



Germany dominates European cell biology research in terms of publication and citation numbers. The whole of Europe, on the other hand, is clearly outperformed by the USA. “Top cited” papers are on cell death and cell signalling.

Who’s a cell biologist and who’s not? Today, the answer might produce more grey figures than black and white ones. Just take a look, for example, at how the *Journal of Cell Biology* describes its editorial scope, “Areas of interest include, but are not restricted to: cell adhesion and motility; cellular communication; cell cycle and division; cell growth, survival, and death; cell structure and dynamics; cellular disease mechanisms; cytoskeleton and molecular motors; gene expression and RNA metabolism; ...” Still there? Well, we’re not through yet. The list continues “... methods and techniques; nuclear organization, function, and structure; organelle biogenesis and homeostasis; protein and membrane trafficking; signal transduction; stem cell biology; systems and computational cell biology.”

Have you noticed? There is a lot of overlap with other life science disciplines in this list. Accordingly, the American Society for Cell Biology (ASCB) writes under “The Facets of Cell Biology”, “Modern cell biology is a dynamic discipline that combines the interests of a variety of scientific fields including molecular biology, biochemistry, biophysics, microbiology, physiology, developmental biology, cytology, and genetics – fields that were once almost completely independent of each other.”

A fuzzy field

This fuzziness surrounding modern cell biology doesn’t create much difficulty when comparing the research outputs of individual European countries during the period 1996 to 2007, since only publications in recognised cell biology journals were analysed. However, as already outlined in the first sentence, a con-

siderable problem arose when assessing which individual researcher should be primarily regarded as a cell biologist, and which should not (see table p. 36).

Therefore, we had to introduce a couple of restrictions to the authors’ analysis. We excluded researchers working mainly on topics around DNA and gene expression, as we are planning a separate analysis on “(Molecular) Genetics”. Likewise, we excluded authors focussing on pure protein structure and function because they will get their chance in an upcoming analysis on “Protein Biochemistry”. Nevertheless, quite a considerable number of “grey fields” remained qualified for our “cell biology” analysis. Fields, which in the meantime, might have actually moved closer to other disciplines – like, for example, cell death and apoptosis to immunology or synaptic vesicle turnover to neurobiology.

Critical view on proteins and DNA

But let’s first turn to the comparison of national publication performance in cell biology journals during the period 1996 to 2007. As said, our analysis had to be restricted to the 157 expert journals listed in the subject category “Cell Biology” of Thomson Reuter’s database *Web of Science*, used for this analysis. Of course, particularly in cell biology many of the “top papers” are published in multidisciplinary science journals like *Nature*, *Science* or *PNAS*. Since, however, *Web of Science* doesn’t provide any tools to automatically extract relevant cell biology articles with sufficient reliability, we weren’t able to include the articles from these journals in the performance analysis of individual countries (see tables p. 43).

Subsequently, some of the most prominent papers in the field were not included in this part of the analysis. Despite this limitation, we believe that a survey, restricted to the specialist journals only, nevertheless provides sufficiently valid indicators for the countries' overall productivity in cell biology research. On the contrary, rankings of the most-cited researchers and papers (see tables p. 44) could be analysed from publications in all journals.

Applying these directives, Germany emerged as Europe's leading nation in cell biology: almost 24,000 articles that appeared in cell biology journals between 1996 and 2007 listed at least one author working in a lab in Germany. To-date, those publications have brought Germany a total of more than half-a-million citations, well ahead of England (440,000) and France (320,000).

With a little pan-European help

This excellent result for Germany, however, has to be slightly put into perspective. There is no doubt that quite a number of high profile publications from the European Molecular Biology Laboratory (EMBL), which, despite being based in Heidelberg, is not solely German but a pan-European research institute, significantly contributed to Germany's top performance in cell biology.

Another "strong performer" is Switzerland: fifth in terms of total citations and winner in the category "citations per article". On average, each "Swiss article" has been cited more than 31 times to-date. Only Scotland achieved a similarly high "citation per article"-ratio (30.1); England (25.9) and Israel (25.7) follow in considerable distance in third and fourth place, respectively.

However, the whole of Europe (including Israel) was significantly outperformed by the USA. US-based authors contributed to almost 35% more articles in the cell biology journals than all European authors together, who have collected about 35% more citations to-date. Thus, Europe and the US at least drew equal in the average number of citations per article.

Sure, it's cell biology but...

As usual, lists of the most-cited papers and authors very nicely reflect the "hottest" topics of the discipline during recent years. Topic number one is clearly cell death and apoptosis, which is represented by three of the four most-cited researchers: Guido Kroemer (1st), Peter Krammer (3rd) and Jürg Tschopp (4th), as well as by the 2nd and 5th most-cited papers. However, as said, today many would assign this field to immunology rather than to cell biology. (Incidentally, immunology itself once started as a sub-discipline of cell biology.)

Another well-represented topic is cell signalling (Philip Cohen, 5th, Johann Auwerx, 11th, Dario Alessi, 14th, Carl-Henrik Heldin, 15th). The most-cited cell biology paper 1996-2007 about protein kinases by Philip Cohen's group in Dundee also belongs to this field.

Cell signalling, of course, is heavily intertwined with the cell biology of cancer, which is, for example, represented by Hans Clevers (8th), Pier Guiseppe Pelicci (18th) and Moshe Oren (23rd). And the same holds for fields like angiogenesis (Kari Alitalo, 2nd, Werner Risau, 17th), cell adhesion (Alan Hall, 6th, Reinhard Fässler, 26th) and cell cycle (Kim Nasmyth, 16th, Jiri Bartek, 19th).

Once again, we are reminded of how, during recent decades, cell biology has developed from almost exclusively "looking at things through the microscope" into a multi-method core life science discipline, whose feelers, nowadays, stretch into nearly every other biomedical field.

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Europe...

Country	Citations	Articles	Cit./Art.
1. Germany	512,989	23,703	21.6
2. England	443,370	17,095	25.9
3. France	321,885	14,073	22.9
4. Italy	183,225	11,051	16.6
5. Switzerland	164,832	5,291	31.2
6. Netherlands	142,882	5,791	24.7
7. Spain	97,996	5,821	16.8
8. Sweden	96,308	4,683	20.6
9. Scotland	90,589	3,008	30.1
10. Israel	78,607	3,053	25.7
11. Belgium	65,625	3,054	21.5
12. Austria	61,784	2,626	23.5
13. Denmark	49,722	2,487	20.0
14. Finland	38,154	1,800	21.2
15. Russia	30,717	3,100	9.9
16. Poland	20,614	2,452	8.4
17. Norway	19,468	1,209	16.1
18. Hungary	17,989	1,711	10.5
19. Ireland	15,737	985	16.0
20. Wales	13,044	766	17.0

Articles appearing between 1996 and 2007 in cell biology journals as listed by Thomson Scientific's *Web of Science*. The numbers of citations are accurate as of July 2009. A country's figures are derived from articles where at least one author working in the respective European nation is included in the author's list. Israel is included because it is a member of many European research organisations and programmes (EMBO, FP7 of the EU...).

... and the World

	Citations	Articles	Cit./Art.
Europe	2,046,659	110,076	18.6
USA	3,155,135	168,516	18.7
Japan	491,704	32,136	15.3
Canada	262,534	15,596	16.8
Australia	127,447	7,314	17.4
South Korea	49,766	5,919	8.4
China	45,935	5,330	8.6



Publication Analysis 1996-2007 – Cell Biology

Most Cited Authors...

	Cit-ations	Art-icles
1. Guido Kroemer , Inst Gustave Roussy, INSERM, Villejuif	35,937	311
2. Kari Alitalo , Mol. Cancer Biol. Biomedicum Univ. Helsinki	23,576	246
3. Peter H. Krammer , German Canc. Res. Ctr. Heidelberg	22,585	231
4. Jürg Tschopp , Biochem. Univ. Lausanne	22,520	194
5. Philip Cohen , MRC Protein Phosphoryl. Unit Univ. Dundee	20,171	150
6. Alan Hall , Mol. Cell. Biol. Lab., MRC, Univ. Coll. London (s. 2007 New York)	19,961	123
7. Andrej Shevchenko , Max Planck Inst. Mol. Cell Biol. & Genet. Dresden	19,682	112
8. Hans Clevers , Hubrecht Lab., Netherlands Inst. Dev. Biol. Utrecht	18,037	141
9. Santos A. Susin , Immunol. Inst. Pasteur Paris	17,056	89
10. Naoufal Zamzami , Inst Gustave Roussy, INSERM, Villejuif	16,957	81
11. Johann Auwerx , Integrative and Systems Physiology, EPFL, Lausanne	16,919	201
12. Kai Simons , Max Planck Inst. Mol. Cell Biol. & Genet. Dresden	16,299	90
13. David Wallach , Dept. Biol. Chem. Weizman Inst. Rehovot	15,669	140
14. Dario R. Alessi , MRC Protein Phosphoryl. Unit Univ. Dundee	15,599	120
15. Carl-Henrik Heldin , Mol. Cell Biol. Ludwig Inst. Canc. Res. Univ. Uppsala	14,160	176
16. Kim Nasmyth , Dept. Biochem. Univ. Oxford	13,364	109
17. Werner Risau , Max Planck Inst. Physiol. & Clin. Res. Bad Nauheim	12,647	68
18. Pier Guiseppe Pelicci , European Inst. Oncol. Milan	12,481	178
19. Jiri Bartek , Dept. Cell Cycle and Cancer Inst. Canc. Biol. Copenhagen	12,296	154
20. Julian Downward , Cancer Res. UK London Res. Inst.	11,950	121
21. F. Ulrich Hartl , Max Planck Inst. Biochem. Martinsried	11,671	101
22. Sten Orrenius , Toxicol., Inst. Environ. Med. Karolinska Inst. Stockholm	11,237	145
23. Moshe Oren , Mol. Cell Biol. Weizman Inst. Rehovot	11,144	114
24. Yosef Yarden , Dept. Regulat. Biol. Weizmann Inst. Rehovot	11,036	107
25. Reinhard Jahn , Max Planck Inst. Biophys. Chem. Göttingen	10,176	118
26. Reinhard Fässler , Max Planck Inst. Biochem. Martinsried	9,562	172
27. Erich A. Nigg , Cell Biol. Univ. Basel	9,330	115
28. Michael J. Berridge , Cell Signalling The Babraham Inst. Cambridge	9,092	62
29. Walter Neupert , Physiol. Chem. Univ. Munich	9,076	176
30. Ari Helenius , Biochem. ETH Zurich	8,897	83



Citations of articles published between 1996 and 2007 were recorded until May 2009 using the *Web of Science* database from Thomson Scientific. The "most cited papers" had correspondence addresses in Europe or Israel.

... and Papers

	Citations
1. Davies, SP; Reddy, H; Caivano, M; Cohen, P Specificity and mechanism of action of some commonly used protein kinase inhibitors. <i>BIOCHEMICAL JOURNAL</i> , 351: 95-105 Part 1 OCT 1 (2000)	2,199
2. Susin, SA; Lorenzo, HK; Zamzami, N; [...]; Siderovski, DP; Penninger, JM; Kroemer, G Molecular characterization of mitochondrial apoptosis-inducing factor. <i>NATURE</i> , 397 (6718): 441-446 FEB 4 (1999)	1,859
3. Carmeliet, P; Ferreira, V; Breier, G; [...]; Collen, D; Risau, W; Nagy, A Abnormal blood vessel development and lethality in embryos lacking a single VEGF allele. <i>NATURE</i> , 380 (6573): 435-439 APR 4 (1996)	1,830
4. Haupt, Y; Maya, R; Kazaz, A; Oren, M Mdm2 promotes the rapid degradation of p53. <i>NATURE</i> , 387 (6630): 296-299 MAY 15 (1997)	1,761
5. Scaffidi, C; Fulda, S; Srinivasan, A; Friesen, C; Li, F; Tomaselli, KJ; Debatin, KM; Krammer, PH; Peter, ME Two CD95 (APO-1/Fas) signaling pathways. <i>EMBO JOURNAL</i> , 17 (6): 1675-1687 MAR 16 (1998)	1,740