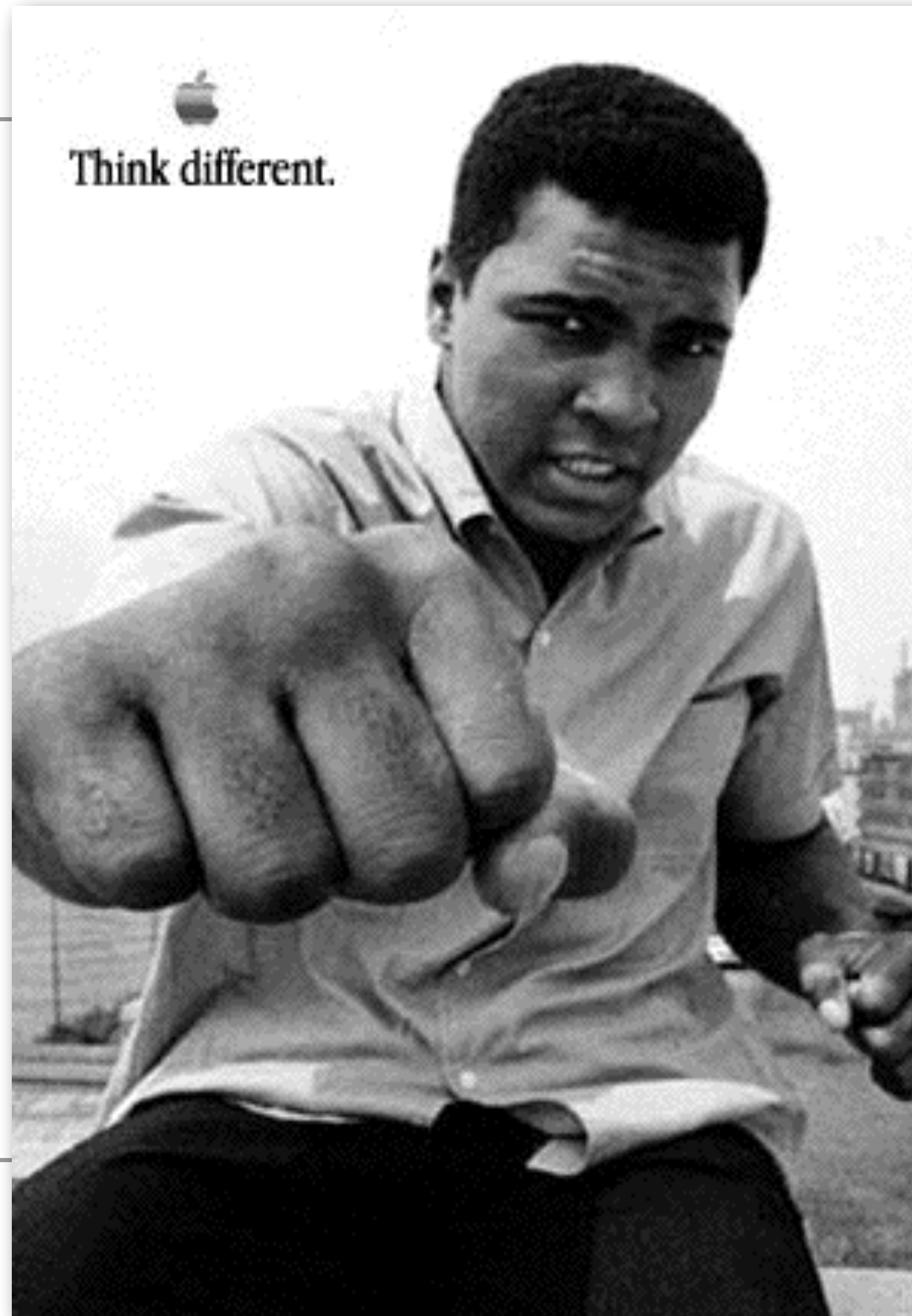


LB145-Spring 2025



1. **Pick up** Name Folder

- Pick up name folder and set it up at seat.

2. **Sit** with your group.

- laptops on outer perimeter (avoid distracting)

3. **Clicker** Attendance

- Launch your Top Hat, and get ready to click.

You joined the MSU CF lab



CURE=Course-based Undergrad Research Experience

YOU

EXPERIENCE

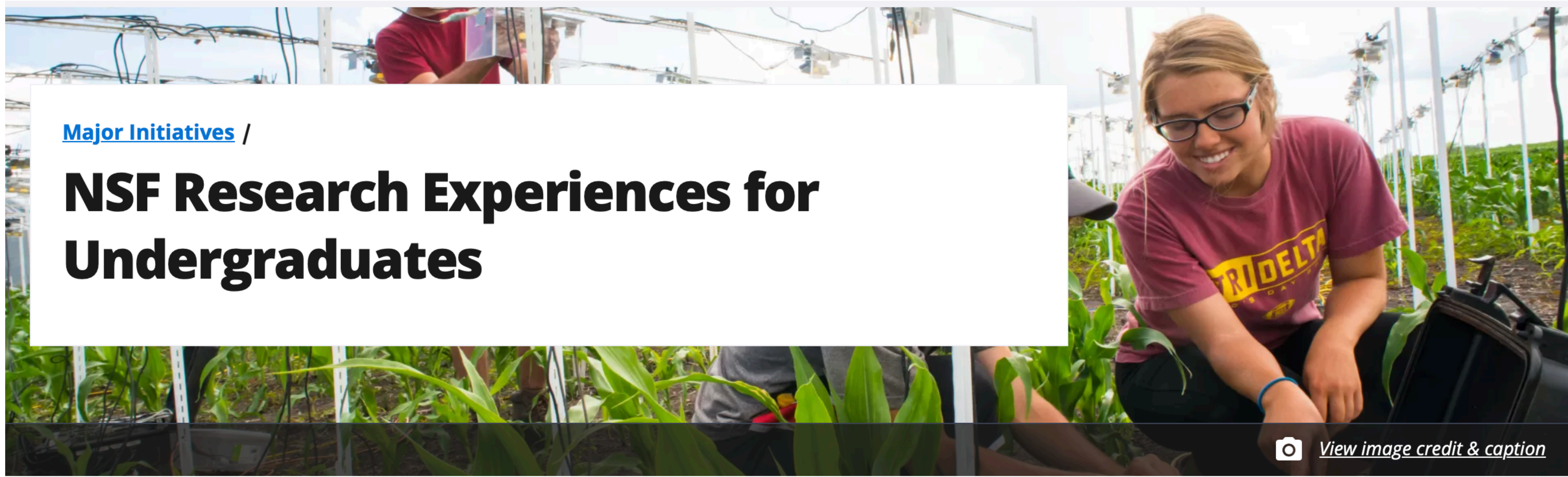
Cystic Fibrosis Lab Internship

January 2025-May 2025

Research intern with Douglas B. Luckie, Ph.D., Director of MSU Cystic Fibrosis

Research Laboratory, Michigan State University, East Lansing MI (cf.psl.msu.edu)

- Planned, pursued and presented experimental results on a research project aimed at using a PCR-based strategy to identify the {your mutation} of the human CFTR gene.
 - Gained experience with polymerase chain reaction (PCR), DNA sequence analysis, primer design, troubleshooting, genomic DNA extraction and agarose gel electrophoresis methods.
- Initiated a secondary research project to test the Yaku et al 2008 method using intentional mismatch to reduce rate of false positives when using PCR to diagnose SNPs.
 - Gained skills in experimental design, DNA sequence comparisons and analysis via BLAST, comparative primer design and testing.
- Participated in all aspects of lab work which included: preparation of solutions; maintaining lab notebook; and reading/presenting published research/figures in journal club as well as own research data/findings in formal talks during research seminar settings, and authoring manuscripts for publication.



[Major Initiatives](#) /

NSF Research Experiences for Undergraduates

 [View image credit & caption](#)

NSF Research Experiences for Undergraduates

The U.S. National Science Foundation Research Experiences for Undergraduates (NSF REU) program supports intensive research by

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Apply for a REU

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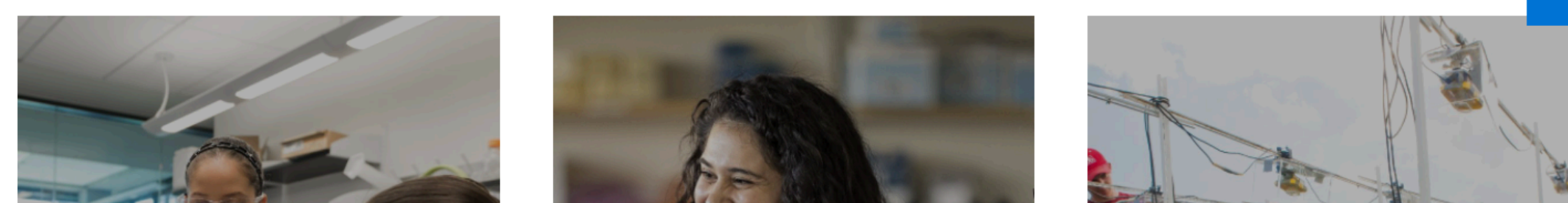


Organization(s)

[National Science Foundation \(NSF\)](#)

Undergraduates (college and university students) can apply directly to REU Sites to participate in research projects across the United States and the world. REU-supported students receive stipends and in many cases assistance with housing, meals and travel. (For additional research opportunities, explore the [Information for Undergraduates](#) page.)

Feedback



SURB

Summer Undergraduate Research in Biology

Research Areas

Requirements

Application

Publications

Contact Us

If you have questions about SURB, please contact:

[Dr. Courtney Davis](#)

Natural Science Division
Pepperdine University
24255 Pacific Coast Highway
Malibu CA 90263-4321

Pepperdine University Seaver College Undergraduate Research in Biology



In the [summer 2025](#) (May 11-July 26), Pepperdine University is planning to host the Summer Undergraduate Research Program in Biology (SURB) developed specifically for students who are interested in pursuing a career in biological research, science education, environmental science, biomathematics or biotechnology. Pepperdine biology faculty will work closely with selected students in diverse areas of biological research. Successful applicants will be provided a generous stipend, on-campus housing, a unit of biology research credit, funding for travel to Malibu, and a budget for the purchase of research supplies. Students will be introduced to varied research tools and techniques and will partner with a faculty member to develop a project idea for their summer research. Then the full SURB group will complete their research proposals and engage in a research retreat, often at the James Reserve near Idyllwild, CA. Over the remainder of the summer, students will pursue individual research projects under the direction of their faculty mentor. Guest scientists will periodically visit the program to give seminars and meet with the SURB research students. The research program will conclude with a student research symposium in late July.

Students may elect to study in one of seven areas, and selection criteria include their interest in research-based careers, their academic credentials, and teacher recommendations. Depending on faculty participation, which varies from year to year, students may be accepted to do research in a second or third choice of preference.

The salary stipend for SURB students is \$700 per week or \$7,700 for the eleven week program and reflects what Pepperdine University reasonably expects to pay for this stipend. Student participants in the SURB program will also receive a weekly

Application

Publications



Contact Us

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[Dr. Courtney Davis](#)

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Pepperdine University
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estions about
contact:

[avis](#)

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iversity
Coast Highway
63-4321



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Students must complete the online application using the National Science Foundation's Education and Training Application (ETAP) for this program. Further details are available on the [application page](#). Application components will include 1) the NSF registration form, 2) SURB-specific application questions, 3) a brief essay stating the reason(s) why you would like to

CITY MUSEUM
ST. LOUIS, MO 63102
CITYMUSEUM.ORG

Apply for a REU

The treehouse area was expanded in 2012, incorporating more found natural woods and creating a wondrous multistory indoor climber...and secret tunnels!

Dr. Luckie, I am so glad I was able to do an REU internship this summer at the Donforth Center in St. Louis (thanks again for the letter of rec!). I got to focus on a project related to the evening complex in the circadian clock of plants. Basically I was able to validate some interactions in tobacco using Co-IPs and western detections (lots!) I've learned a ton here and St. Louis is a really cool city. Thanks for suggesting the REU programs back in LB145. Hope all is well.
- Jessica Goldsworthy

Photo by Andy Wissman

Dr. Douglas Luckie
W-26D Holmes Hall, Michigan State
East Lansing, MI 48823



Luckie
s Hall
University
MI, 48823

Student that has been employed by the lab. I hope you are enjoying your summer! - Joanna

The Nanjing Changjiang River Bridge

Announcements

- 1. On Monday 20min & two questions will be provided for feedback on course evaluation.**

We will provide this -> more feedback is better!

SPLS: PLEASE COMMENT

1. How much did the laboratory **help your learning?**

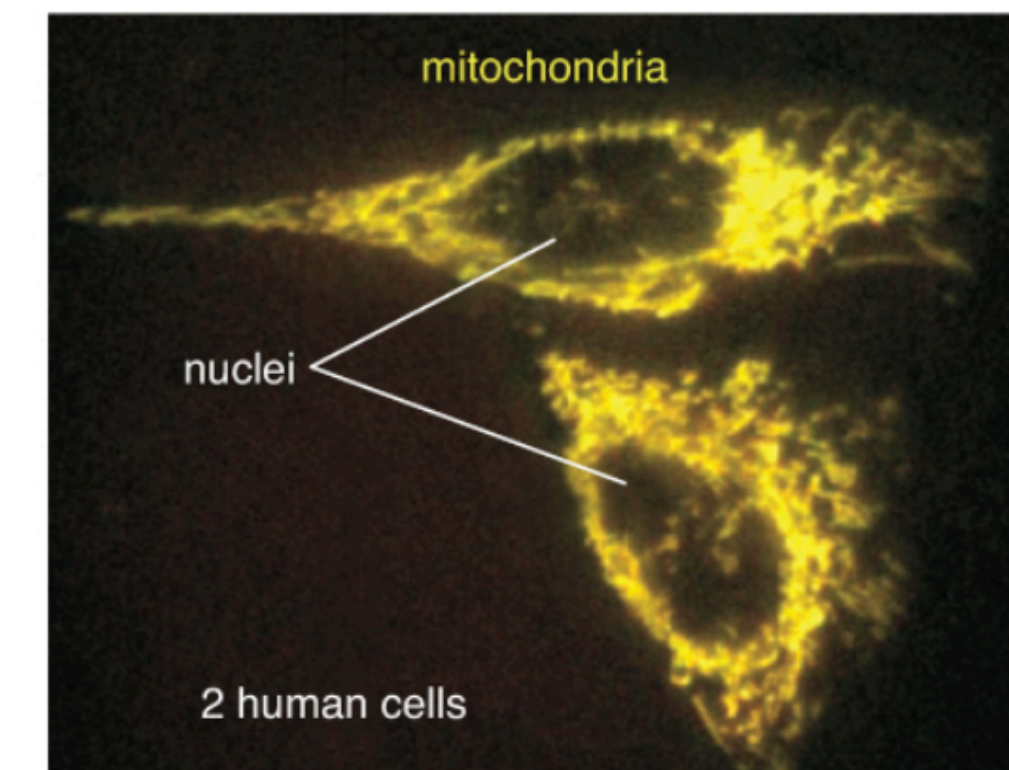
- **practical skills:** (*ability & confidence* using lab equipment, making running gels, PCR, genome prep, use pipetmen, power supply, spec, prepare agarose, following protocols etc)
- **mental skills:** (*thinking/talking/reading* like a scientist, experimental design, DNA sequence analysis, knowledge of how stuff works in lab as well as inside cell/human body)

2. Which you predict **helped your/others learning** most?

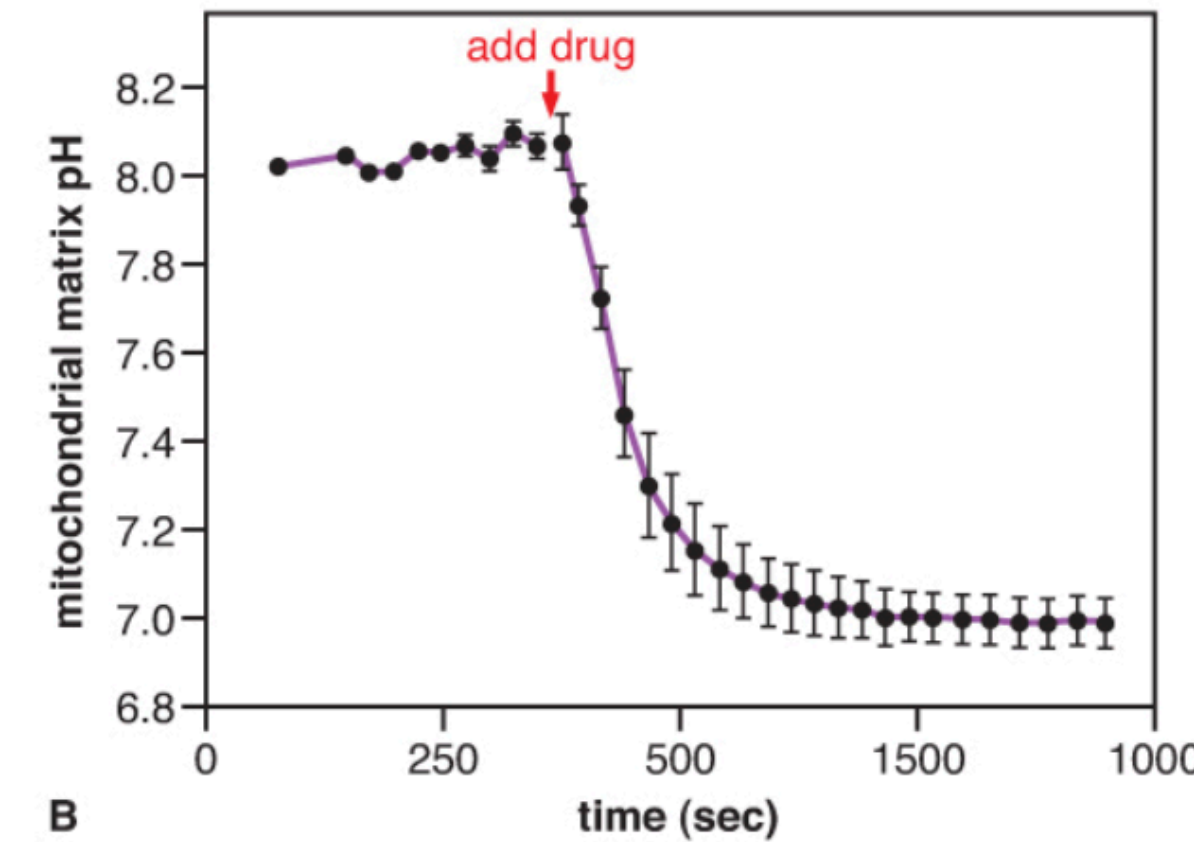
- **exercises:** verbal final exam, group exam, take-home exam, clickers, biology theater/acting out processes, cell drawing or cell movies, your group, reading research papers, the textbook, other.



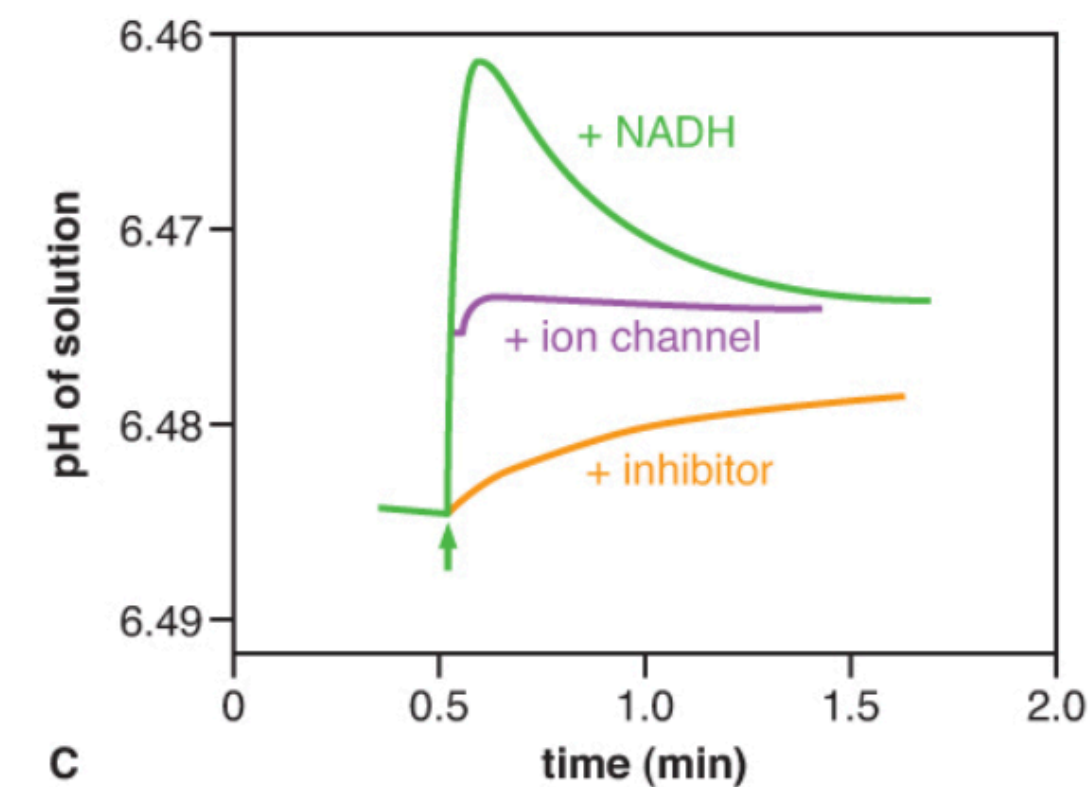
One of the keys to understanding how mitochondria convert the potential energy in NADH and FADH₂ into ATP was realizing the pH inside mitochondria differed from the pH of the cytoplasm (Figure 10.20). Using modern methods, investigators have engineered fluorescent proteins that alter their color depending on the surrounding pH. These pH indicator proteins are located in the lumen of the mitochondria, also called the **mitochondrial matrix** (Figure 10.20A). The change in colors is not readily visible to our eyes, so computer programs quantify the pH-induced color shift. To verify that the pH of the mitochondrial matrix is different from the cytoplasm, investigators monitored the pH inside mitochondria and then added a drug to insert H⁺ ion channels in the inner mitochondrial membrane (see Figure 6.15A). The added ion channels would let H⁺ ions flow down their concentration gradient until the cytoplasm and the matrix have the same pH of 7.0 (Figure 10.20B). Cell biologists had demonstrated previously that the outer mitochondrial membrane is rather porous and does not exclude



A

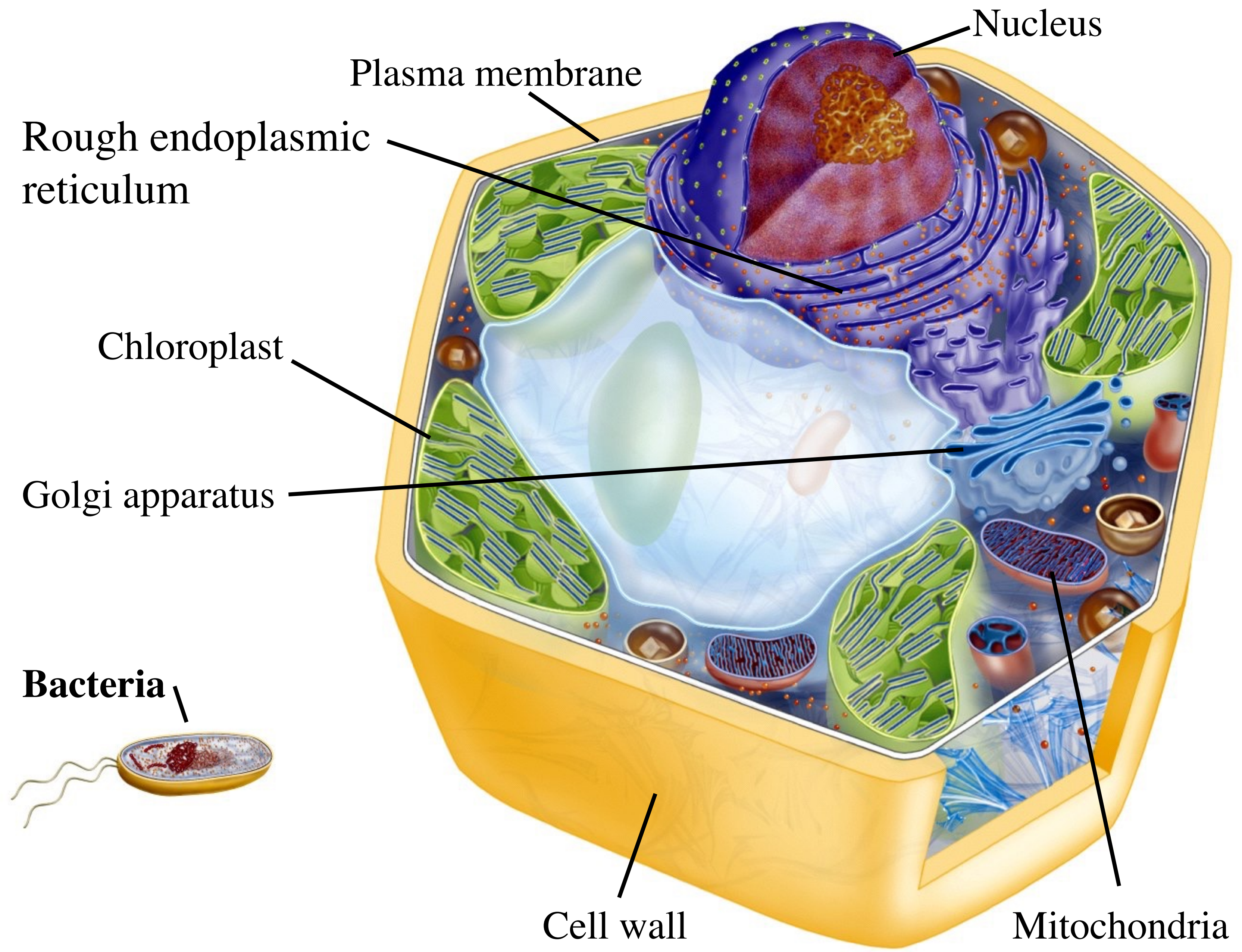


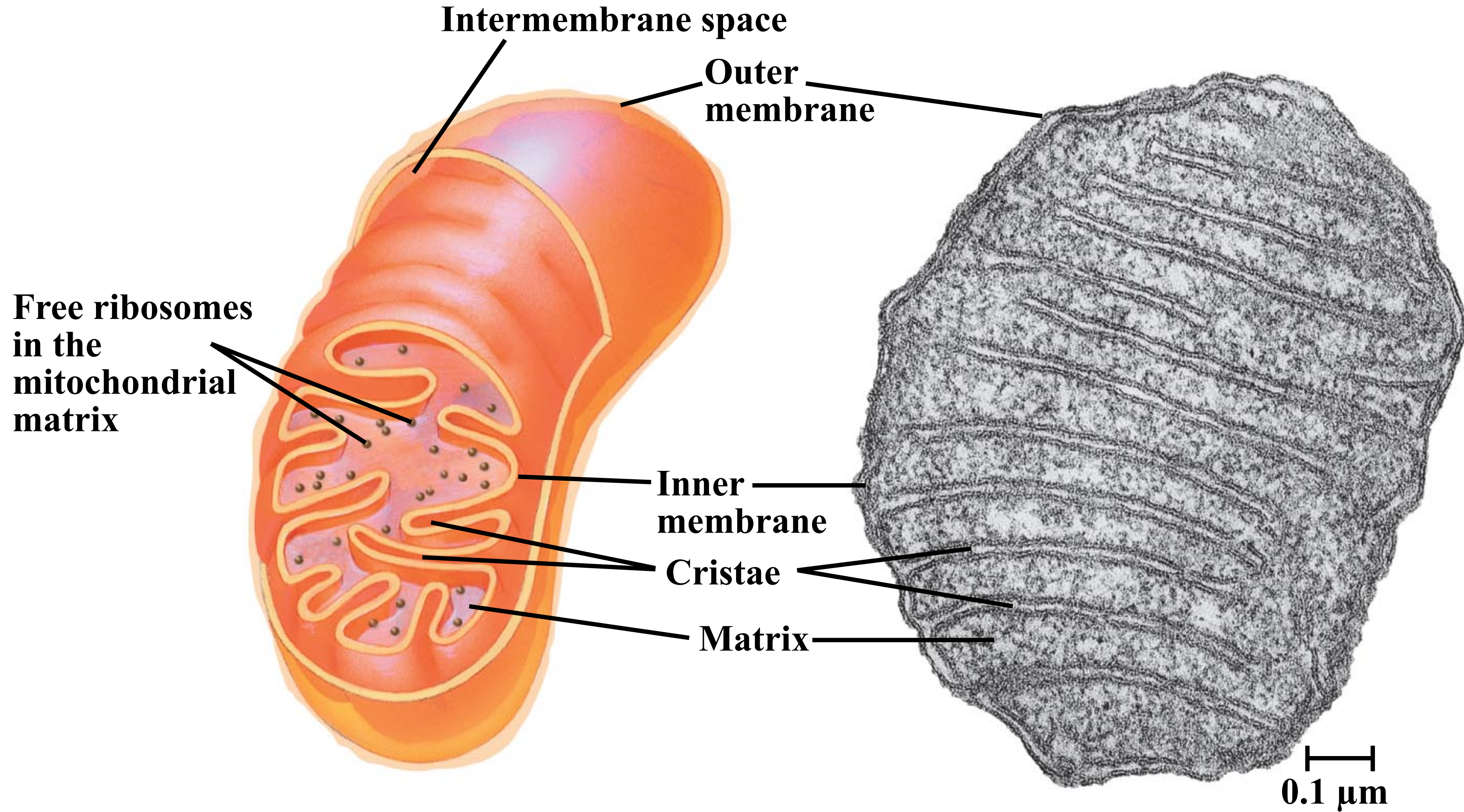
B

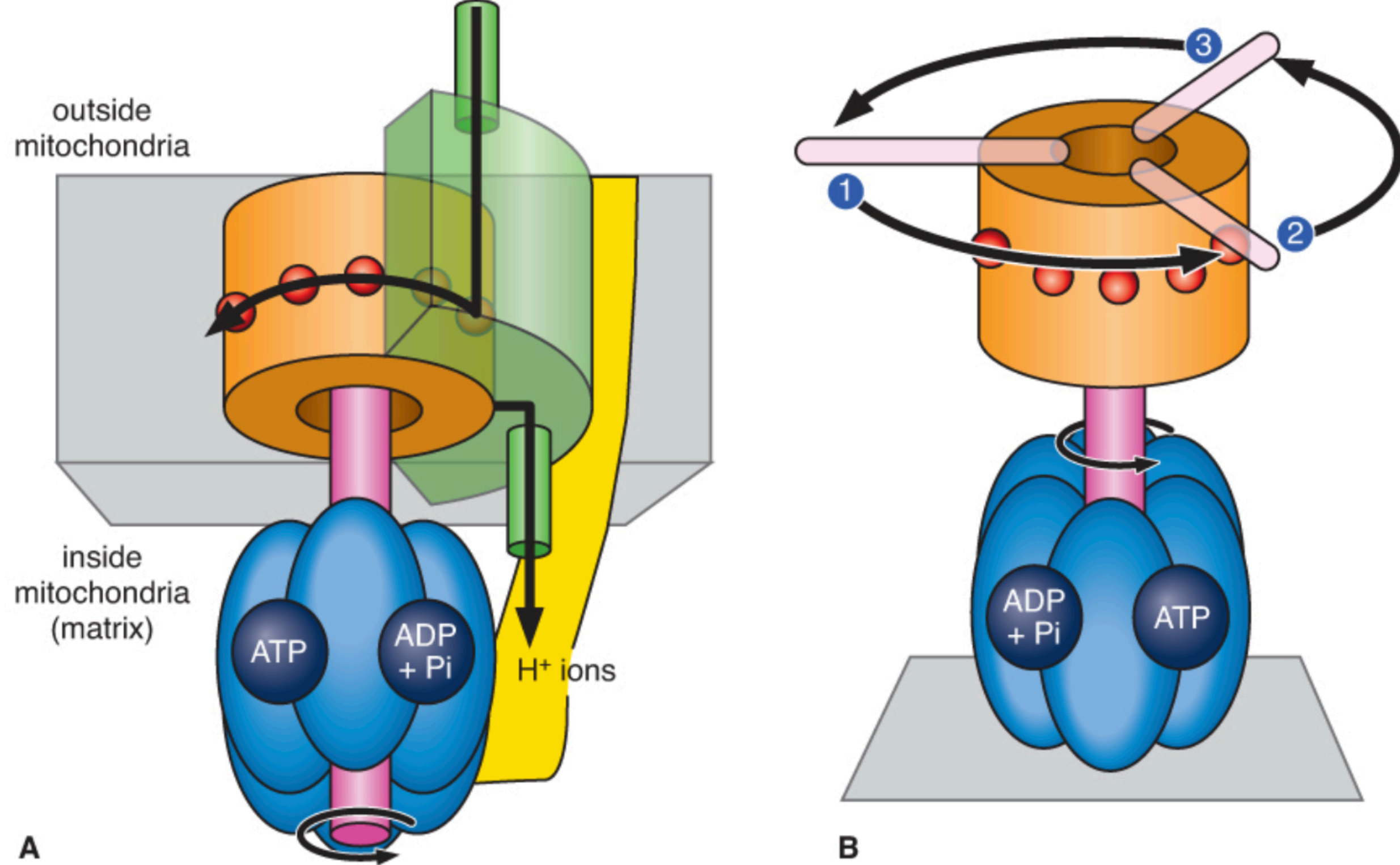


C

Figure 10.20 Measuring the pH inside mitochondria. **A**, Fluorescent protein inside mitochondria glows differently depending on the local pH. **B**, pH inside mitochondria before and after adding H⁺ ion channel (+/- standard error). **C**, Change in the pH of a solution containing vesicles with







Trifecta

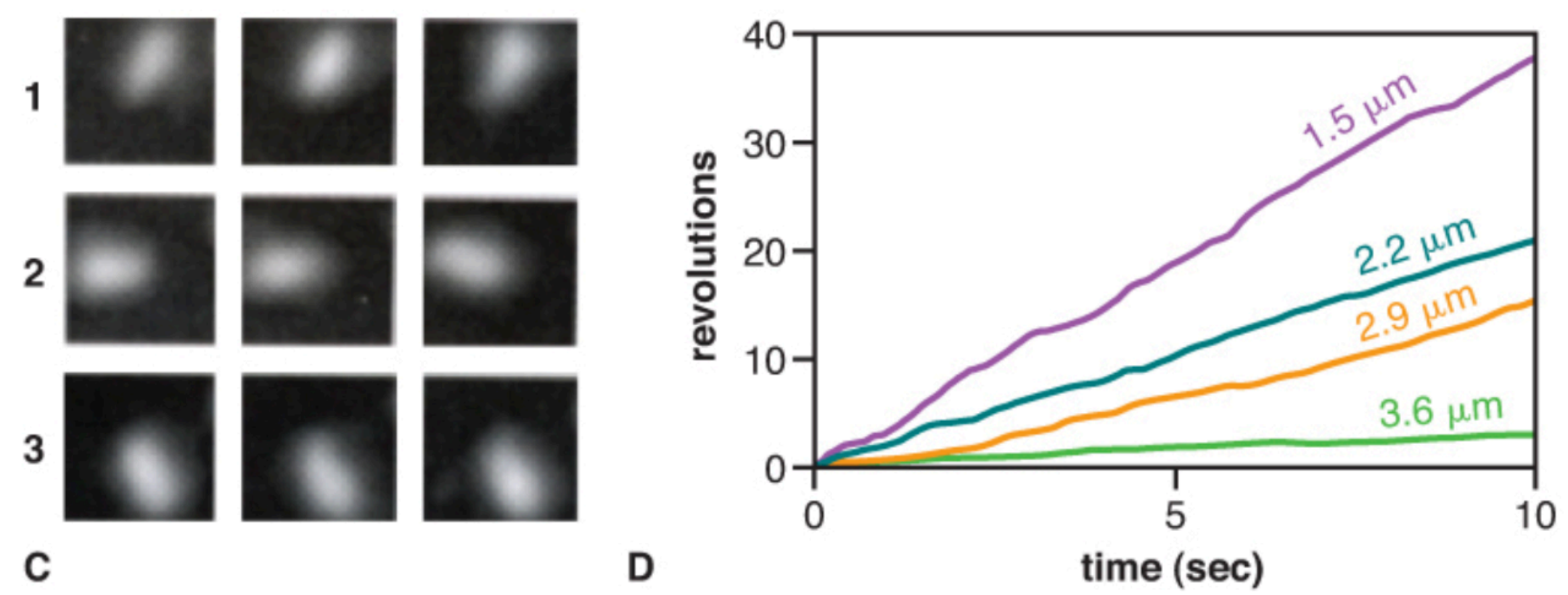
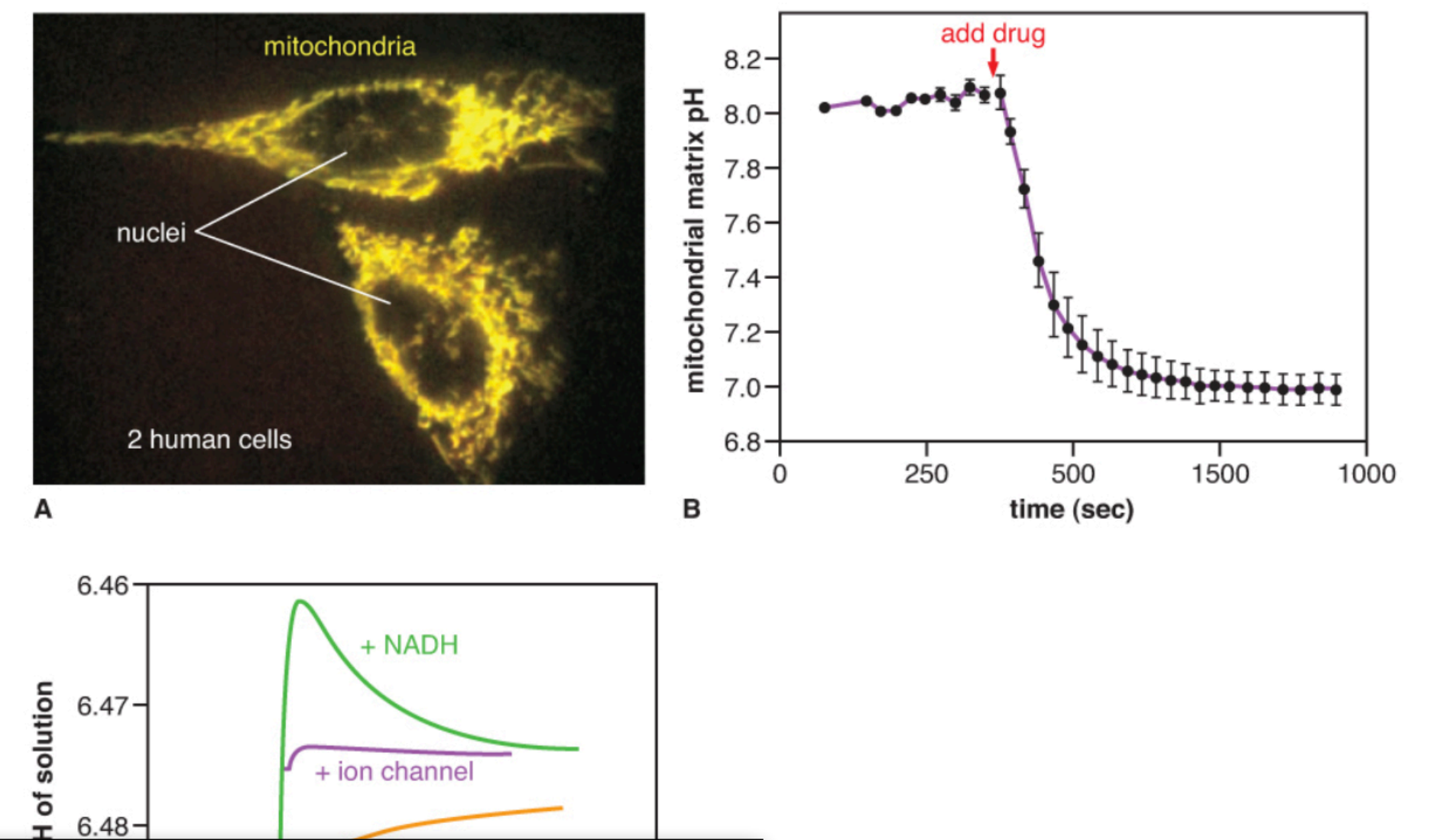


Figure 10.22 ATP synthase spins like a turbine to produce ATP. **A**, Molecular structure of ATP synthase is very similar to a human-made turbine. **B**, Immobilized ATP synthase spins its base backward when consuming ATP as visualized by attached actin rod. **C**, Photos from spinning actin from movie. **D**, Spinning rate of ATP synthase is affected by length of actin rod.

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The next experiment was the critical one to connect reducing power of NADH and FADH₂ to the pH inside mitochondria (Figure 10.20C). Biochemists produced membrane vesicles devoid of any mitochondrial proteins and then experimentally inserted a protein complex from mitochondria hypothesized to play a role in ATP production. The mitochondrial protein complex was added to the experimental vesicles so that the luminal side of the vesicle was functionally equivalent to the mitochondrial matrix and outside the vesicles was functionally equivalent to the intermembrane space. The investigators measured the pH of three solutions (outside the vesicles) containing equivalent preparations of these experimental vesicles before adding one of three treatments: NADH alone (green line); NADH plus H⁺ ion channel (purple line); NADH plus a drug that inhibits the mitochondrial protein's function (orange line).



Trifecta: purpose, methods, findings

Figure 10.20 Measuring the pH inside mitochondria. **A**, Fluorescent protein inside mitochondria glows differently depending on the local pH. **B**, pH inside mitochondria before and after adding H⁺ ion channel (+/- standard error). **C**, Change in the pH of a solution containing vesicles with mitochondrial protein complex after treatments as indicated; green arrow indicates when each preparation received indicated treatment. Panel A modified from Abad *et al.*, 2004; figure 2c. Abad, Maria F. Cano, Giulietta Di Benedetto, *et al.*, 2004. Mitochondrial pH monitored by a new engineered green fluorescent protein mutant. *Journal of Biological Chemistry*. Vol. 279(12): 11521 – 11529. Copyright 2004 The American Society for Biochemistry and Molecular Biology. Panel B modified from Llopis *et al.*, 1998; figure 3e. Llopis, Juan, J. Michael McCaffery, *et al.*, 1998. Measurement of cytosolic, mitochondrial, and Golgi pH in single living cells with green fluorescent proteins. *PNAS*. Vol. 95: 6803–6808. Copyright (1998) National Academy of Sciences, U.S.A. Panel C courtesy Leung *et al.*, *J Biol Chem* 250 (21): 8467-8471, 1975.

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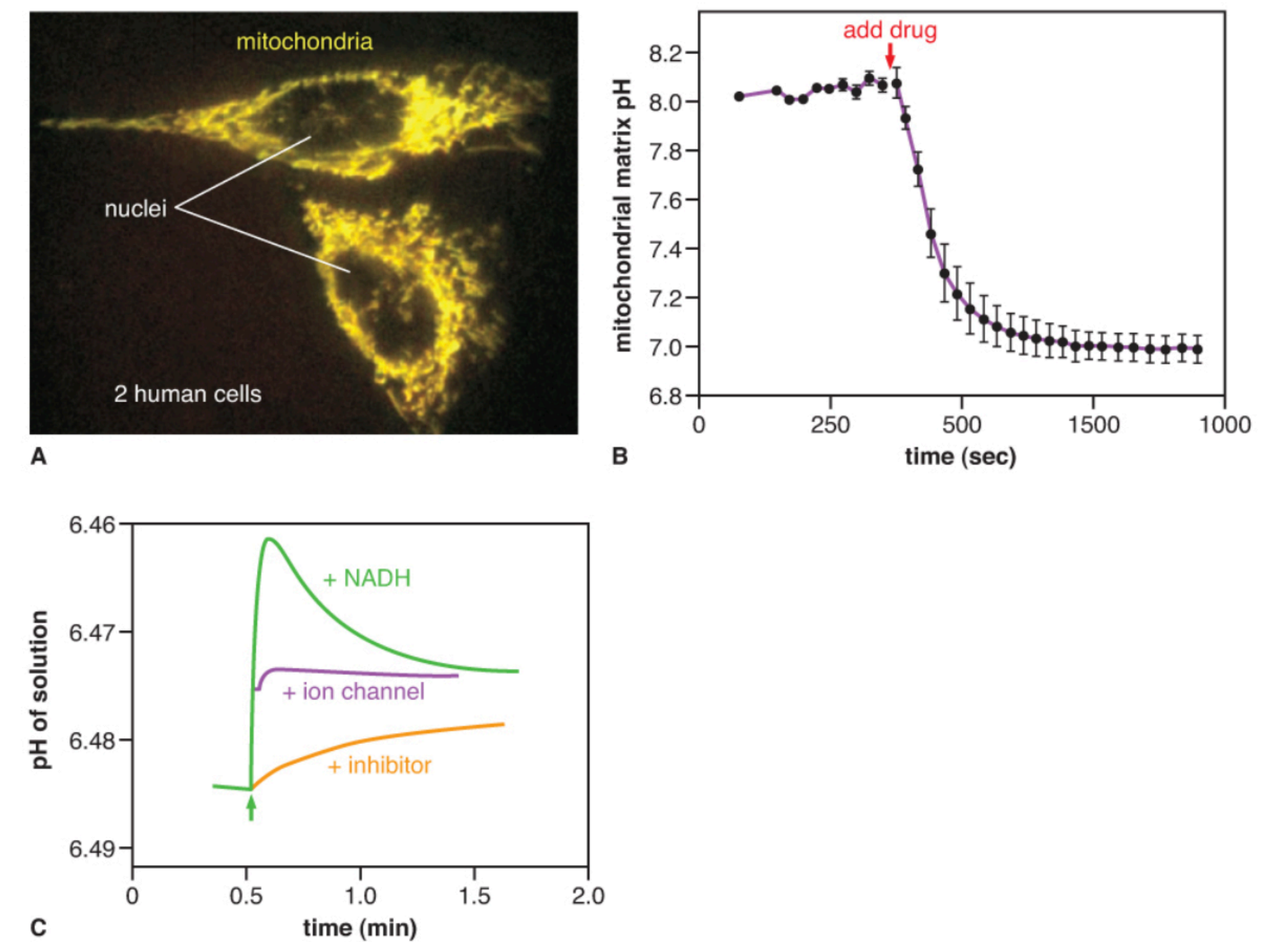
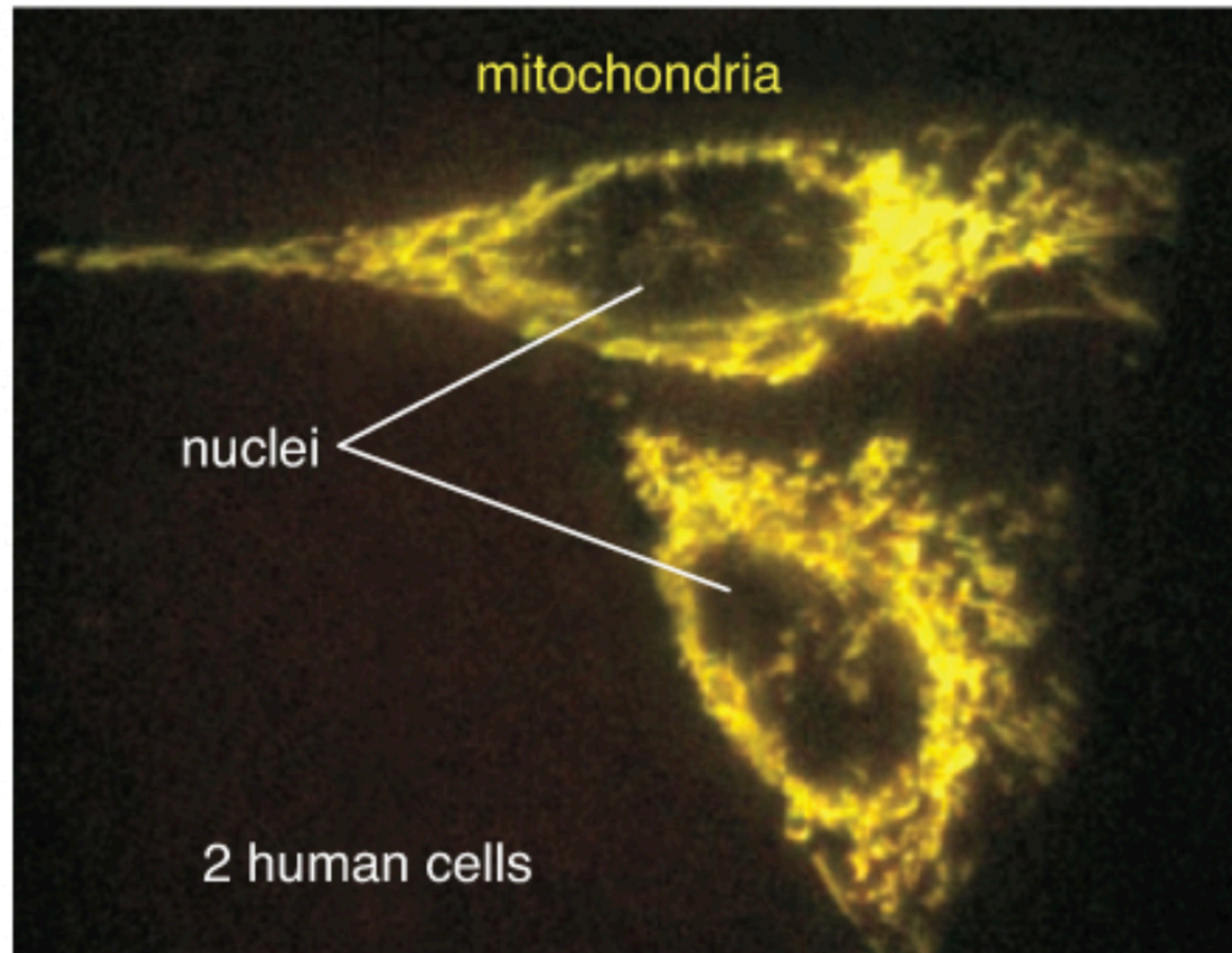


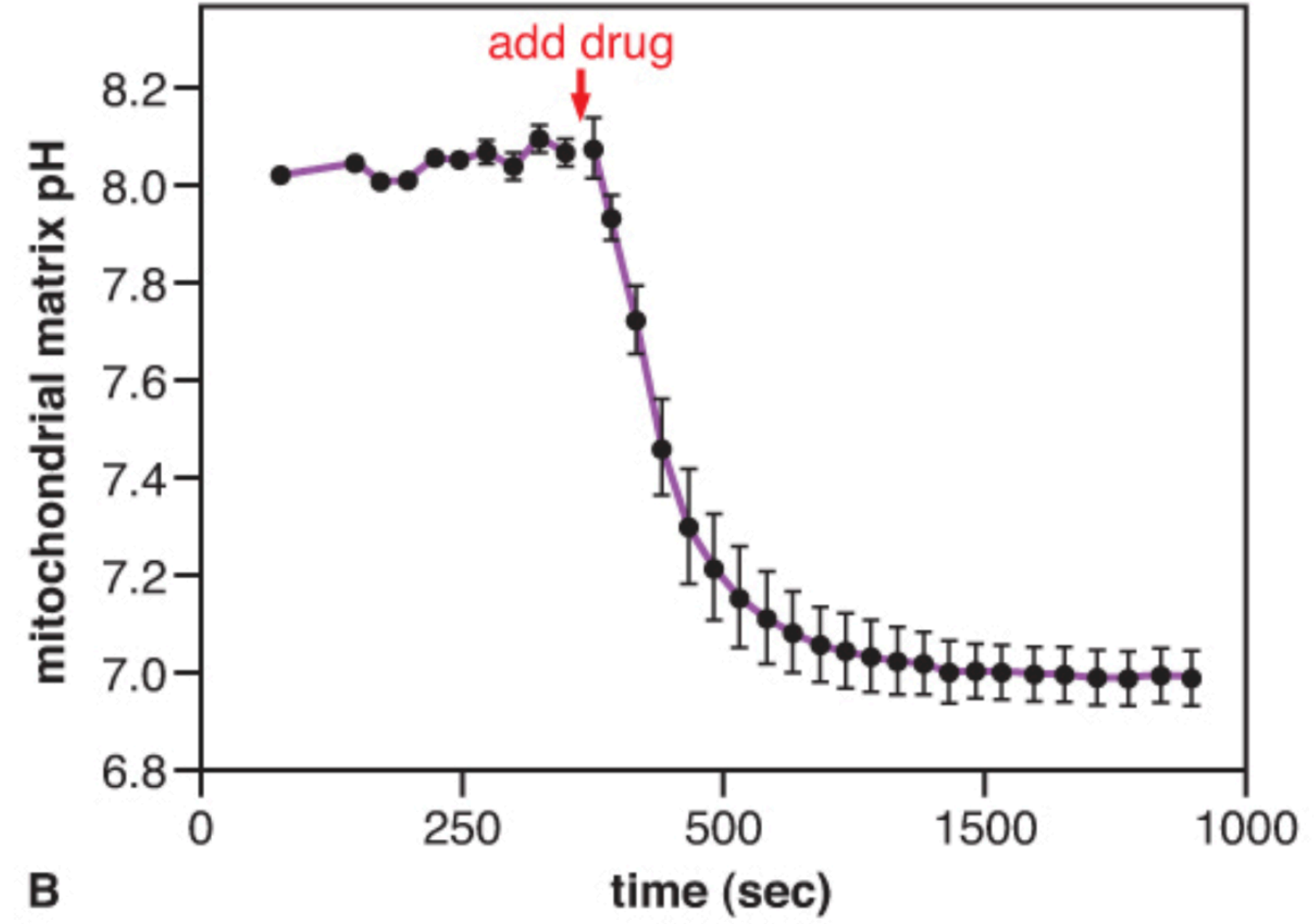
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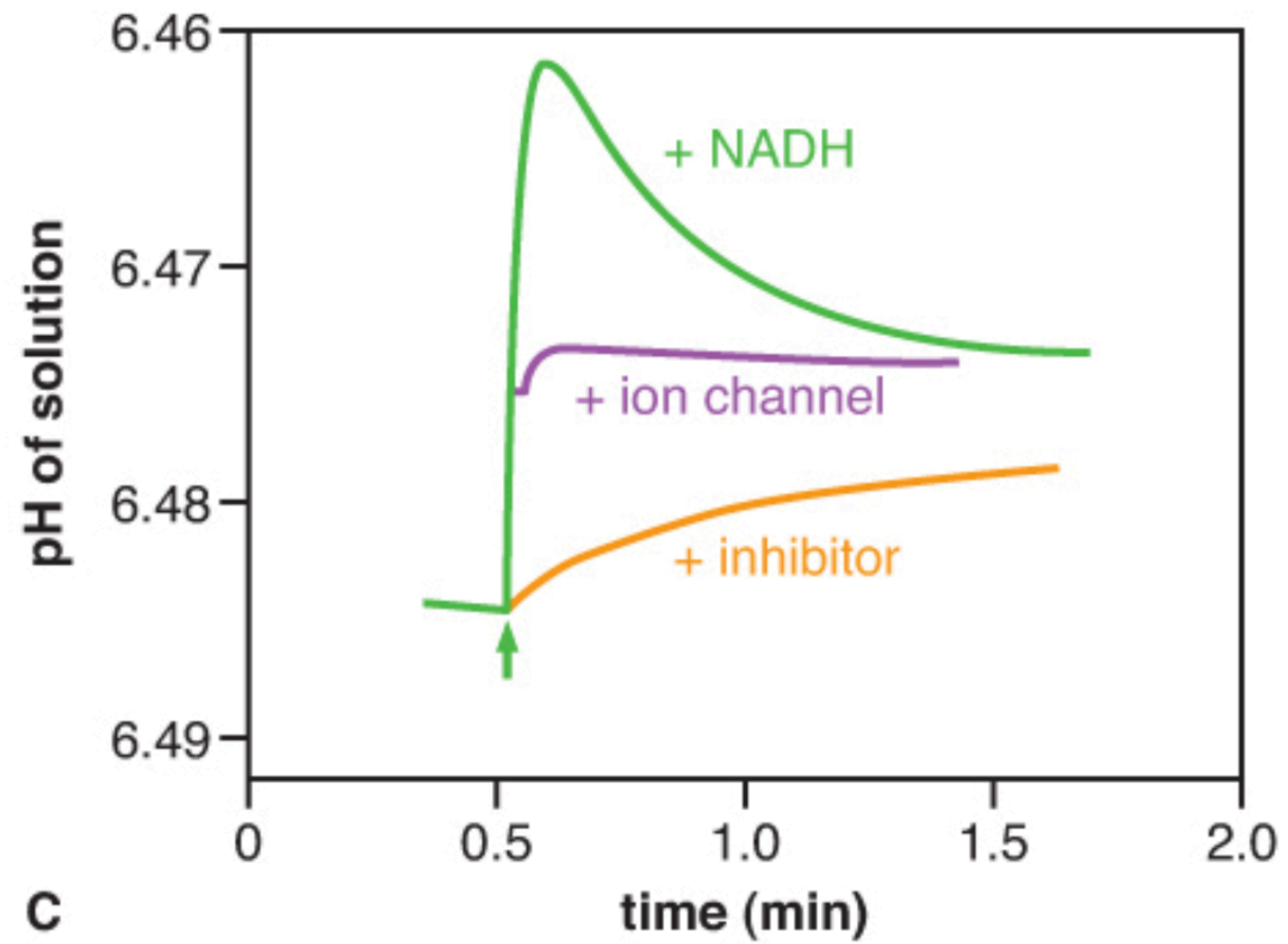
Prepare to
Explain:
Purpose,
Methods,
Findings
(trifecta)



A

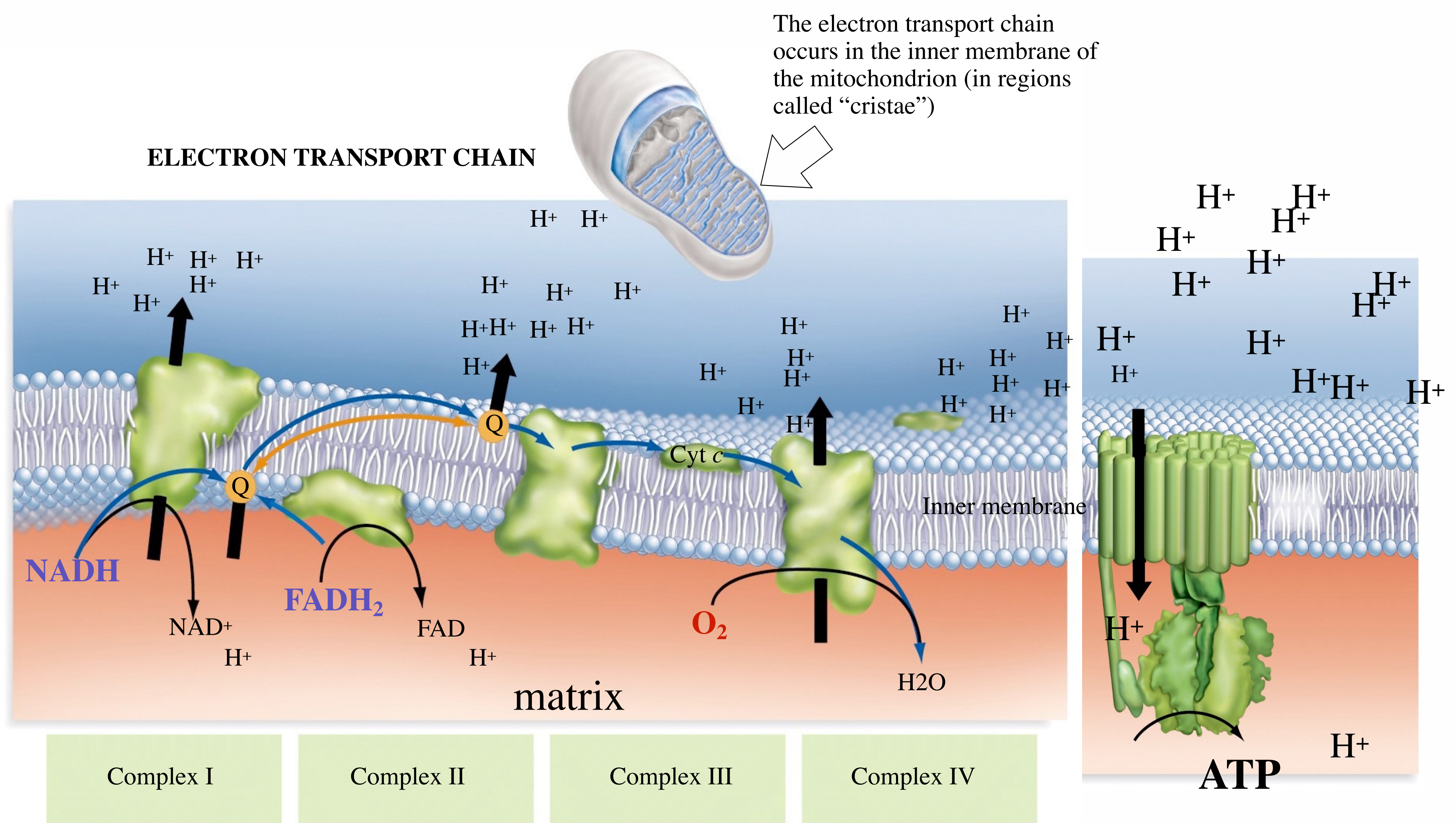


B



C

Trifecta



1. What is backwards? 2. How much ATP? 3. Poke hole?