BIOCHEM/NUTR SCI 550/560: Principles of Human Disease and Biotechnology

Spring 2023

Lectures: 175 Biochemistry (Khorana Auditorium)
T, Th. 8:50-9:40AM

Instructors: Jason Cantor, PhD
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Office hours by appointment only. Please contact the instructors by e-mail.

Teaching assistant: Jess Davidson
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Office hours by appointment only. Please contact the instructors by e-mail.

Prerequisites: BIOCHEM 501, 507, or graduate/professional standing

Course website: https://canvas.wisc.edu/courses/328902
Please check regularly for announcements and related readings (examples listed at end of this document).

Course Designations and Attributes:
Level: Advanced
Breadth: Biological Sciences; counts toward the Natural Science requirement
L&S Credit; counts as Liberal Arts and Science credit
50% Graduate Coursework

Credits: 2

Instructional Mode: Face-to-face

Course Description:
Covers basic and applied biochemical principles related to human disease. Topics such as: cancer, including cell cycle regulation, oncogenes and tumor suppressors, and cellular metabolism; metabolic disorders, including cardiovascular disease, metabolic syndrome, and diabetes; biotechnology, including metabolomics, CRISPR-based genetic screens, and experimental models of human disease.

Credit Hours:

This course will consist of two 50-minute lectures per week and carries the expectation that students will work on course learning activities (reading, writing, problem sets, studying, etc.) for about 2 hours out of the classroom for every class period. The syllabus includes additional information about meeting times and expectations for student work.

Attendance:
It is important and expected that you will attend all lectures. Please be prompt, as late arrivals tend to distract others in the class. There is a strong correlation between class attendance/participation and student understanding/performance in the course. Between the second and third modules, there will be a series of class periods dedicated to short presentations led by student teams – attendance and participation is again expected.

Regular and Substantive Student-Instructor Interaction:
Interaction with faculty and instructional staff in each course is a crucial component of the high-quality education UW–Madison offers. It is key to providing every student with the Wisconsin Experience. A qualified instructor will provide direct instruction during regularly scheduled class meetings (twice weekly). A qualified instructor will also provide regular feedback on student coursework and provide information regarding course content and competency.

Course objectives:
This course has three main objectives: (1.) to teach students about basic biochemical principles that underlie our understanding of cancer and other metabolic disorders, (2.) to familiarize students with certain basic and translational approaches in biotechnology that are used to study and treat these diseases, and (3.) to introduce students to primary scientific literature and the process of critically reading and presenting biological research. At the end of the course, students should be able to:

- Critically evaluate and accurately describe findings from primary research publications
- Analyze how genetic and cell cycle perturbations contribute to cancer progression
- Identify genetic and environmental factors impact altered cellular metabolism in cancer
- Describe biochemical mechanisms that contribute to cardiovascular disease, metabolic syndrome, and diabetes
- Explain biochemical techniques, engineering strategies, and state-of-the-art technologies used in biomedical research
- Collaborate with peers in a small group
- Apply knowledge of biochemical principles and biotechnology to solve research and disease treatment related problems.
- **Graduate students:** Execute written critical evaluation of primary research literature related to the molecular basis of human diseases and advances in biotechnology.

Course textbook:
This course does not have a required textbook. Reading materials related to lectures will be made available on the course website.

Exams:
Three exams are scheduled during class periods. Exams will assess understanding of material in the preceding module. Given the lectures allotted for each topic, the first exam (cancer) will count for 25% of the total grade, while the second (metabolic disorders) and third (biotechnology) exams will each count for 15% of the total grade.

All exams are closed-book and closed-notes. All cell phones must be stored away during exams – use of a cell phone or texting during an exam will lead to an automatic failure of the exam. If use of a calculator is warranted for a particular exam, only basic scientific (not graphing) will be permitted. There will be no make-up exams offered – the only exceptions are out-of-town scientific meetings (plans must be discussed with the instructors at least 3 weeks prior to the exam date); serious illness that necessitates confinement, medical care, or hospitalization; serious family illness/emergency.

Students will have one week after the exam is returned to request for re-grading. Requests must be accompanied by a rationale and nothing is to be marked on the original exam itself. Also note that any exams submitted for re-grade will be subject to a complete evaluation of the entire exam and not limited to only the request in question. There will also be no re-grades considered for exams written in pencil.

Poster project/presentation:
Students will work in teams of 3 to create a poster that presents a primary research paper selected from a pre-selected list. The TA will assist students in the formation of said teams and in the selection of the publication to be evaluated. All posters will be displayed in the Biochemistry Atrium.

In addition, each team will also prepare a 5-7 minute "flash talk" overview of their assigned paper to be presented over 3-5 total slides (PowerPoint or Keynote) during a designated class session (see schedule). Each student will be responsible for presenting at least 1 slide, and all presentations will be followed by a 3-minute period for questions from other teams. The talk should highlight major topics of the reading and also include at least one thought-provoking question raised by the team. Each group will come up with 1-2 weaknesses of the study and the next experiment that would address the weakness(es) in a separate slide after their conclusions. Taken together, this project will count for 25% of the final grade. Grades will be assigned based on the presentation style (poster and slides) and quality of discussion/analysis.

Software needed to prepare posters and presentations is freely available for personally-owned computers from the Campus Software Library (campus software library) and on machines in several Campus Computer Labs. Most computer labs have staff available to assist, Mac and Windows OS, evening and weekend hours, and assistive technology (campus computer labs). Adobe Illustrator software for preparing posters is available in some Campus Computer Labs. We recommend the CALS computer lab (1675 Observatory Drive; Cals computer lab) and the WisCel center on the 4th floor of Wendt Commons (215 N Randal Ave; Wendt WisCel). These labs have the most complete software collections. Large format poster printing is available at Steenbock Library (Steenbock poster printing) and College Library (College Library poster printing).

Graduate students:
Graduate students will be required to compose a written review-like evaluation of the publication selected for the cornerstone poster project. This document will contain at least 4 pages (single spaced, excluding references and figures) and is expected to include the following sections: (i) summary of background, research objectives, findings; (ii) identification of at least 2 weaknesses, with explanation, among the experimental methods, data analysis/representation, proposed interpretation and conclusions made by the primary authors; (iii) at least one additional proposed experiment that could strengthen the paper; (iv) commentary on the big-picture impact of the findings and possible future directions. This assignment will be 20 points of the final grade. Feedback will be provided in written form.

Problem sets:
There will be a total of 9 problem sets (8 graded) assigned over the duration of the course. Students must work independently, but are permitted to consult with the TA. Problem sets are submitted online at the

Canvas Assignments Page before 5:00PM on the corresponding due date. Answer keys will be posted ~24 hr after the due date/time – late submissions for a maximum of 50% credit will not be accepted after the answer key has been posted. The 8 graded problem sets will account for 20% of the total grade.

Grading:

Note that point totals are out of 100 points (120 points Graduate Students) and will be fit to a curve as necessary. Scores that cluster near the class mean will be awarded a **B**, with the scale adjusting accordingly (up or down). Below are listed the historical averages for final grades in this course, which are subject to change based on overall class performance. The curve will be applied on the final point total, not for each exam or assignment.

Grade point breakdown for undergraduate students

Exam 1	25
Exam 2	15
Exam 3	15
Poster project/ presentation	25
Problem sets	20
Total	100

Grade point breakdown for graduate students

Exam 1	25
Exam 2	15
Exam 3	15
Poster project/ presentation	25
Problem sets	20
Review paper	20
Total	120

Historical Averages for Letter Grades

Undergraduates (UG): percentage out of 100 possible points
Graduate students (Grad): percentage out of 120 possible points

Points (UG)	Points (Grad)	Grade
91-100	110-120	A
86-90	104-109	AB
76-85	96-103	B
70-75	90-95	BC
60-71	80-94	C
50-59	72-79	D
0-49	0-71	F

Academic Integrity:

Each student must be vigilant of academic integrity at all times. Any form of cheating, fabrication, plagiarism or academic dishonesty will not be tolerated, and can result in disciplinary action. This includes – but is not limited to – failure on the associated exam/assignment (or course), disciplinary probation, or suspension. The University of Wisconsin Office of Student Conduct and Community Standards states:

Students are expected to uphold the core values of academic integrity which include honesty, trust, fairness, respect and responsibility. These core values, combined with finding one's purpose and passion and applying them in and out of classroom learning, produce students who become extraordinary citizens. This unique path

of opportunities, created by each student, is commonly known as the Wisconsin Experience and impacts our campus community and beyond in significant and positive ways.

Further details can be found here: https://conduct.students.wisc.edu/misconduct/academic-integrity/

Notice for students with disabilities:
Students with disabilities may request appropriate academic accommodations from the McBurney Disability Resource Center: http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php

The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA."

Accommodations for religious holidays:
Per the University of Wisconsin-Madison policy, students must notify course instructors within the first two weeks of the semester of the specific dates conflicting with an exam or assignment. https://kb.wisc.edu/page.php?id=21698

If you must miss a class, assignment, or exam in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.

Recorded lecture materials and online deposition:
Lecture materials and recordings for this course are protected intellectual property at UW-Madison. Students in this course may use the materials and recordings for their personal use related to participation in this class. Students may also take notes solely for their personal use. If a lecture is not already recorded, you are not authorized to record my lectures without my permission unless you are considered by the university to be a qualified student with a disability requiring accommodation. [Regent Policy Document 4-1] Students may not copy or share lecture materials and recordings outside of class, including posting on internet sites or selling to commercial entities. Students are also prohibited from providing or selling their personal notes to anyone else or being paid for taking notes by any person or commercial firm without the instructor's express written permission. Unauthorized use of these copyrighted lecture materials and recordings constitutes copyright infringement and may be addressed under the university's policies, UWS Chapters 14 and 17, governing student academic and non-academic misconduct.

REPRESENTATIVE SCHEDULE OF COURSE CONTENT:

Date	Topic	Instructor	Poster Project	Problem Set (due date)
Jan. 24	Introduction, Oncogene Theory	Meyer, Cantor		
Jan. 26	Eukaryotic Cell Cycle Regulation	Meyer	Begin forming teams	
Jan. 31	Cell cycle regulators: Extrinsic and Intrinsic Signals	Meyer		PS 1 due (Jan. 30)
Feb. 2	Cell cycle regulators: Death signaling	Meyer		
Feb. 7	Genome instability and repair	Meyer		PS 2 due (Feb. 6)
Feb. 9	Tumor Suppressor	Meyer	Teams finalized	
Feb. 14	Introduction to Cancer Metabolism: Warburg Effect	Cantor	Teams view paper choices	PS 3 due (Feb. 13)
Feb. 16	How intrinsic factors influence cancer metabolism	Cantor		
Feb. 21	How extrinsic factors influence cancer metabolism	Cantor		PS 4 due (Feb. 20)
Feb. 23	Therapeutic targeting of cancer metabolism	Cantor	Teams submit paper choices	
Feb. 28	*Discussion & Review*	TA	TA finalizes paper choices	PS 5 due (Feb. 27)
Mar. 2	***EXAM 1***			
Mar. 7	Cardiovascular Disease overview	Meyer		
Mar. 9	Lipid metabolism and familial hypercholesterolemia	Meyer		
Mar. 14	Spring Break			
Mar. 16	Spring Break			
Mar. 21	Tangier Disease	Meyer		PS 6 due (Mar. 20)
Mar. 23	Metabolic Syndrome	Meyer	Submit poster draft for critique	
Mar. 28	Type II Diabetes	Meyer		PS 7 due (Mar. 27)
Mar. 30	*Discussion & Review*	TA	Reserve time to print poster	
Apr. 4	***EXAM 2***			
Apr. 6	***Flash Talks # 1***		Posters displayed prior to Apr 6	
Apr. 11	***Flash Talks # 2***			
Apr. 13	***Flash Talks # 3***			
Apr. 18	Introduction to Metabolomics	Cantor		
Apr. 20	Protein engineering for biomedical application	Cantor		
Apr. 25	CRISPR-based genetic screens	Cantor	Poster Eval sheets due	PS 8 due (Apr. 24)
Apr. 27	Immunotherapy	Cantor		
May 2	Experimental modeling of human cell biology	Cantor	Graduate Review Paper due	PS 9 due (May 1)
May 4	*Discussion & Review*	TA		
TBD	***EXAM 3***			

REPRESENTATIVE LIST OF READING MATERIALS:

- Butler D. UN targets top killers. Nature. 2011 Sep 14;477(7364):260-1. doi: 10.1038/477260a.
- Gibbs WW. Untangling the roots of cancer. Sci Am. 2003 Jul;289(1):56-65. doi: 10.1038/scientificamerican0703-56. PMID: 12840947.

- Hubbard SR, Miller WT. Receptor tyrosine kinases: mechanisms of activation and signaling. Curr Opin Cell Biol. 2007 Apr;19(2):117-23. doi: 10.1016/j.ceb.2007.02.010. Epub 2007 Feb 16. PMID: 17306972; PMCID: PMC2536775.
- Malumbres M, Barbacid M. Mammalian cyclin-dependent kinases. Trends Biochem Sci. 2005 Nov;30(11):630-41. doi: 10.1016/j.tibs.2005.09.005. Epub 2005 Oct 19. PMID: 16236519.
- Vetter IR, Wittinghofer A. The guanine nucleotide-binding switch in three dimensions. Science. 2001 Nov 9;294(5545):1299-304. doi: 10.1126/science.1062023. PMID: 11701921.
- Youle RJ, Strasser A. The BCL-2 protein family: opposing activities that mediate cell death. Nat Rev Mol Cell Biol. 2008 Jan;9(1):47-59. doi: 10.1038/nrm2308. PMID: 18097445.
- Hoeijmakers JH. Genome maintenance mechanisms for preventing cancer. Nature. 2001 May 17;411(6835):366-74. doi: 10.1038/35077232. PMID: 11357144.
- Vousden KH, Lu X. Live or let die: the cell's response to p53. Nat Rev Cancer. 2002 Aug;2(8):594-604. doi: 10.1038/nrc864. PMID: 12154352.
- Liberti MV, Locasale JW. The Warburg Effect: How Does it Benefit Cancer Cells? Trends Biochem Sci. 2016 Mar;41(3):211-218. doi: 10.1016/j.tibs.2015.12.001. Epub 2016 Jan 5. Erratum in: Trends Biochem Sci. 2016 Mar;41(3):287. Erratum in: Trends Biochem Sci. 2016 Mar;41(3):287. PMID: 26778478; PMCID: PMC4783224.
- Vander Heiden MG, DeBerardinis RJ. Understanding the Intersections between Metabolism and Cancer Biology. Cell. 2017 Feb 9;168(4):657-669. doi: 10.1016/j.cell.2016.12.039. PMID: 28187287; PMCID: PMC5329766.
- Vander Heiden MG, Cantley LC, Thompson CB. Understanding the Warburg effect: the metabolic requirements of cell proliferation. Science. 2009 May 22;324(5930):1029-33. doi: 10.1126/science.1160809. PMID: 19460998; PMCID: PMC2849637.
- Cantor JR, Sabatini DM. Cancer cell metabolism: one hallmark, many faces. Cancer Discov. 2012 Oct;2(10):881-98. doi: 10.1158/2159-8290.CD-12-0345. Epub 2012 Sep 25. PMID: 23009760; PMCID: PMC3491070.
- Liu GY, Sabatini DM. mTOR at the nexus of nutrition, growth, ageing and disease. Nat Rev Mol Cell Biol. 2020 Apr;21(4):183-203. doi: 10.1038/s41580-019-0199-y. Epub 2020 Jan 14. Erratum in: Nat Rev Mol Cell Biol. 2020 Jan 31;: PMID: 31937935; PMCID: PMC7102936.
- DeBerardinis RJ, Chandel NS. Fundamentals of cancer metabolism. Sci Adv. 2016 May 27;2(5):e1600200. doi: 10.1126/sciadv.1600200. PMID: 27386546; PMCID: PMC4928883.
- Yuan TL, Cantley LC. PI3K pathway alterations in cancer: variations on a theme. Oncogene. 2008 Sep 18;27(41):5497-510. doi: 10.1038/onc.2008.245. PMID: 18794884; PMCID: PMC3398461.
- DeNicola GM, Cantley LC. Cancer's Fuel Choice: New Flavors for a Picky Eater. Mol Cell. 2015 Nov 19;60(4):514-23. doi: 10.1016/j.molcel.2015.10.018. PMID: 26590711; PMCID: PMC4676726.
- Huber V, Camisaschi C, Berzi A, Ferro S, Lugini L, Triulzi T, Tuccitto A, Tagliabue E, Castelli C, Rivoltini L. Cancer acidity: An ultimate frontier of tumor immune escape and a novel target of immunomodulation. Semin Cancer Biol. 2017 Apr;43:74-89. doi: 10.1016/j.semcancer.2017.03.001. Epub 2017 Mar 6. PMID: 28267587.
- Kamphorst JJ, Nofal M, Commisso C, Hackett SR, Lu W, Grabocka E, Vander Heiden MG, Miller G, Drebin JA, Bar-Sagi D, Thompson CB, Rabinowitz JD. Human pancreatic cancer tumors are nutrient poor and tumor cells actively scavenge extracellular protein. Cancer Res. 2015 Feb 1;75(3):544-53. doi: 10.1158/0008-5472.CAN-14-2211. PMID: 25644265; PMCID: PMC4316379.

- Kato Y, Ozawa S, Miyamoto C, Maehata Y, Suzuki A, Maeda T, Baba Y. Acidic extracellular microenvironment and cancer. Cancer Cell Int. 2013 Sep 3;13(1):89. doi: 10.1186/1475-2867-13-89. PMID: 24004445; PMCID: PMC3849184.
- Lyssiotis CA, Kimmelman AC. Metabolic Interactions in the Tumor Microenvironment. Trends Cell Biol. 2017 Nov;27(11):863-875. doi: 10.1016/j.tcb.2017.06.003. Epub 2017 Jul 19. PMID: 28734735; PMCID: PMC5814137.
- Longley DB, Harkin DP, Johnston PG. 5-fluorouracil: mechanisms of action and clinical strategies. Nat Rev Cancer. 2003 May;3(5):330-8. doi: 10.1038/nrc1074. PMID: 12724731.
- Luengo A, Gui DY, Vander Heiden MG. Targeting Metabolism for Cancer Therapy. Cell Chem Biol. 2017 Sep 21;24(9):1161-1180. doi: 10.1016/j.chembiol.2017.08.028. PMID: 28938091; PMCID: PMC5744685.
- Goldstein JL, Brown MS. A century of cholesterol and coronaries: from plaques to genes to statins. Cell. 2015 Mar 26;161(1):161-172. doi: 10.1016/j.cell.2015.01.036. PMID: 25815993; PMCID: PMC4525717.
- Ikonen E. Cellular cholesterol trafficking and compartmentalization. Nat Rev Mol Cell Biol. 2008 Feb;9(2):125-38. doi: 10.1038/nrm2336. PMID: 18216769.
- Innerarity TL. Structural biology. LDL receptor's beta-propeller displaces LDL. Science. 2002 Dec 20;298(5602):2337-9. doi: 10.1126/science.1080669. PMID: 12493900.
- Rudenko G, Henry L, Henderson K, Ichtchenko K, Brown MS, Goldstein JL, Deisenhofer J. Structure of the LDL receptor extracellular domain at endosomal pH. Science. 2002 Dec 20;298(5602):2353-8. doi: 10.1126/science.1078124. Epub 2002 Nov 29. PMID: 12459547.
- Kang MH, Singaraja R, Hayden MR. Adenosine-triphosphate-binding cassette transporter-1 trafficking and function. Trends Cardiovasc Med. 2010 Feb;20(2):41-9. doi: 10.1016/j.tcm.2010.03.006. Erratum in: Trends Cardiovasc Med. 2010 Apr;20(3):108. PMID: 20656214.
- Osborn O, Olefsky JM. The cellular and signaling networks linking the immune system and metabolism in disease. Nat Med. 2012 Mar 6;18(3):363-74. doi: 10.1038/nm.2627. PMID: 22395709.
- van der Klaauw AA, Farooqi IS. The hunger genes: pathways to obesity. Cell. 2015 Mar 26;161(1):119-132. doi: 10.1016/j.cell.2015.03.008. PMID: 25815990.
- Kahn SE, Cooper ME, Del Prato S. Pathophysiology and treatment of type 2 diabetes: perspectives on the past, present, and future. Lancet. 2014 Mar 22;383(9922):1068-83. doi: 10.1016/S0140-6736(13)62154-6. Epub 2013 Dec 3. PMID: 24315620; PMCID: PMC4226760.
- Jang C, Chen L, Rabinowitz JD. Metabolomics and Isotope Tracing. Cell. 2018 May 3;173(4):822-837. doi: 10.1016/j.cell.2018.03.055. PMID: 29727671; PMCID: PMC6034115.
- Patti GJ, Yanes O, Siuzdak G. Innovation: Metabolomics: the apogee of the omics trilogy. Nat Rev Mol Cell Biol. 2012 Mar 22;13(4):263-9. doi: 10.1038/nrm3314. PMID: 22436749; PMCID: PMC3682684.
- Hansel TT, Kropshofer H, Singer T, Mitchell JA, George AJ. The safety and side effects of monoclonal antibodies. Nat Rev Drug Discov. 2010 Apr;9(4):325-38. doi: 10.1038/nrd3003. Epub 2010 Mar 22. PMID: 20305665.

- Kazlauskas RJ, Bornscheuer UT. Finding better protein engineering strategies. Nat Chem Biol. 2009 Aug;5(8):526-9. doi: 10.1038/nchembio0809-526. PMID: 19620988.
- Packer MS, Liu DR. Methods for the directed evolution of proteins. Nat Rev Genet. 2015 Jul;16(7):379-94. doi: 10.1038/nrg3927. Epub 2015 Jun 9. PMID: 26055155.
- Doench JG. Am I ready for CRISPR? A user's guide to genetic screens. Nat Rev Genet. 2018 Feb;19(2):67-80. doi: 10.1038/nrg.2017.97. Epub 2017 Dec 4. PMID: 29199283.
- Joung J, Konermann S, Gootenberg JS, Abudayyeh OO, Platt RJ, Brigham MD, Sanjana NE, Zhang F. Genome-scale CRISPR-Cas9 knockout and transcriptional activation screening. Nat Protoc. 2017 Apr;12(4):828-863. doi: 10.1038/nprot.2017.016. Epub 2017 Mar 23. Erratum in: Nat Protoc. 2019 Jul;14(7):2259. PMID: 28333914; PMCID: PMC5526071.
- van der Oost J, Westra ER, Jackson RN, Wiedenheft B. Unravelling the structural and mechanistic basis of CRISPR-Cas systems. Nat Rev Microbiol. 2014 Jul;12(7):479-92. doi: 10.1038/nrmicro3279. Epub 2014 Jun 9. PMID: 24909109; PMCID: PMC4225775.
- Fesnak AD, June CH, Levine BL. Engineered T cells: the promise and challenges of cancer immunotherapy. Nat Rev Cancer. 2016 Aug 23;16(9):566-81. doi: 10.1038/nrc.2016.97. PMID: 27550819; PMCID: PMC5543811.
- Lim WA, June CH. The Principles of Engineering Immune Cells to Treat Cancer. Cell. 2017 Feb 9;168(4):724-740. doi: 10.1016/j.cell.2017.01.016. PMID: 28187291; PMCID: PMC5553442.
- Sharma P, Allison JP. The future of immune checkpoint therapy. Science. 2015 Apr 3;348(6230):56-61. doi: 10.1126/science.aaa8172. PMID: 25838373.
- Weber EW, Maus MV, Mackall CL. The Emerging Landscape of Immune Cell Therapies. Cell. 2020 Apr 2;181(1):46-62. doi: 10.1016/j.cell.2020.03.001. PMID: 32243795.
- Ast T, Mootha VK. Oxygen and mammalian cell culture: are we repeating the experiment of Dr. Ox? Nat Metab. 2019 Sep;1(9):858-860. doi: 10.1038/s42255-019-0105-0. PMID: 32694740.
- Cantor JR. The Rise of Physiologic Media. Trends Cell Biol. 2019 Nov;29(11):854-861. doi: 10.1016/j.tcb.2019.08.009. Epub 2019 Oct 14. PMID: 31623927; PMCID: PMC7001851.
- DelNero P, Hopkins BD, Cantley LC, Fischbach C. Cancer metabolism gets physical. Sci Transl Med. 2018 May 23;10(442):eaaq1011. doi: 10.1126/scitranslmed.aaq1011. PMID: 29794058; PMCID: PMC5990021.
- Horvath P, Aulner N, Bickle M, Davies AM, Nery ED, Ebner D, Montoya MC, Östling P, Pietiäinen V, Price LS, Shorte SL, Turcatti G, von Schantz C, Carragher NO. Screening out irrelevant cell-based models of disease. Nat Rev Drug Discov. 2016 Nov;15(11):751-769. doi: 10.1038/nrd.2016.175. Epub 2016 Sep 12. PMID: 27616293.