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Title: How do plants use their DNA blueprint?

Summary: All organisms on Earth have a blueprint within them that provides the necessary information to develop and grow. This blueprint, also called the genome, consist of long stretches of four nucleotides (A, C, T, and G) that makes up the DNA sequence. Hidden in the DNA sequence is parts (genes) that encode for proteins and enzymes. We call these coding regions, and they are read and copied into RNA, via a process called transcription. Transcribed coding RNA is later used as a mobile plan to be used in protein synthesis. Surprisingly, in higher organisms most of the DNA is not coding and an outstanding question in modern biology is why these organisms have additional non-coding DNA. For example, our human genome only consists of 1-2% coding DNA. Since the sequencing of the human genome, many believed that the extra DNA was non-functional, and the term "junk-DNA" appeared. However, not all is what it seems.

Pioneering research by my research group and others have shown that much of the non-coding DNA is transcribed into RNA but not used for protein synthesis. In fact, we believe that non-coding DNA sequences provide extensive regulatory power. The challenge has been to detect all the non-coding transcription that occurs in an organism. Non-coding RNA is often short-lived and difficult to see with classical molecular biology methods. Therefore, we have provided innovative methods to overcome these challenges by capturing RNA prior to degradation in a genome-wide manner. Thus, we are only beginning to understand the impact of non-coding DNA regions and their transcription, and my research aims to understand the role of non-coding transcription in plants.

Plants represent a rather unique group of higher organisms where genome sizes differ greatly. The model plant thale cress has a genome consisting of 125 million bases while some conifers, like spruce and pine have genome sizes of around 20 billion bases. In contrast, all mammals have around 3 billion bases in their genomes and birds around 1.5 billion bases. Importantly, all higher organisms have approximately the same number of genes (20000-30000). The large variation of genome size in plants suggests that different plants have employed distinct evolutionary strategies to host a genome with varied inclusion of non-coding DNA regions. I will discuss why plants have accumulated non-coding DNA and how they use their DNA blueprint.