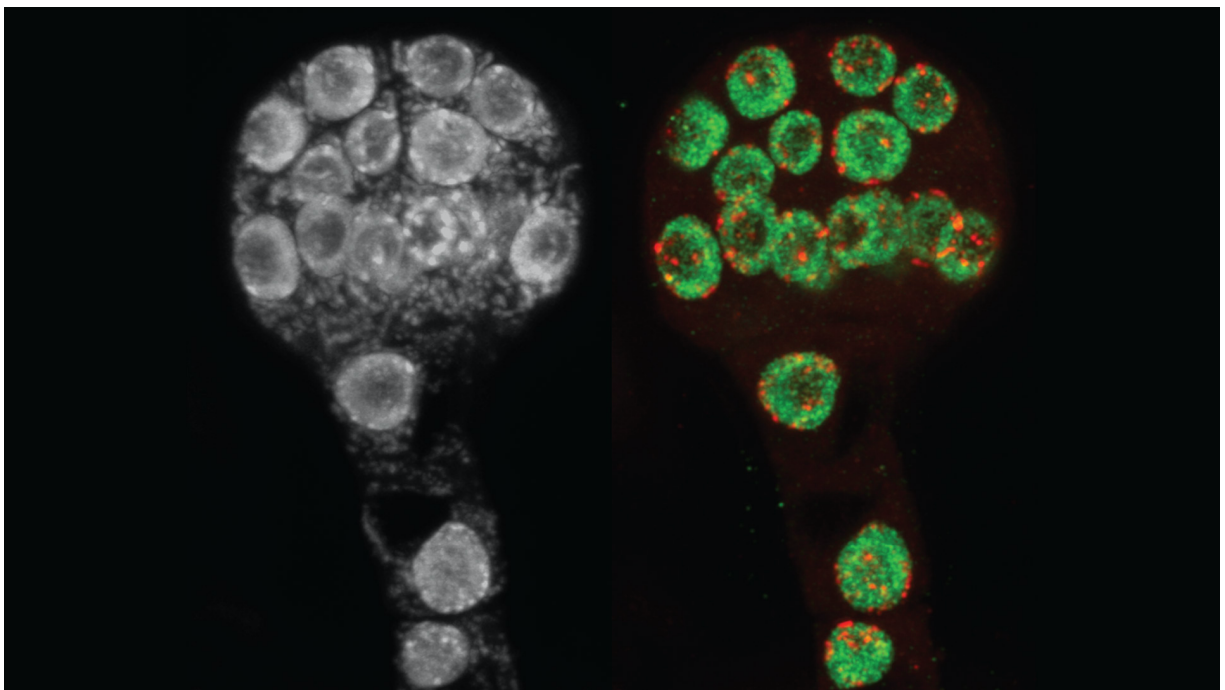




How plants leave behind their parents' genomic baggage



Plants use chemical, or epigenetic, modifications to control the activity of their genes. Red and green mark epigenetic modifications in the DNA (gray on the left) of an early embryo of an *Arabidopsis thaliana* plant. Cold Spring Harbor Laboratory Professor & HHMI Investigator Rob Martienssen's team discovered one of the genes responsible for attaching these modifications at the right spots in the genome. Image: Daniel Grimanelli and Jean-Sébastien Parent/Martienssen lab

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Passing down a healthy genome is a critical part of creating viable offspring. But what happens when you have harmful modifications in your genome that you don't want to pass down? Baby plants have evolved a method to wipe the slate clean and reinstall only the modifications that they need to grow and develop. Cold Spring Harbor Laboratory (CSHL) Professor & HHMI Investigator Rob Martienssen and his collaborators, Jean-Sébastien Parent and Institut de Recherche pour le Développement Université de Montpellier scientist Daniel Grimanelli, discovered one of the genes responsible for reinstalling modifications in a baby plant's genome.

A plant's genomic modifications—called epigenetic modifications—help turn off genes at the right times. Epigenetic changes accumulate with age. Martienssen explains:

► “If you think about a tree, the flowers that arise a hundred years after it germinated, they're obviously a long way from the original acorn, and an awful lot of epigenetic changes could happen in that period. And so, these are important resets for development so that you don't inherit this epigenetic collateral damage.”

Martienssen's team discovered that after baby plants remove the epigenetic modifications, the SUVH9 protein puts back the ones they need to survive. Without SUVH9, plants develop poorly because the wrong genes turn on at the wrong time. Parent, a research scientist at Agriculture and Agri-Food Canada, says:

The Takeaway

Small chemical “epigenetic” modifications help plants control their genes. Baby plants erase these modifications to start with a fresh genome every generation. CSHL scientists discovered a gene responsible for reinstalling the beneficial modifications important for survival. Reinstalling these modifications on mobile genetic elements called transposons

► “I remember this moment where we were like, ‘Wow! This is not what we expected.’ There was an opening for an actor that was not accounted for in the standard models, and that was the most innovative part of our story.”

The SUVH9 protein uses small snippets of RNA to look for the right places to reinstall the beneficial modifications, which are on mobile genetic elements known as transposons. The SUVH9 protein adds the epigenetic modifications to them, and this ensures nearby genes are turned off at the right time. Reinstalling the beneficial modifications also stops the transposons from jumping around in the genome and disrupting other genes.



Plants must keep mobile genetic elements called transposons in check; otherwise, seedlings develop poorly. SUVH9 is a protein that helps silence transposons by adding epigenetic modifications to them. These images show 4-week old *Arabidopsis thaliana* plants that grew with functional SUVH9 enzyme (left) and without functional SUVH9 enzyme (right). Image: Parent/Martienssen lab

The scientists think SUVH9 protein contributed to today’s plant diversity. By stopping harmful transposons from disrupting genes, the protein

may explain the diversity of flowering plants.

Principal Investigator



Rob Martienssen

Professor & HHMI Investigator

William J. Matheson

Professor

Cancer Center Member

Ph.D., Cambridge University, 1986

Tags

evolutionary biology

Plant Biology

plant genetics

Rob Martienssen

allowed different species to evolve. Parent says:

► “One of the big mysteries about flowering plants is how they manage to become so diverse and to generate so many different species so quickly in evolutionary history. And, we believe that we are touching here a part of a molecular mechanism that can allow this sort of flexibility.”

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