Although only a few hundred years old, the scientific method has proven incredibly useful when it comes to presenting explanations for what is happening in the world around us, at every level of organisation. The application of the process is hugely successful, yet misconceptions within each scientific field can mean that sometimes ideas do not reach their full potential.

One widespread misunderstanding is that cyanobacterial blooms are terrible, and should be prevented or harvested to give us clear, beautiful waters. In fact, these blooms are extremely valuable ecological events in all aquatic ecosystems where they occur – provided of course that we do not allow them to increase through eutrophication. They function initially as the aquatic equivalent of ‘green lawns’, and eventually turn into natural ‘fertiliser heaps’ delivering key cellular components such as carbon and nitrogen upon which the rest of the surrounding aquatic organisms rely.

I think the most commonly misconstrued aspect of phylogenetics is that the use of phylogenies is restricted to reconstructing the past evolutionary processes of a group of organisms, eg. the pace at which a lineage has diversified and the order of splitting events that have occurred in the distant past. Some even demote it to ‘curiosity-based science’ that has no application to present day problems, despite the real worth that a healthy sense of curiosity can have for society.

Furthermore, understanding the relationships between organisms can offer practical statistical solutions when it comes to summarising
the many changes we see in communities. When certain species are increasing in number, others are decreasing, thus changing the proportions of important traits that offer ecosystem functions. Phylogenies summarise the collective genetic information inherent in living systems, which is currently eroding as environments degrade. They therefore offer a scientific metric for detecting the consequences of long-term change in ecosystems on our collective genetic heritage, and I think this is underappreciated.

Dr Francesc Piferrer (Institute of Marine Sciences):

In general, people are not aware of the fact that, when compared to mammals that essentially have one genetic sex-determining mechanism, ‘lower’ vertebrates can have multiple – both genetic and environmental. In addition, the relative prevalence of different mechanisms in fish has historically been poorly understood – at one time many scientists believed that temperature-dependent sex determination was common in fish; however, we now know that this is not the case. This can also be applied to the incidence of hermaphroditism, or sex change in fish – we are now aware that hermaphrodite species account for less than 5 per cent of the 30,000 or so known fish species. Understanding the mechanisms of sex determination and differentiation provides the scientific knowledge or basis for its manipulation. For example, the production of monosex stocks for farming or sterile fish can be achieved through the induction of triploidy. Another common misconception is that these types of fish are genetically-manipulated when, in fact, they are not.

Dr Bengt Jeppsson (Lund University):

The study of probiotics is not considered a serious science by some doctors; however, the tide is turning. Many effects have been ascribed to the ingestion of probiotics without the science to back them up – in my opinion this has done the field a disservice.

Benoit Baurens (AKKA Informatique et Systèmes):

Within InsPired GEOdata CLOUD Services (InGeoCloudS), I would highlight the misperception of what the ‘cloud’ is, and fears over the security of this technology. Security is often cited as a no-go decision factor when envisaging ‘moving to the cloud’. Yet security must be considered as a multi-faceted concept that includes, in the case of cloud computing usage, the perceived loss of control of these data, fuzziness about their actual geographical location and that of their backups, access restrictions, intrusion enforcement in the technical infrastructure. When contemplating these axes, one must conclude that a public organisation – such as the InGeoCloudS consortium – will have no difficulty in defining and implementing satisfying security means within its own infrastructure that take all of these facets into account.

Moreover private companies that are now positioned on the cloud service provider market benefit from strong experience and, overall, incomparable financial means for putting in place secured data centres, secured work environments for their customers, and systematic processing for assessing, revising and improving their security rules. So, in conclusion, the literature and experts all say that your data have never been in a safer place than the cloud!

Dr Sasha Dall (University of Exeter):

I think the most commonly misconstrued aspect of the design-analysis approach is that I take to understanding evolved systems – the so-called ‘adaptationist paradigm’ – is that outsiders often think that to be a practitioner you have to believe or presume that every single feature of any organism is perfectly adapted to the current environment. This couldn’t be further from the truth.

Any serious adaptationist would quite happily accept that most organisms are unlikely to be perfectly adapted to their current environments and therefore show completely evolutionarily optimal behaviour in any particular habitat they are found in. Nevertheless, we use logic deduced from the Darwinian notion of adaptation to hypothesise about the kind of behaviour we expect evolved systems to exhibit. We expect to be wrong most of the time, since representations or abstractions of all models are wrong in some way, but how we are wrong can be informative.

By being systematic and progressive in our model development – the way we hypothesise – we can learn a lot about a wide range of systems even if we only know about a few aspects of their basic biology beforehand. For instance, the most successful adaptationists start with the simplest, most general specifications of the socioecological pressures that animals are likely to face, or have repeatedly faced over the generations, and then layer additional complicating factors into their models, as required, to address where they fail to explain real animal behaviour: a well-crafted and analysed model can tell you exactly why you are wrong in a particular way. This has allowed us to study systems involving both genetic and non-genetic inheritance, which are often problematic to analyse with more traditional evolutionary modelling approaches such as population genetics.

Dr-Ing Paul Janssen (Belgian Nuclear Research Centre):

What bothers me is that cyanobacteria, or microalgae, do not get the appreciation they deserve. Enormous amounts of research money goes into plant biology and related biotechnology to improve crops or produce biomass, while the many benefits of using microalgae are often overlooked.