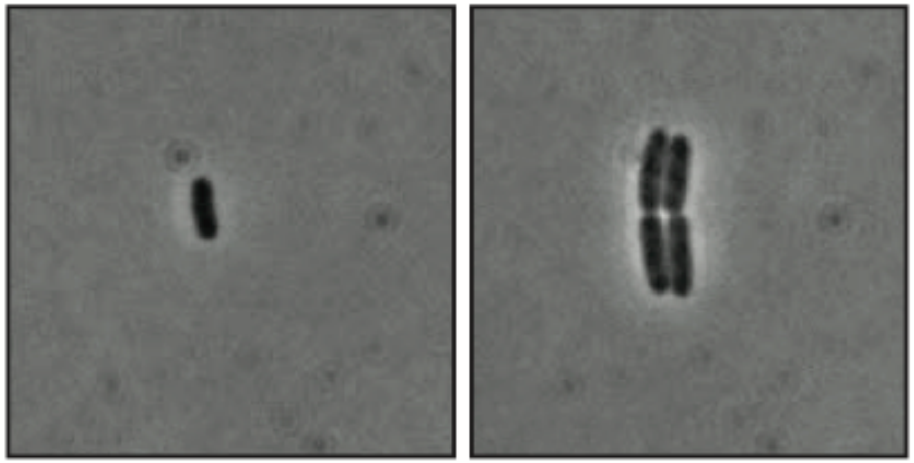


Fig. 3.18

modified from Ducret *et al,* 2009

E. coli Cells Dividing

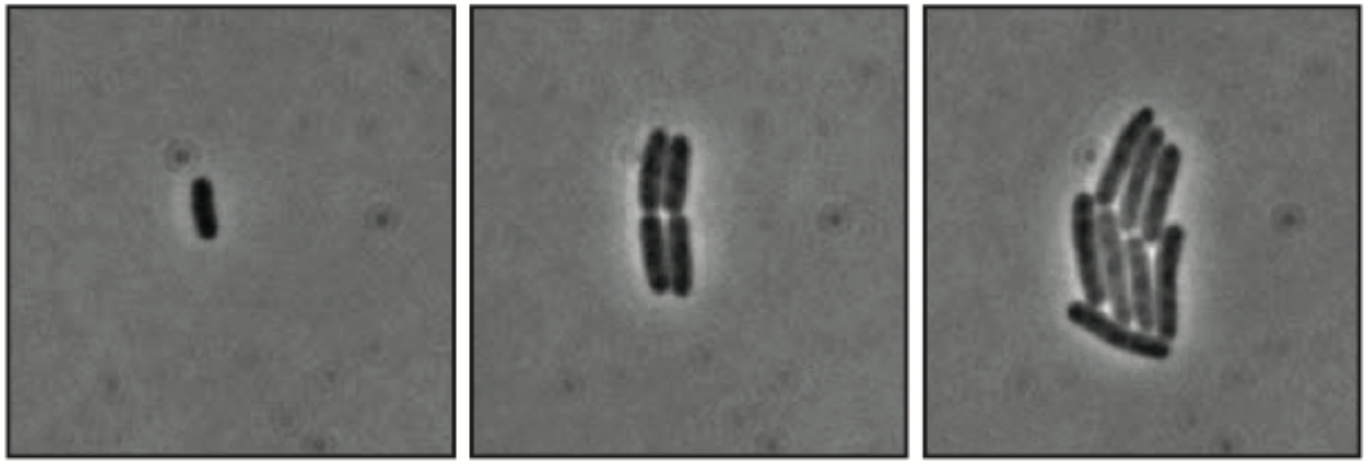
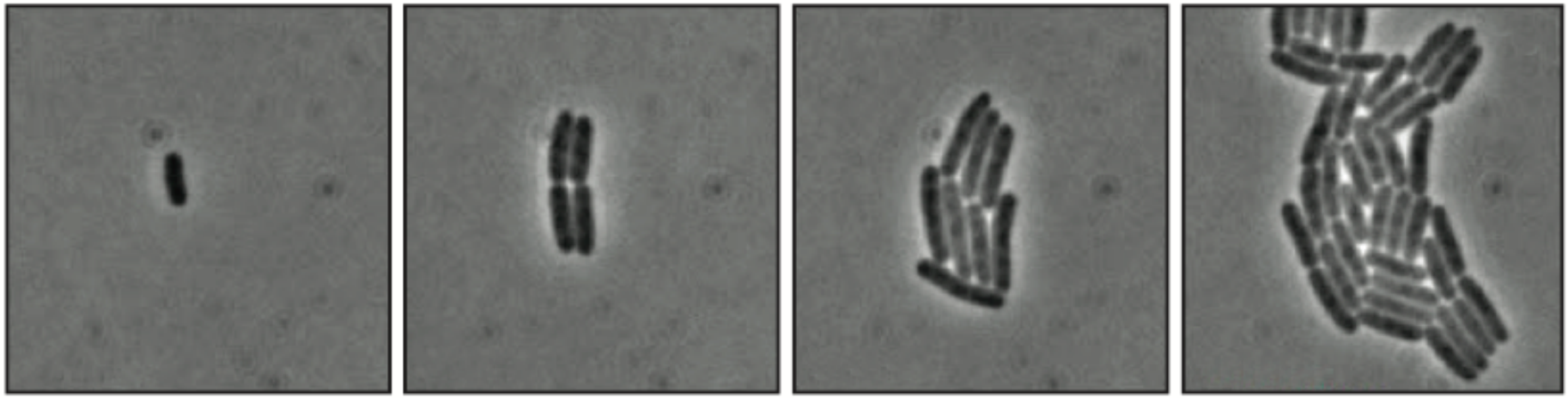


Fig. 3.18

modified from Ducret *et al,* 2009

E. coli Cells Dividing



See the online movie Ecoli_dividing.mov

Fig. 3.18

modified from Ducret *et al,* 2009