Re: Junk DNA: A hypothesis

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From: Larry Moran (*lamoran_at_bioinfo.med.utoronto.ca*)
Date: 01/25/05

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On Tue, 25 Jan 2005 00:23:02 −0500 (EST),
Tim Tyler <tim@tt1lock.org> wrote:
> Larry Moran <lamoran@bioinfo.med.utoronto.ca> wrote or quoted:
>> Tim Tyler <tim@tt1lock.org> wrote:
>> > Larry Moran <lamoran@bioinfo.med.utoronto.ca> wrote or quoted:
>
>> >> Why do you feel the need to find an adaptionist
>> >> explanation for junk DNA?
>> >
>> > I don't. However, I do think it is worthwhile examining
>> > the various selective forces that act on junk DNA, in the
>> > hope of learning more about them.
>>
>> What are the "selective forces" that act on junk DNA?
>
> They look something like this:
>
> Likely negative selective forces
> −−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
>
> 1) Junk DNA has a metabolic cost. In increases nutrient
> demands, and takes time and energy to copy.

It seems obvious that there's a metabolic cost associated with making more DNA. It's a very minor cost compared to everything else that's going on inside the cell and it's a cost that is only charged when the cell divides.

However, just because you can identify an expense does not mean that it is a "negatively selective force." The "force" has to meet some minimum level before it becomes evolutionarily significant.

> 2) Junk DNA harbours self−replicating DNA capable of
> horizontal transmission between loci − such DNA
> acts like a germ−line virus, and causes mutations.

Again, in order for this to be evolutionarily significant it has to rise above some minimum level. It's not clear that there is negative

selection in this case.

So, as far as I'm concerned there are no costs associated with excess DNA
that are significant in terms of fitness. Thus, there's no reason to
have to invent compensating positive selection.

> ..and probably many others.
>
> Likely positive selective forces
> −−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
>
> 1) Junk DNA acts as spacing, and affects linkage.
>
> Decreasing linkage can have selective benefits − e.g.
> when it separates genes that benefit from recombination,
> such as disease−restance genes.

You have yet to offer a single example of how this might work. Try
and come up with something simple that we can all understand. You might
want to use some single−celled eukaryote that has lots of junk DNA
as your model.

> 2) "Junk" DNA improves evolvability by creating
> "neutral networks" − and allowing scratch space
> to allow evolution to work.

Nope, this doesn't cut the mustard.

> 3) Junk DNA reduces the chance of crossovers occurring
> in the middle of genes that don't like being split −
> and can increase the chance or crossing over in the
> middle of any genes that need to be expressed in
> a range of forms.

This is nonsense. It's based on a flawed understanding of molecular
biology.

> 4) Junk DNA can act as a sponge for intracellular mutagens
> that bind to DNA − decreasing the effective mutation rate
> in coding regions.

Another silly idea.

> 5) Junk DNA changes the nuclear volume − and having a large
> nucleus can be beneficial[1].

This is ridiculous. Rudyard Kipling would be proud.

Larry Moran