

Beyond Impact Factors: Understanding the Data in the Journal Citation Reports

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Each June, authors, editors, librarians, and publishers eagerly await the Thomson Scientific release of the new *Journal Citation Reports*® (*JCR*®) containing the *JCR* Impact Factor and other citation statistics for the previous year. In 2004, the *Journal Citation Reports on the Web* (*JCR Web*) features not only a new year's data set, but also a new interface providing considerably more information about the journals' citation dynamics, the degree and type of interaction it has with the broader scientific literature, what citations contribute to the calculation of per-

formance metrics, and the average citation "life-span" of articles published in the journal.

More than an arcane resource for librarians, *JCR* is more and more a way for scientists and authors to identify the critical journals in their field, either to focus their reading or to help identify an appropriate and influential journal to which they can submit an article for publication. As a growing population of scientists use the *JCR* data, it is increasingly important that they use the information wisely to form an understanding of the journal.

This article will provide an overview of two new features in the 2003 *JCR Web*—navigational links to category information and the Cited Journal graph—and some explanation of their use in understanding the citation behavior of individual journals. The 2003 *JCR* data for the *American Journal of Physiology–Cell Physiology* will provide all the examples and images shown.

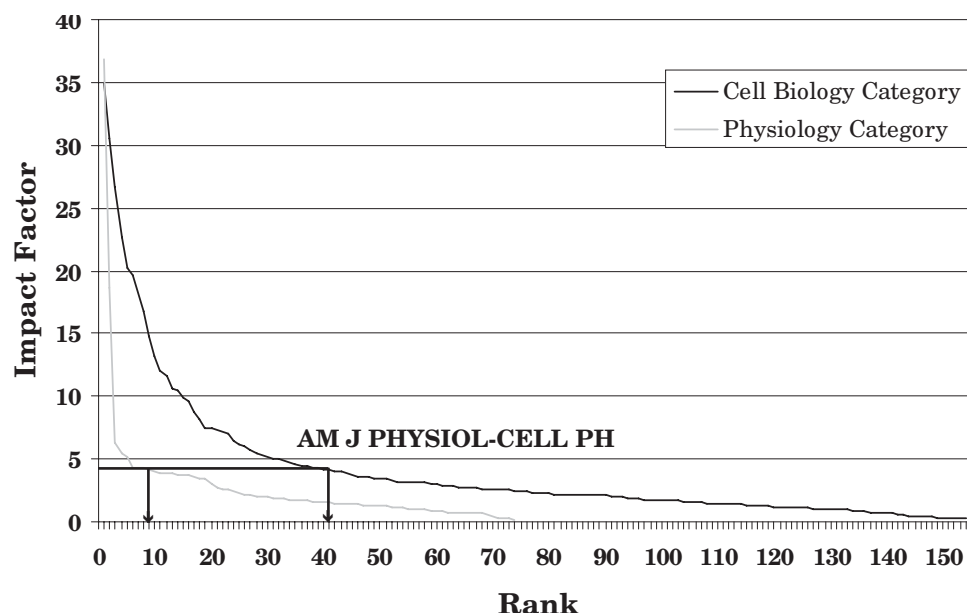
The *JCR* Impact Factor of each journal is often a matter of intense scrutiny for authors and editors of a publication. The *JCR* Impact Factor is an average rate of citation for articles one or two years after their initial publication (1). It is calculated by considering one year of indexed references from the 8,900 journals in the Thomson ISI citation databases. These citations are collected by the title of the journal referenced and filtered by the year referenced. The 2003 *JCR* Impact Factor for the *American Journal of Physiology–Cell Physiology* is calculated as follows. In 2003, Thomson ISI indexed 14,004 citations to *AM J PHYSIOL-CELL PH*. (Note: For indexing, titles are unified to a standardized, 20-character abbreviated title.) Of those citations, 1,221 referenced an item published in 2002, and 1,754 referenced an item published in 2001. Thus, the sum of the citations to articles in 2001 or 2002 is 2,975 (21% of the total number of citations to the journal in 2003). These citations are divided by the number of "citable items," that is, articles or reviews indexed by Thomson ISI from the *American Journal of Physiology–Cell Physiology* in 2001 and 2002. In 2001, Thomson ISI indexed 392 articles or reviews and 333 in 2002, a total of 725 items for the 2-year period. Therefore, the calculated *JCR* Impact Factor in 2003 is, as shown in the *JCR Web*.

Publication and citation prac-

Table 1. The JCR Impact Factor Calculation

Cites in 2003 to articles published in:			
	2002=	1,221	
	2001=	1,754	
	Sum:	2,975	(Cites to recent articles)
Number of articles published in:			
	2002=	333	
	2001=	392	
	Sum	725	(Number of recent articles)
Calculation:	$\frac{\text{Cites to recent articles}}{\text{Number of recent articles}}$	$\frac{2,975}{725}$	= 4.103

Figure 1. Rank in Category vs. JCR Impact Factor



tices differ greatly among the many subjects covered in the *JCR–Science Edition*, and a *JCR* Impact Factor needs to be considered relative to the impact of other journals of similar types and subjects. Two new navigational links in the *JCR Web* provide assistance for understanding the Impact Factor. Each record in the *JCR Web* now contains a link to the scope note for the assigned category or categories for the journal. The scope notes are written and regularly updated by Thomson Scientific Editors to reflect the coverage and content goals of each category. This provides users with an understanding of how the journal is assigned to each category and what are considered journals of similar content.

Each assigned category has an additional link that goes to a summary page listing all the journals assigned

to or ranked in that category. The list can be sorted alphabetically or ranked by each of the major performance metrics: total citations, *JCR* Impact Factor, Immediacy Index, Cited Half-Life, or number of published articles in the most recent year. Moving from the journal to the category list is one way to encourage citation metrics being taken in a rational context of related materials.

While *JCR* Impact Factors are calculated independently of categorization, they can appear very differently in the context of different categories. The *American Journal of Physiology-Cell Physiology* is categorized both in the Cell Biology category and in the Physiology category. Its 4.103 Impact Factor ranks the journal at 41st among the 156 journals in the Cell Biology category—placing it just outside the top

25% of journals in that category. Journals in the Cell Biology category range in Impact Factor from over 35 (35.041 for *Nature Reviews Molecular Cell Biology*) to less than 0.5 for the last 10 journals in the ranked list.

In Physiology, however, *AM J PHYSIOL-CELL PH* ranks as 9th among the 74, or among the top 20% of journals in this category. Although the top-ranked journal in the Physiology category—*Physiological Reviews* with a 2003 Impact Factor of 36.831—is in the same range as that for the Cell Biology category, the Impact Factors drop more quickly as one moves down the ranked list (see Figure 1); thus, the same Impact Factor, when considered among a different population of journals, can result in a significant difference in rank. For journals in some subjects in engineering and applied sciences, the top-ranked journal in the category can have an Impact Factor below 1.0.

While these informational links place the *JCR* Impact Factor in the context of subject, the Cited Journal graph highlights the relationship between a journal's Impact Factor and its overall citation pattern. The graph is derived from the Cited Journal data that tabulate all journals that have cited *AM J PHYSIOL-CELL PH* during the year 2003, divided according to the year referenced. The top line of the Cited Journal data, shows the sum by cited year for all journals, thus, creating a time-course of citation activity (see Figure 2).

Plotting these data as cited year versus number of citations results in the Cited Journal Graph for *AM J PHYSIOL-CELL PH* in 2003 (see Figure 3).

The graph shows an age-profile of the *AM J PHYSIOL-CELL PH* articles that were cited in the year 2003. For example, 1,385 citations, nearly 10% of the total number of citations, are to articles published in *AM J PHYSIOL-CELL PH* in 2000. The dark grey sections on top of each column indicate journal self-citations, that is, instances when an article in *American Journal of Physiology-Cell Physiology* cited a previous article also in the journal. These data are also derived from the Cited Journal list. Journal self-citations are included in the calculation of all citation metrics, and they usually form a valid and valuable

Using the upgraded web-based Journal Citation Report, we calculated five-year Impact Factors for all the APS journals and some of their competitors.

-Margaret Reich, APS Director of Publications and Executive Editor

Journal	2003 IF	5-yr IF
AJP-Cell Physiology	4.103	3.969
Cell	26.626	27.413
Journal of Biological Chemistry	6.482	6.999
Molecular Biology of the Cell	7.454	7.344
Journal of Clinical Investigation	14.307	13.783
AJP-Endocrinology and Metabolism	3.828	3.712
Endocrinology	5.063	5.101
Diabetes	8.298	8.31
AJP-Gastrointestinal and Liver Physiology	3.421	3.522
Gastroenterology	12.718	12.199
Hepatology	9.503	8.505
AJP-Heart and Circulatory Physiology	3.658	3.635
Circulation Research	10.117	10.422
Cardiovascular Research	5.164	5.061
AJP-Lung Cellular and Molecular Physiology	3.735	3.835
American Journal of Respiratory Cell and Molecular Biology	4.015	4.222
Experimental Lung Research	1.345	1.541
AJP-Regulatory, Integr and Comparative Physiology	3.627	3.192
Journal of Experimental Biology	2.271	2.626
Journal of Physiology-London	4.352	4.491
AJP-Renal Physiology	4.344	4.314
Journal of the American Society of Nephrology	7.499	6.654
American Journal of Kidney Diseases	3.897	4.119
Kidney International	5.302	5.328
Journal of Applied Physiology	3.027	3.08
Journal of Neurophysiology	3.876	4.2
NIPS (now Physiology)	3.682	3.117
Physiological Genomics	4.368	NA
Physiological Reviews	36.831	35.652
Advances in Physiology Education	0.755	0.372

Figure 2. Cited Journal Data for AM J PHYSIOL-CELL PH.
(NOTE: The full list of citing journals contains 860 titles.)

All Years	14,004
2003	235
2002	1,221
2001	1,754
2000	1,385
1999	1,187
1998	1,320
1997	1,184
1996	1,202
1995	830
1994	746
Rest	2,940

scholarly acknowledgement of the literature published in the journal (2). Making these data readily apparent indicates how effectively the journal is interacting with the larger corpus of published material.

The first column in the Cited Journal graph contains citations that contribute to the Immediacy Index calculation. The graph highlights the fact that citation activity in the first year of publication is a minor component of the total citation activity. While some bibliometrics scholars have suggested that these citations be included in the Impact Factor, examin-

ing the time-distribution of citation suggests that first-year citation activity precedes the most active period of citation to a set of articles. While an important reflection of early acknowledgement, these citations should be considered separately from the key performance metric—the *JCR* Impact Factor.

The next two columns (cited years 2002 and 2001) indicate that sub-set of total citations that are used to calculate the *JCR* Impact Factor. The Cited Journal graph places these citations in the context of the total citations to the title in 2003. Reviewing the Cited Journal graphs for many journals reveals that this two-year window of analysis represents a time of most active change in citation rate for the vast majority of journals, even in diverse subjects. The *JCR* Impact Factor interval is chosen to represent a particularly dynamic period in the citation life-span of articles. The *JCR* Impact Factor is a powerful reflection of a journal's performance precisely because it contains this active period of change. However, presenting this short, responsive interval in the context of a 10-year period emphasizes other characteristics of the journal's citation performance.

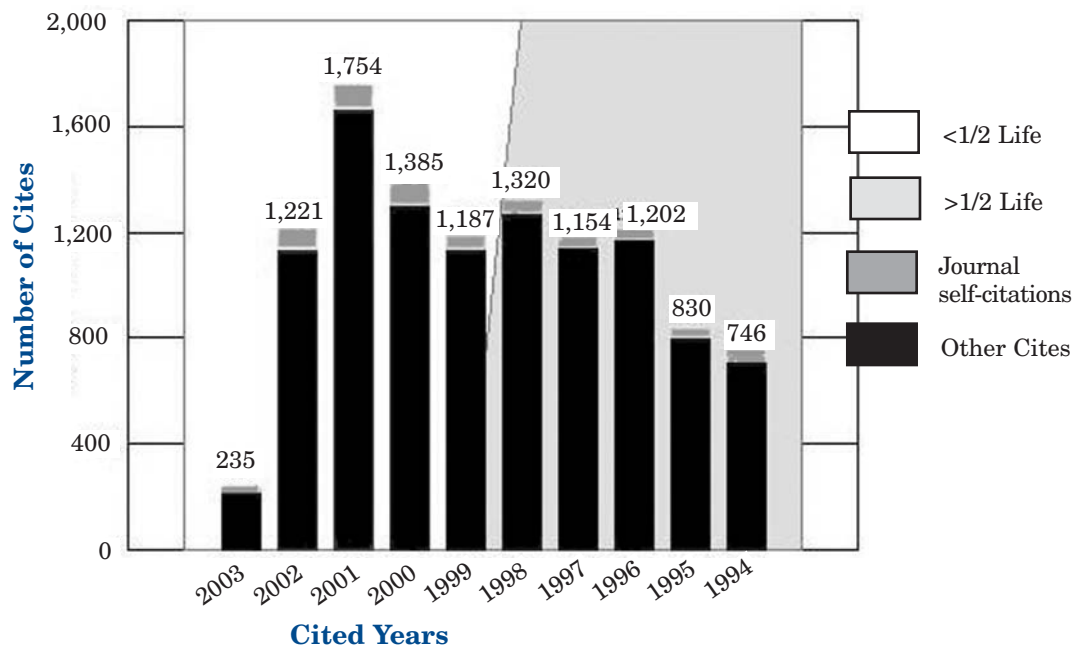
The 10-year period of citations to *AM J PHYSIOL-CELL PH* shows that citation activity peaked two years post-

publication. However, there is a distinct plateau across the six years from 2003 to 1996, during which articles published in *AM J PHYSIOL-CELL PH* were still actively participating in scholarly communication. Citations markedly drop after that, although there are still citations to articles 15 or more years after publication.

While longer-interval metrics, designed to complement the two-year interval of the *JCR* Impact Factor, are being studied now, the Cited Journal graph's 10-year display does provide a way for users of the *JCR* to evaluate the longer-term citation activity of a journal. An additional reference-point for this type of analysis is the Cited Half-life. On the Cited Journal graph, Cited Half-Life appears as a grey-white division of the background. Half of a journal's citations are to articles published before the cited half-life, which indicates the average citation life-span of articles in the journal.

The Journal Citation Reports is an invaluable resource for information about a journal's influence and impact. While the *JCR* Impact Factor is used most often as a reflection of the journal's performance, the additional data on citation behavior offers critical context for the correct understanding of this metric.

Figure 3. Citations to the journal (per cited year). This graph shows the distribution by cited year of citations to articles published in the journal AM J PHYSIOL-CELL PH.



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