Science and technology

Babbage

Epigenetic anointment

Dec 23rd 2010, 16:21 by The Economist online

Tweet 56 Like 170

LIFE in the hive is nasty, brutish and short—if you are a worker bee, that is. Workers spend the 20 days or so of their adulthoods constructing honeycomb, feeding larvae, foraging for nectar and pollen beyond the hive, and never producing offspring. The queen, by contrast, lives on for years in languor, fed and preened by workers as she lays up to 2,000 eggs a day for honeybee posterity.

Yet these starkly different fates emerge from the same genome. Who becomes royal and who a drudge depends on who gets fed with a fantabulous substance called royal jelly. The jelly does this by modulating the expression of the insect's genes, but the details have hitherto been obscure.

In a study published in *PLoS Biology*, Ryszard Maleszka of the Australian National University and his colleagues illuminate some of those details. One of the ways that genes are regulated is by a process called methylation. This adds chemicals called methyl groups to DNA. These then obstruct the machinery responsible for turning genetic instructions into working proteins—a phenomenon known as epigenesis. Dr Maleszka has shown that royal jelly acts, at least in part, by changing the pattern of methylation. He and his team have produced a methylation map (a "methylome") of the DNA in honeybee brains.

They found 561 genes whose methylation patterns were different in queens and workers. Most of these genes encode humdrum proteins that regulate a cell's metabolism or transmit molecular signals that keep it ticking over. Differences in these genes presumably explain the different body sizes and lifespans of queens and workers. A few of the affected genes, though, are involved in brain development and signalling between nerve cells. These would explain differences in behaviour.

A recurring theme was that the epigenetic marks found can pick and choose from alternative options offered by the genome. Genes are divvied up into pieces that may be swapped in or out of the final instructions for making a protein, allowing a cell to fine-tune a protein to its needs. Queens and workers differed in how methyl tags were clustered at the splicing sites between these pieces. For example, the splicing sites of the gene needed to make the short version of a protein called GB18602 (of unknown function, although its counterpart in fruit flies is involved in fat and sugar metabolism) were tagged with methyl groups in workers but not in queens. This strongly correlated with the meagre amounts of the short version of GB18602 found in workers and its abundance in queens.

How these precise patterns of methylation arise remains a mystery, which may involve some as yet unknown guidance molecules that instruct the methylating enzyme exactly where to tag the genome. This is a crucial question for human health, too, because epigenetic marks on certain genes can spur disease (the runaway cell division that causes cancer being one important example). With a genome a tenth the size of a human's, and less crowded with methyl tags to boot, the honey bee may lead the way to the principles behind how these epigenetic patterns emerge—and ultimately determine fates beyond the hive.

reddit Tweet 56 Like 170

Recommend (85) E-mail Share Print Permalink

Related items

TOPIC: Biology »
- A new species of human: The old man of the mountain returns
- Sexual selection: Hunkier than thou
- Embryonic stem cells: Testing science

TOPIC: Genetics »
- Cancer and obesity: Malignant flab
- Science: Exciting electrons
- Science: Going for a Song?

TOPIC: Life sciences »
- The meaning of a fetus: Bearing witness
- Biology and biography: The Q&A: Oliver Sacks, neurologist
- Explaining autism: Energy drain

TOPIC: Science »
- Economist Asks: Flicker or stub?
- Recommended economics writing: Link exchange
- The Babbage diet: Six diet tips from our Science pages

Readers' comments

The Economist welcomes your views. Please stay on topic and be respectful of other readers. Review our comments policy.

You must be logged in to post a comment.
Please login or sign up for a free account.

Post your comment

Sort: Oldest first | Newest first | Readers' most recommended

1-7 of 7

HardcoreKeynesian wrote: Dec 24th 2010 12:40 GMT

test

Recommend (27) Permalink Report abuse

D. Sherman wrote: Dec 24th 2010 2:06 GMT

This is a fascinating bit of research and it's nice to have it reported in the popular press where a layman like myself might run across it. There aren't too many new fields of research available these days, but this sounds like one of them. Whether or not it ever leads to a cure for cancer, which seems to be the popular definition of useful research, it definitely adds in a significant way to the body of human knowledge. That alone is good enough for me.

Recommend (30) Permalink Report abuse

tocharian wrote: Dec 24th 2010 2:30 GMT

What are we gonna feed Kate Middleton?

(I'm just kidding!)

Recommend (29) Permalink Report abuse

Gurinder Shahi wrote: Dec 24th 2010 2:50 GMT

Fascinating...

Beyond these findings in worker versus queen bees, a growing body of evidence suggests that epigenetic changes arising from differences in exposure to environmental factors may play a far greater role in shaping our destinies than we have generally recognized.

It is becoming increasingly clear, for example, that epigenetics plays a central role in such phenomena as cell differentiation where cells that eventually become, say, red blood cells or muscle cells follow very different developmental pathways even though they have essentially the same genetic make-up. Conversely, we are finding that it is possible to reverse epigenetic programming so relatively undifferentiated stem cells can be generated from previously specialized cells.

Even more intriguing is the likelihood that some epigenetic changes acquired during one's lifetime might actually be passed on from one generation to the next, and that this "neo-Lamarckian" mechanism may be ubiquitous in helping organisms to evolve in response to changes in the environment.

The more we learn, the more we realize that there is much more to learn...as I see it, these are exciting times!

Recommend (54) Permalink Report abuse

Devils Advocate_2 wrote: Dec 24th 2010 7:56 GMT

[tocharian wrote: Dec 24th 2010 2:30 GMT What are we gonna feed Kate Middleton?

(I'm just kidding!)]

With Suu Kyi's?

Devi's

Recommend (20) Permalink Report abuse

Chippe wrote: Dec 25th 2010 10:22 GMT

Could it be that resveratrol acts in an epigenetic way to switch on the survival gene in organisms, even in mammals. Why is it that few people can believe this proven fact.

Recommend (14) Permalink Report abuse

Single Speak wrote: Dec 26th 2010 1:09 GMT

Well, good to know that some are born to be genetically royal. Is there any similar traits in human gene?

Recommend (13) Permalink Report abuse

1-7 of 7

Comment (7) Recommend (85)
E-mail Share
Print Permalink

About *Babbage*

In this blog, our correspondents report on the intersections between science, technology, culture and policy.

Follow Babbage on Twitter »

RSS feed

***Economist* blogs**

- Americas view
- Asia view
- Babbage
- Bagehot's notebook
- Banyan's notebook
- Baobab
- Blighty
- Buttonwood's notebook
- Charlemagne's notebook
- Daily chart
- Democracy in America
- Eastern approaches
- Free exchange
- Gulliver
- Johnson
- Lexington's notebook
- Multimedia
- Newsbook
- Prospero
- Schumpeter's notebook
- The World in 2011: Cassandra
- Which MBA?

Most commented Most recommended

1. Banyan: Great disorder under heaven
2. China and the Nobel peace prize: The empty chair
3. Save the date: Save the date
4. Belarus's election: Lukashenka uncovered
5. The future of English: English as she was spoke
6. Hungarian politics: Hungry for power
7. India and China: Pushing back
8. India's languishing countryside: A village in a million
9. Doctoral degrees: The disposable academic
10. Germany and the euro: We don't want no transfer union

Over the past five days

Latest blog posts - All times are GMT

Putin's victory
From **Eastern approaches** - 1 hour 12 mins ago

Côte d'Ivoire: an omen for Africa in 2011?
From **The World in 2011: Cassandra** - 2 hours 10 mins ago

The empty middle
From **Democracy in America** - 2 hours 48 mins ago

Our 20 top charts of 2010
From **Daily chart** - 3 hours 15 mins ago

Crash points
From **Free exchange** - 3 hours 22 mins ago

Hugo Chávez's Venezuela and Brazil's new president
From **Americas view** - December 30th, 09:02

The business traveller's cellular lifeline
From **Gulliver** - December 29th, 23:22

More from our blogs »

Products & events

Stay informed today and every day

Subscribe to *The Economist's* free e-mail newsletters and alerts.

Get e-mail newsletters

Subscribe to *The Economist's* latest article postings on Twitter

Follow *The Economist* on Twitter

See a selection of *The Economist's* articles, events, topical videos and debates on Facebook.

Follow *The Economist* on Facebook