

Milestones in gene expression

We are pleased to bring you *Nature Milestones in Gene Expression* – a supplement representing a collaborative effort between *Nature Cell Biology* and other Nature journals.

As in preceding *Nature Milestones* supplements, we chart landmark discoveries in a field with a series of short summaries of original papers. Here, we cover the key papers that reported groundbreaking findings in transcription, chromatin and epigenetics over the past 50 years, against the backdrop of established views at the time of their publication and their impact on the evolution of the field. The 23 Milestones and the discussed papers were selected with the assistance of a panel of 36 experts.

A swathe of processes including post-transcriptional, translational and even post-translational events can arguably fall under the remit of 'gene expression'. Covering these diverse aspects is beyond the scope of a single Milestones issue, and therefore we have focused on three aspects of gene expression that are inextricably linked — transcription, chromatin and epigenetic regulation.

These Milestones begin with studies in prokaryotes and bacteriophages that laid the foundations of the field by providing some of the earliest conceptual and experimental frameworks for studying transcription. Transcriptional regulation is undeniably more complex in higher eukaryotes, and this is illustrated in several milestones that discuss topics such as the identification of the different eukaryotic RNA polymerases; the discovery of the elaborate transcriptional activation machinery and its mechanism of action; and the discovery of enhancer elements to control transcription. Although the significance of chromatin in transcription was dismissed for many years, it is ironic that much of today's effort is focused on understanding the processes that unravel chromatin, and explaining how covalent modifications of histones and DNA control gene expression. Beginning with a discussion of the nucleosome hypothesis, we highlight the series of findings that ultimately led to a dramatic shift in the direction of the field towards understanding the impact of chromatin on gene expression. A distinct theme that emerges from these articles is that a combination of genetics, biochemistry and structural studies underpin progress in this area, and that often key developments have been driven by complementary findings in different model systems. We hope that the *Milestones in Gene Expression* will be equally enjoyable and informative for both the aficionado and the novice. This content is freely available on a dedicated web site (<http://www.nature.com/milestones/geneexpression>) until June 2006.

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Intelligent debate

The Kansas State Board of Education has voted, by a narrow margin, to introduce new science standards that retain the study of evolution in the curriculum but also encourage schools to teach the "scientific evidence" that questions evolution (<http://www.ksbe.state.ks.us/>). Although they do not explicitly propose including 'intelligent design' in the curriculum, their assertion that the debate between evolutionary biologists and proponents of intelligent design is a scientific disagreement opens the door for introducing creationism in a new guise. Kansas faced a similar challenge in 1999, when Kansas Citizens for Science narrowly avoided a school board decision to restrict Darwinian teaching (*Nature* **436**, 753; 2005). Last month, voters ousted eight 'intelligent design' supporters from the school board in Dover, PA, raising hopes for a reversal in Kansas before these new standards go into effect in 2007.

The notion that the diversity and complexity of life cannot have emerged through a process of natural selection alone, but must instead have been guided by an 'intelligent design', has risen in prominence in recent years. Although Kansas has a history of dissent on the issue, many other US states are entering the debate (<http://www.npr.org/>), with some advocating the use of stickers in biology textbooks to warn readers that the evolutionary ideas contained are "only a theory". Pressure on school curricula to include anti-Darwinian concepts has also surfaced in parts of Europe, although not to the same degree as in the US (*Nature Cell Biol.* **7**, 99; 2005). More recently, it has also found favour with leading figures in the Vatican. To the American public (51% of whom reject evolution, according to a recent CBS News poll), intelligent design has been offered as a 'scientifically valid' alternative to evolution.

Proponents of this movement not only portray evolution as controversial and hypothetical, but also present intelligent design as a legitimate science, freed of the religious associations of creationism by having left the designer un-named. Detractors are depicted as lacking intellectual integrity in failing to allow discussion of alternative viewpoints. The Discovery Institute, a think tank promoting intelligent design, aims to underscore the scientific rigour of their position by listing peer-reviewed papers and books on, and in support of, intelligent design on its website; including a 'concept' article on protein folds published in *Nature* (*Nature*, **410**, 417; 2001).

So how should scientists respond? Some argue that debating with proponents of design would legitimise their claims (*Nature* **434**, 550; 2005), but dismissing them may damage our credibility with the public (see Book Review on page 1150 of this issue). Whatever the fate of evolutionary theory in the US classroom, a public who believes that intelligent design enjoys the same status as natural selection is in sore need of an education in the nature of scientific enquiry and debate. Universities, research institutions, journals and individual scientists must take every opportunity to make this the focus of the debate over science education.

Owing to a technical error, the pages of this manuscript were originally mis-numbered by a 100 pages. This has now been corrected online. The corrected online manuscript is numbered 100 pages higher than the mis-numbered version.