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Black Queen tells microbes to be lazy

15:58 27 March 2012 by [Michael Marshall](#)

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Confronted by a deadly threat, most bacteria let someone else handle it.

According to the Black Queen hypothesis, evolution pushes microorganisms to lose essential functions when there is another species around to perform them. The idea could explain why microbes are so dependent on each other.

[Jeffrey Morris](#) of Michigan State University in East Lansing got the idea from an ocean-dwelling bacterium called *Prochlorococcus*. "It is the most common photosynthetic organism on Earth," he says, but for decades no one could grow it.

That's because *Prochlorococcus* relies on other bacteria to break down toxic hydrogen peroxide. This led Morris to the Black Queen hypothesis, named after the card game Hearts, in which players try to discard the costly queen of spades.

For microorganisms every ability is costly – carrying genes and making proteins uses up energy – so they benefit from [losing genes](#) if possible.

As long as one microbe breaks down hydrogen peroxide all bacteria in the area benefit, so it is in the microbes' interests to discard the associated genes quickly.

Morris acknowledges that this kind of outsourcing is a dangerous game to play, though. In theory, all of the microbes may lose the genes at the same time, leaving none to deal with hydrogen peroxide.

Unpublished experiments support the Black Queen hypothesis. Morgan created *Escherichia coli* vulnerable to hydrogen peroxide, then gave them a resistance gene. Many, but not all, of the bacteria promptly lost the gene.

[William Costerton](#) of the Center for Genomic Sciences in

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Microbes discard extra genes in the same way that card players try to ditch the queen of spades in the game Hearts (Image: [Monkey Business Images/Rex Features](#))

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Pittsburgh, Pennsylvania, thinks the idea makes sense. "Some species may be 'donkey engines' for whole consortia [that] are unable to grow in the absence of the donkey."

Morris says the "donkey" microorganisms that do the community's dirty work would ultimately become [keystone species](#). That is, they would be extremely important to the ecosystem – even essential for its survival – despite being relatively rare.

The Black Queen hypothesis explains how evolution can produce helpers and beneficiaries without the two having to interact or cooperate, says [Martin Hahn](#) of the Austrian Academy of Sciences in Mondsee.

But microorganisms do lose abilities for other reasons. Hahn studies bacteria called *Polynucleobacter*, which cannot move or detect signals from their neighbours (*PLoS One*, DOI: [10.1371/journal.pone.0032772](https://doi.org/10.1371/journal.pone.0032772)). These abilities are not Black Queens because they cannot be outsourced.

Journal reference: *mBio*, DOI: [10.1128/mBio.00036-12](https://doi.org/10.1128/mBio.00036-12)

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