The Eigenfactor™ Metrics: How Does the *Journal of Biological Chemistry* Stack Up?

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The scientific literature comprises a vast network of research papers, linked to one another by scholarly citations; this network traces the spread of ideas through the scientific community.[1] At the Eigenfactor™ Project, we use the structure of this network to assess the influence of scholarly journals and to map out relations among scientific fields.[2]

The main idea behind the Eigenfactor Metrics is that a journal's influence is determined by a weighted sum of the citations that it receives. Citations from influential journals such as *Nature*, *PLoS Biology*, or *Cell* carry more weight than citations from second- and third-tier journals. Which journals are influential is determined by an iterative procedure analogous to Google's PageRank algorithm.[3] Although iterative rankings require more complicated computations than measures like impact factor, the reward of accounting for the variable influence of citation sources is a much richer measure of journal quality.

We use two primary measures to rank scholarly journals. The Eigenfactor™ Score measures a journal's total influence; with all else being equal, larger journals have higher Eigenfactor scores. The Article Influence™ Score measures the influence *per article* of a journal. As a per article measure of prestige, the Article Influence is comparable to Impact Factor. At the Eigenfactor website (www.eigenfactor.org) we provide the Eigenfactor scores and Article Influence scores for more than 8,000 scholarly journals over the past decade, based on citation data from the Thomson-Reuters *Journal Citation Reports* (*JCR*).[a]

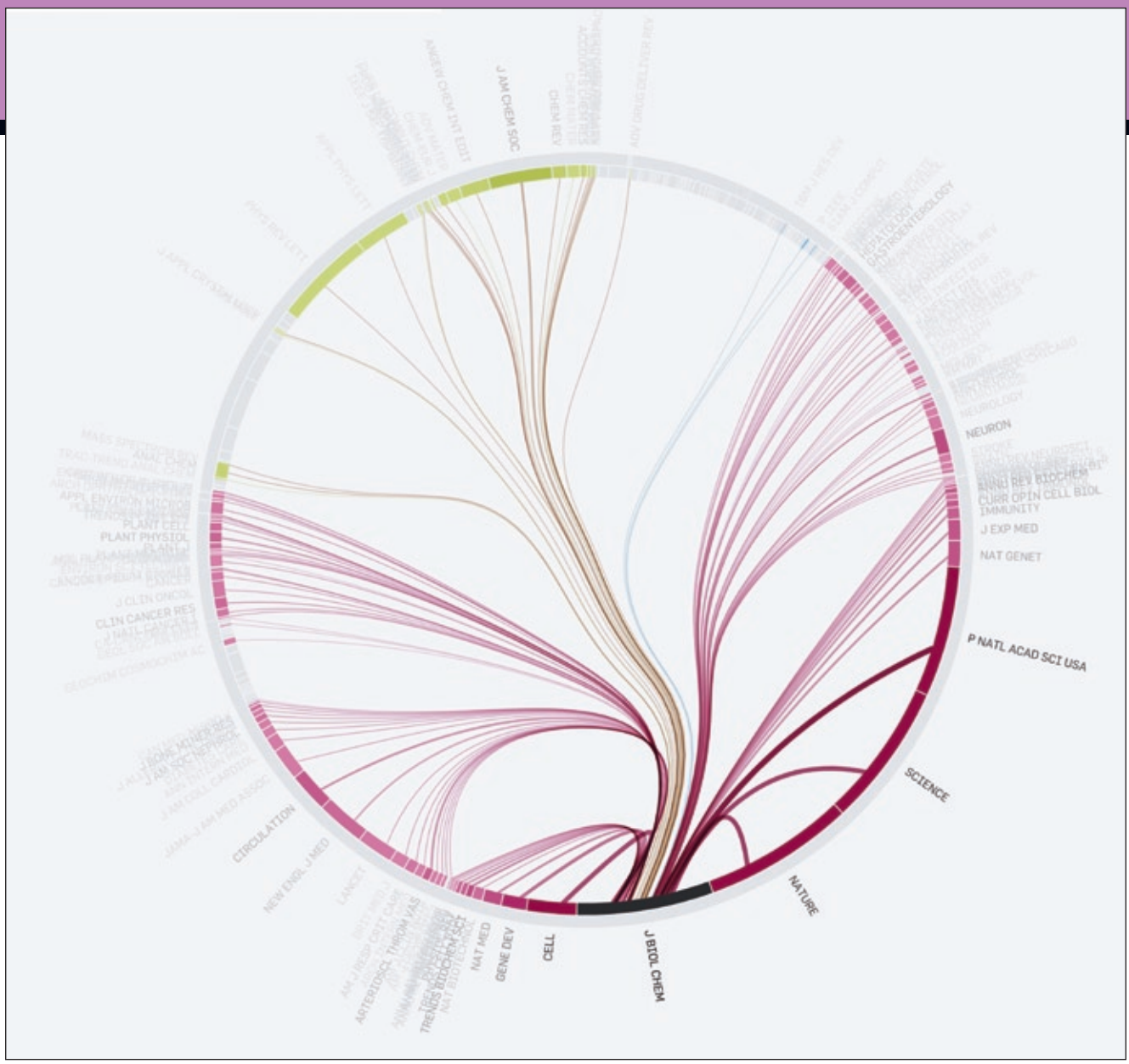
So what do the Eigenfactor metrics tell us about the *Journal of Biological Chemistry (JBC)*? In 2006,[b] *JBC* had an Eigenfactor Score of 1.82. Basically, this score tells us that the journal is both large and influential. The Eigenfactor algorithm estimates that the *JBC* constitutes 1.82 percent of the *total* citation traffic in all of the scientific literature. In fact, *JBC* has the fourth-highest Eigenfactor score out of the 7,611 journals indexed, after only *Science*, *Nature*, and *Proceedings of the National Academy of Science, U. S. A.*

The 2006 Article Influence Score for *JBC* is 2.4. This means that an article in this journal is on average 2.4 times more influential than the average article in the *JCR*, placing it in the top 5 percent of all journals in all fields.

Another important consideration is the price of a journal. In studying the economics of scientific publishing, we have been struck by the enormous discrepancies in journal prices.[4] In most disciplines, the library subscription prices for journals produced by for-profit publishers are three to five times as much per page as those charged for journals produced by societies and university presses. The high prices of many for-profit journals do not reflect higher quality as measured by citation rates, but they have contributed to the current serials crisis that leaves even large research libraries unable to afford all of the journals that their users demand.

Quantitative measures of cost effectiveness are therefore useful as libraries struggle to make difficult subscription decisions, and as authors endeavor to steer their best work toward journals that provide good value to the scholarly community. Our Cost Effectiveness[c] tool provides a way of quantifying the value per dollar that a journal provides; the basic assessment metric is the "subscription cost per Eigenfactor score." By this measure, the *JBC* is an exceptionally good deal—the third best deal in all of science, placing it in the 99.9th percentile in terms of the value per dollar that it offers.

The Eigenfactor Project is not, however, only about ranking and assessing cost effectiveness. It is also about understanding the structure of the sciences and mapping the way that citations flow among the disciplines. The radial diagram in Fig. 1 illustrates one of the interactive tools we have developed for exploring these patterns. In this figure, we see the flow of citations between the *JBC* and 399 other leading journals in the natural and social sciences. The most striking aspect of this diagram is the breadth of reach that the *JBC* has across the sciences. We see strong connections not only to chemistry, biochemistry, and molecular biology but also to neuroscience, medicine, evolutionary



Citation flow for the *Journal of Biological Chemistry*, from well-formed.eigenfactor.org/radial.html. The figure highlights the citation relationships between the *JBC* and the rest of science. The colors depict major groups within science. For example, the *greenish* color represents physics and chemistry. The *thickness* and *opacity* of the lines connecting the different journals indicate connection strength.

biology, ecology, geosciences, and physics. We also see the major gaps in citation influence: there is little connection between *JBC* and the area of astronomy and astrophysics, for obvious reasons. The interactive on-line version of this diagram allows one to select any field or journal and see its citation flow patterns; this application can be found at well-formed.eigenfactor.org/radial.html.

The Eigenfactor Project began as an attempt to better evaluate the scholarly literature, using citation data and powerful tools from network and information theory. In the process, we have found that citation networks tell us not just about relative ranks among journals but also about the connections between them. We hope to use this information to better understand the nature and structure of the scientific enterprise.

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REFERENCES

1. de Solla Price, D. J. (1965) Networks of Scientific Papers. *Science* **149**, 510-515.
2. Bergstrom, C. T. (2007) Eigenfactor: Measuring the Value and Prestige of Scholarly Journals. *C&RL News* **68,** (5).
3. Brin, S., and Page, L. (1998) The Anatomy of a Large-scale Hypertextual Web Search Engine. *Computer Networks and ISDN Systems* **30**, 107-117.
4. Bergstrom, C. T., and Bergstrom, T. C. (2004) The Costs and Benefits of Library Site Licenses to Academic Journals. *Proc. Natl. Acad. Sci. U.S.A.* **101**, 897-902.

FOOTNOTES

[a] As of February 2009, Eigenfactor scores and Article Influence scores are also provided as part of Thomson-Reuters' Journal Citation Reports database.
[b] At the time of publication, the 2006 scores were the latest available on the Eigenfactor.org website. These scores will be updated periodically.
[c] Cost Effectiveness rankings can be found at www.eigenfactor.org/pricesearch.php.