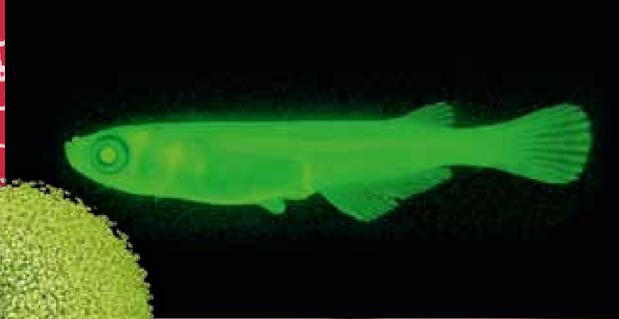
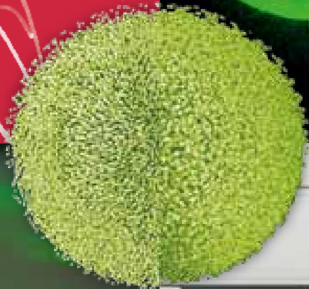
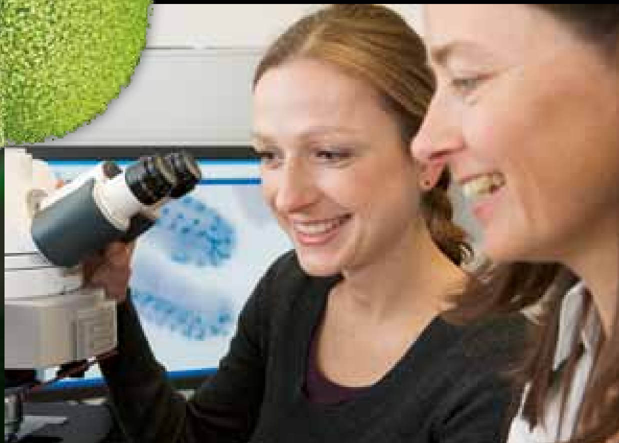
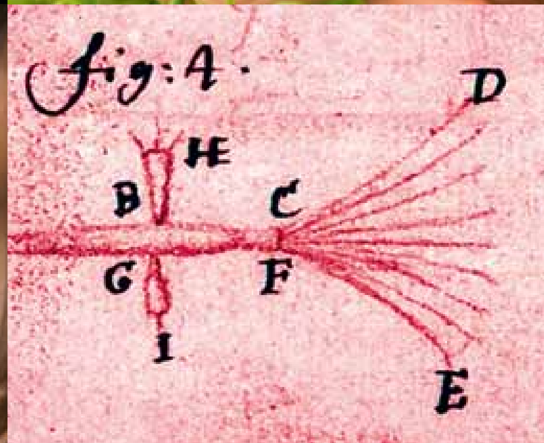
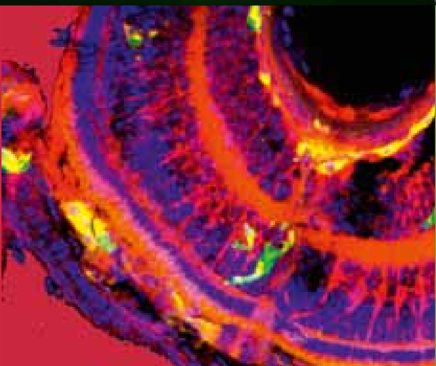


COS at a glance



Centre for
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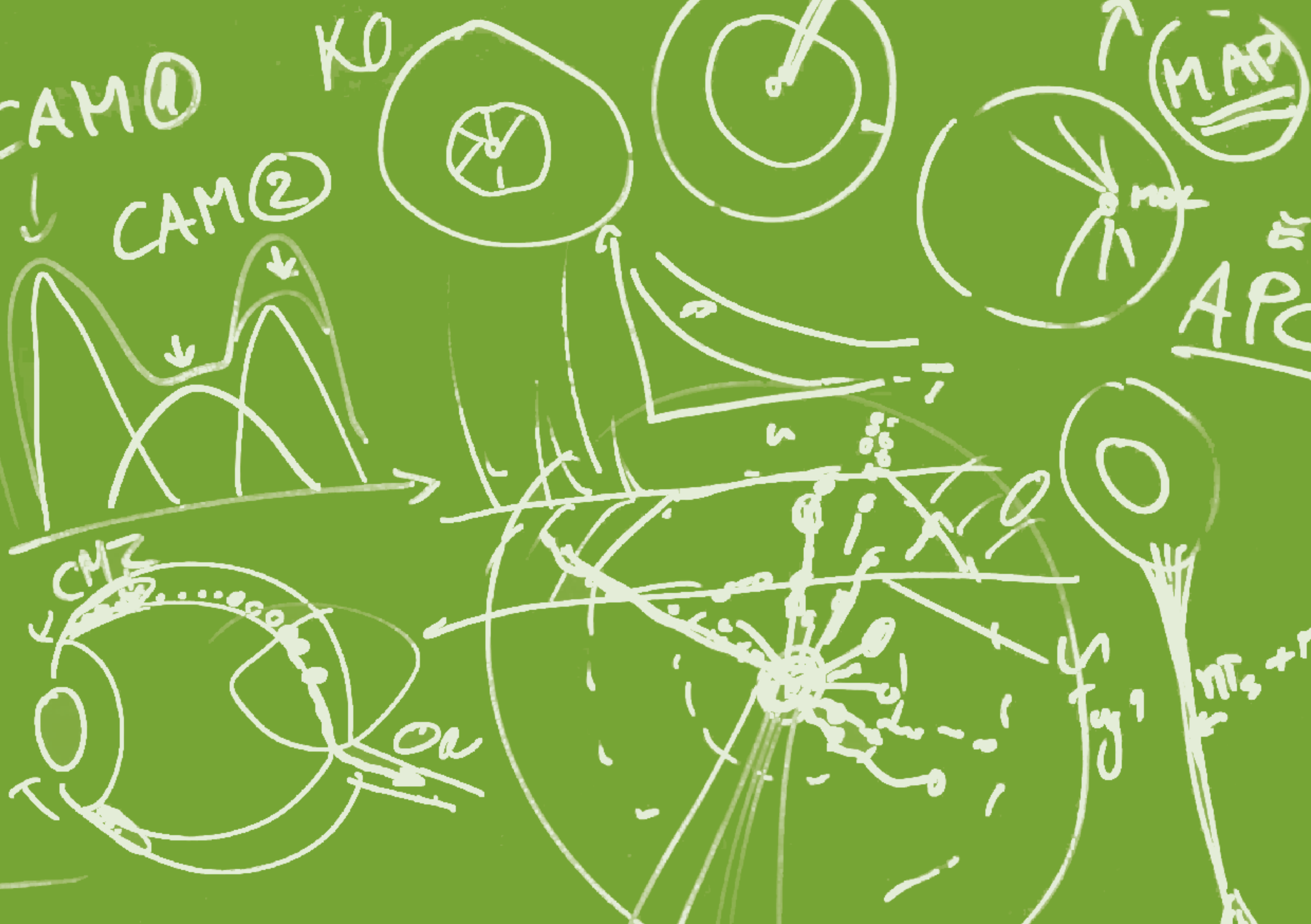
Studies
Heidelberg



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A vision of integration in research and teaching

An interview with COS managing director Jochen Wittbrodt

You‘re well along in the process of establishing a new centre with an intriguing name. Why are we moving from molecular biology to „organismal biology“?

The key thing in molecular biology initially was the way it developed into a central part of biology; then it became a tool. Today everyone is using molecular biology – developmental biologists, cell biologists; I don‘t think there are really any „pure“ molecular biologists anymore. You see that in some of the developments on the Heidelberg campus. Institutes that were initially devoted to molecular biology are now starting to do different things, mainly centered around cell biology. What‘s organismal biology? I see it as taking a step back, possibly two. Molecular biology exposes the fine details of systems; what we‘re trying to do is look at the entire system, be it an organ, an animal, a plant – aiming at a view of an entire organism within its context. It‘s probably a rephrasing of things that people knew all the time – all biology should be „organismal“. I think this development has been triggered by methods that have been used very systematically and successfully. We aim to be able to zoom in from this large scale of the complete organism in it's context to the level of precise molecular details, and I think this is what is fully represented within COS.

Everyone is using molecular biology and genomic tools; what is coming is an ability to visualize the consequences of the activity of the genome in real time. This effort lies between imaging and genomics and is called metabolomics – rather than looking at the first products of the genome in terms of messenger RNAs and proteins, we look at the products that are metabolized by the activities of the genome. This is a more precise representaion of what is happening within a cell, within a greater context. It requires the types of synergies we are developing within COS, and it is shifting our focus in a new direction.

Genomics gave a particular view of the whole: you could monitor the complete response of a genome or a proteome to certain changes in conditions. Now your own work involves imaging complete embryos over time, as they develop, and monitoring specific processes within them.

I want to see things. That‘s ironic; I was initially attracted to molecular biology because you didn‘t see things. You‘d do experiments, and eventually you‘d deduce from the results how things worked at an invisible scale, which had a great intellectual appeal. It was also necessary because we didn‘t have the tools to do things differently. In the meantime what is tremendously exciting is that if you‘re smart enough in combing your genetic and molecular tools, you can observe things directly as they are happening. This is, for me, a very exciting perspective: to move from deducing what is happening to really seeing it, and grabbing it while it‘s happening. It‘s the future.

What was the initial inspiration to set up this centre?

It‘s hard to say. I know where it happened; it happened while I was at EMBL with a call from the university. I was sitting in the cafeteria with Thomas Holstein; it was summer; we were sitting outside in front of the sculpture of the DNA helix, and Thomas said, „Jochen, under what conditions would you consider coming down to the university? Wouldn‘t it be great if we could establish a centre based on the model of EMBL or ZMBH there?“ At that time there were two centres in biology: the Center for Molecular Biology (ZMBH) and the Biochemistry Center (BZH). The BZH was very "biochemical and molecular," and at that time the ZMBH was more cell biology-oriented. We started spinning off ideas: It might be a centre focused on development, evolution or neurobiology, or it could be a centre whose aim is to bridge the gap between the molecule and the organism. The latter seemed more attractive, and we started talking to our colleagues. It would be a challenge: the work was organized into zoology and botany and there wasn't very intense cross-talk. They were still very different disciplines in different buildings. The first step was the recruitment of a plant stem-cell biologist into zoology. That was a move we needed to make to convince our colleagues that we were really serious about a new endeavor.

What stands to be gained by bringing plant and animal biologists together?

It's an integration that can work well and can pay off if you remove barriers; you have to be physically close together. Here in our current building we have groups from former botany and zoology. We sit down together and have coffee; we discuss things. This leads to serendipitous discoveries.

For example, I was having coffee with Karin Schumacher and discovered we are both working on the same gene, she in plants, and we in fish. The gene involved is a vesicular ATPase and it belongs to a big family of molecules that are evolutionarily conserved. This opens exciting possibilities for cross-kingdom rescue experiments… On the cell biological level, you find processes across the tree of life that are very basic and similar, and integration is not that much of a problem. If we'd decided to focus on neurobiology – well, plants don't have a nervous system, so you're not going to get plant specialists to start working deeply in that area. Nor do you want to.

One area that we can integrate very well in is stem cell biology – there's an SFB in this field on campus that has an excellent representation in COS; at least four groups are involved. Both plant and animal biology are well integrated into this project. It's an area where having diverse groups working together can give you an additional benefit, which is a typical question during reviews of SFBs: why link groups who have been working independently for a long time – where's the mutual benefit?

Technology is another area in which things can be integrated very easily; groups and platforms form hubs for exchange. We‘ve just started a next-generation sequencing facility driven by resources within COS, with support from the excellence initiative and the university. Another component is the COS driven Nikon imaging centre, and we‘re aiming at establishing something right in between the two in the area of metabolomics.

My dream – in terms of technology – is that we can really combine genomics, metabolomics, and imaging. We are developing methods for *in-vivo* imaging of organismal physiology during growth, adaptation and disease. This type of technological integration can happen very quickly – it doesn‘t require a long process. Even people who have been working separately can immediately start talking to each other, with respect to conceptual integration. Again, here stem cell biology is wide enough that there can be a great transfer of knowledge between plants and zoology. We have some gaps to fill on the technological side, and here, adding junior groups with both a strong scientific and technical profile will be very useful.

More widely, integration is important to reduce redundancy in the fields, but also in teaching. Rather than having students learn things here and there, and maybe having them accidentally realize, yes, there‘s a lot of overlap between a process that happens in animals and one that happens in plants, why not just tell them? Get that out of the way and turn them loose to use their brains to discover new things, rather than rediscovering the same things over and over again. So that‘s another part of our evolution: we‘re making real changes in the way we educate our students. They should grow up with a different perspective. They‘ll still be forced to make connections themselves, but rather than forcing them to do so in areas that are rather obvious, I‘d rather get their brains working on new problems. They should realize, „This pathway is very similar in plants and animals; so let‘s start digging into its meaning for the organism, starting at a different level.“

Since COS is the centre at the university that is doing most of the teaching in the life sciences, it‘s important that we change our attitude toward learning. In the past this has been very textbook-based; students learn facts and eventually, there is a transfer of knowledge. But it‘s unsatisfactory. Students can emerge with a BSc and a lot of knowledge of facts and techniques, but when required to translate that into meaningful experiments, they often draw a blank.

We‘d like to change this perspective from the very beginning. Sure, we still have textbooks. But instead of passing

along received knowledge, we aim to go behind the facts and ask, „All right, what sort of experiment was behind this? How do you develop a hypothesis and translate questions into experiments? What controls are necessary, how you interpret them, and how you develop the work into a story that can be published?" This is something that has largely been lacking in the current system. We need to have a research-based teaching from the very beginning, to get students to start thinking in experimental rather than textbook terms.

In the long run, I would be happiest if there could be a teaching platform with the best possible equipment, where students could be taught, and where the success of a lecture would immediately transfer into an attraction for a topic. It's rather unfortunate that at the moment the institutes that do most of the teaching often have outdated labs and lecture halls. And institutions that have a lot of money can easily attract students because they have really exciting equipment – rather than with exciting teaching. If we can lift the level of infrastructure so that it's the same for all of them, that would stimulate a cycle of improvements in the quality of teaching. It's a feedback loop, because a high quality of students pushes the level of research.

It's really rewarding here to see the students progress through their entire university career. With the new Bachelor/Master's system, students are exposed to professors right from the beginning. We're doing rotations: students have one year of lectures and courses. Starting in the second year, if a student wishes, they have lab rotations. They have to see at least three different labs; they're close to research. This fits well with our concept that we want to get them to the bench as soon as possible. We're restructuring the system, integrating the pieces, getting the students as close to research as possible, and standing by as tutors.

How practically did the centre get started? How did the funding get pulled together?

Initially we weren't sure how it would work. Once we decided that the project had to be done with the colleagues from botany, we started talking to them. Thomas Rausch was very enthusiastic from the beginning. We had a year or two of discussions about how specifically to piece things together. To get started we've been combining the budgets of the former botany and zoology departments. At the moment it's enough to survive on, and it's a solid platform to move forward because we have a very strong basis in third-party funding. It is obvious that in the intermediate term, excellent performance will pay off through central support and we and the other centres are looking forward to this stimulating competition that will contribute to lifting the quality of both research and teaching.

We‘re also very grateful, of course, for the contributions that Klaus Tschira is making.

We had long discussions with him in the initial phase. At that time he wanted to invest much more into a building; then it became clear that there will be money from central funds from the university for renovations. With the generous support of the Klaus Tschira foundation we could invite visitors to the thrilling COS inaugration symposium in our partially refurbished lecture and renamed Bertalanffy lecture hall. We plan on taking the spirit into a new lecture series with top speakers who present their science to both, colleagues as well as advanced classes at schools in the Heidelberg area.

One of our hopes, of course, is that we can excite him for our teaching concept, which would maximize the impact of investments. Now that some of our initial ideas have become concrete and a bit settled, I think it‘s the time to structure this part of our mission more systematically and start thinking about the entire life sciences campus. We shouldn‘t stop with one centre.

One of the early ideas was having a university situation that would be more of an incubator-style operation. It‘s not the standard style of thinking about a university, where everything is usually permanent and fixed. If you‘re not dynamic, you‘ll end up static, and then it‘s not attractive enough. Nor can it react to new developments the way it should. In addition to professorships that are closely tied to teaching, we need junior groups that are non-tenured, to give us flexibility to move quickly into new areas. Obviously the model can‘t be the same as for pure research institutes, where the majority of positions are non-permanent, because we need a continuity in teaching and teaching style. I think the ideal would be to have a 70/30 relationship.

We have 14 professors from different faculties – twelve from the former zoology and botany departments, one from EMBL, one from KIT. At the moment we also have three independent group leaders, in the sense that they have been recruited in a competitive, international selection process. In the near future, we hope to get more of those. COS has already demonstrated that it is attractive:

one request came from a professor in England who had just received his ERC grant and said he‘d like to come here. All he needs is space and a basic salary and all the rest he could provide. That‘s exactly what should happen, but it‘s difficult at the moment.

Where we‘ve been quite successful is in attracting young scientists with very prestigious Emmy Noether fellowships from the German Research Foundation (DFG). Of two candidates who had been awarded fellowships, we could get one; the other we couldn‘t because we don‘t yet have enough space. We‘d also like to involve senior people who have done great work. We have one such person here: Volker Storch, who is coordinating the zoological museum, the Sunday zoological lecture series, and still doing a lot of teaching. He‘s an example of someone who has reached retirement age but is still giving excellent input. The youngsters can profit a lot from their experience and expertise – not just in daily experiments, but how to handle science in general. It‘s important to have a full spectrum at a place.

What do you think will be a good critical mass in the future, and what kind of people are you most interested in attracting?

If we could arrange seven independent groups, that would be great. They wouldn‘t be the only junior groups here; each professor has his or her own junior groups. If I had the money, I‘d prefer to obtain them through international recruitment. On the other hand, you shouldn‘t disrupt an operation that is working well. Some of our young researchers are aiming at a full independent career track; others are perfectly happy to have a little independence, offering important types of support while being able at the same time to depend on an established professor. It relieves them from administrative burdens while allowing them to do interesting work.

In terms of filling gaps, and the type of person we want to attract – I‘m less interested in finding someone working on a specific topic than finding the right type of scientist. Again, I think that technology-driven junior groups may be the answer, providing we find people who fit. So there are topics that would naturally fit in with the COS and profit from both our mentality and the groups that are already in place. But it‘s more important to find an excellent person who is integrative, who makes a good match. If that‘s the case, they will attract interest from the existing groups and bridge some of the gaps that we still have.


f-actin

A brief interview with Klaus Tschira

Klaus Tschira Stiftung gGmbH/Foto: T. Wegner

For many years, you have been a huge supporter of the life sciences in Germany, providing crucial funding for a number of major projects. Why do you have such a deep interest in science, and particularly the life sciences?

By education I am a physicist, hence my love for science. I speculate that Biology and Informatics will be drivers of development as strong as physics was – primarily in the last 70 years.

Thomas Holstein has mentioned that your generous support for the COS will establish a new lecture hall named after Ludwig von Bertalanffy. Bertalanffy is an important but nowadays almost forgotten zoologist and developmental biologist from Vienna in the 1930s, but also a great mastermind for Systems Biology. He also coined the concept of the steady state in Biology. What is your link to Bertalanffy?

I knew Ludwig von Bertalanffy as the founder of systems theory, which has unfortunately been usurped later by the sociologists, spearheaded by the late Niklas Luhmann. At the 10-year anniversary of the DGFS (Deutsche Gesellschaft für Systemtheorie) there was a Symposium entitled: "10 years of systems' theory, cui bono – Niklas Luhmann or Ludwig von Bertalanfy [sic! With only one "f"]". I feel that LvB deserves a better memory than that.

What is your vision for the future of this type of research in Germany?

I do not know; there are two possibilities. First: Research Results are essentially communicated to the general public, such that we have a sustainable climate favourable towards research. Second: The general perception will be: Who really cares about research? If that turns out to be the case, in the long run, public and private funding will be truncated.

Of course I hope for the first scenario to come true. The Klaus Tschira Stiftung is working for that.

In the United States and some other countries, it is routine for institutes, universities, and other organizations to draw on private support from individuals and foundations. In Germany this is less common. You have set a stellar example. What do you think, overall, should be the role of this type of funding in Germany? How do you think other foundations and individuals could be encouraged to step up and make the kinds of contributions that you have?

As long as the government claims education to be a governmental activity **and maintains a corresponding level of taxation**, most people think that education is also a governmental responsibility and restrict their activities to criticism. It is very difficult to change that attitude. On top of that, too many regulations deter any would-be-philanthropists.

Do you think, in another life, you might have become a scientist?

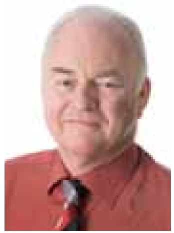
That is quite possible. My original intention in this life was to become one.

Cell Biology & Developmental Biology

Independent Group Leader

Jan Lohmann
CDPEN
Stem Cell Biology

G. Elisabeth Pollerberg
CDPEN
Developmental Neurobiology



David G. Robinson
CDPEN
Cell Biology

Karin Schumacher
CDPEN
Developmental Plant Biology

Jochen Wittbrodt
CDPEN
Animal Physiology & Developmental Biology

Steffen Lemke
CDPEN

Alexis Maizel
CDPEN

Physiology

Ingrid Lohmann
CDPEN

Stephan Frings
CDPEN
Molecular Physiology

Rüdiger Hell
CDPEN
Molecular Plant Biology

Ursula Kummer
CDPEN
Modelling Biological Processes

Thomas Rausch
CDPEN
Molecular Plant Physiology

Sabine Strahl
CDPEN
Cell Chemistry

Position Weight Matrix Legend:

C = Cell Biology
D = Developmental Biology
P = Physiology
E = Evolution
N = Neurobiology

Font sizes for weighting (4, 8, 9, 10, 11, 12)

Evolution

Detlev Arendt
cDPEN
Animal Evolution

Nicholas Foulkes
CDPEN
Circadian Clock Biology

Thomas Holstein
cDPEN
Molecular Evolution & Genomics

Ulrike Engel

Marcus Koch
CDPEN
Biodiversity & Plant Systems

Volker Storch
CDPEN
Senior Professor

Position Weight Matrix Legend:

C = Cell Biology
D = Developmental Biology
P = Physiology
E = Evolution
N = Neurobiology

Font sizes for weighting (4, 8, 9, 10, 11, 12)

Gabi Petersen

Facts and figures

Publications

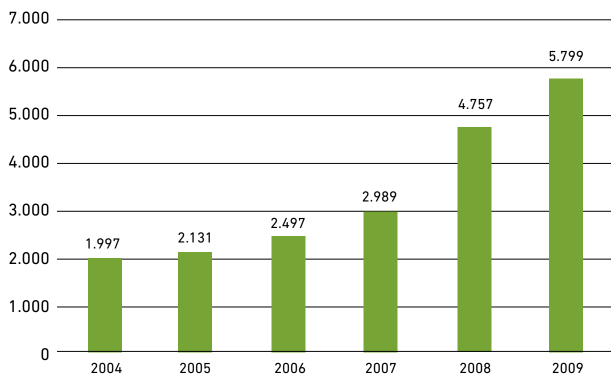
	Publications	Citations	H-Factor
COS Heidelberg University	24,3	510	10,71
Faculty of Biology, LMU Munich	20,2	303	7,90

Publications and their citations are of great importance to the evaluation of scientific progress. The number of publications and the quality of the journals they are published in is a key element in the evaluation of scientific productivity.

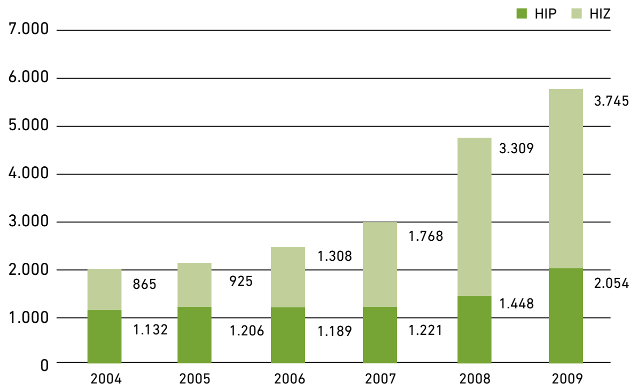
The quality measure of a journal is its impact factor. This shows how often an article is cited in other journals. *Nature* and *Science* currently have an impact factor of 34,5 and 24. *Cell* lies at a rate of 31,1.[18] Out of 340 COS Heidelberg publications, 18 appeared in these three journals.

The second measure for a paper is the frequency of which it is cited. Alongside the citation rate there is also the h-index (Hirsch factor) which has the advantage that a frequently cited paper has little influence on the index itself. This serves as a measure for the continuity of high quality science and discriminates against lucky hits.

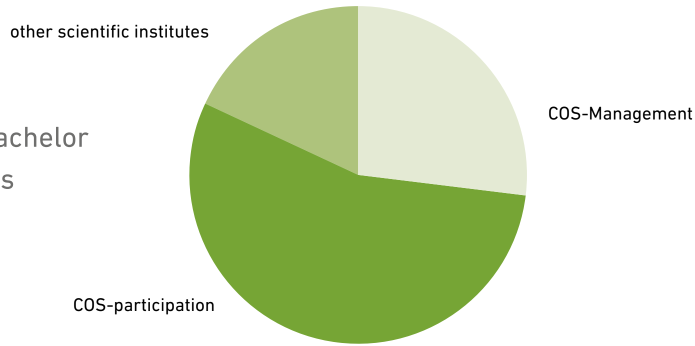
Total COS 3rd party funding in €K



Total COS 3rd party spending in €K



COS teaching participation in bachelor course for faculty of biosciences



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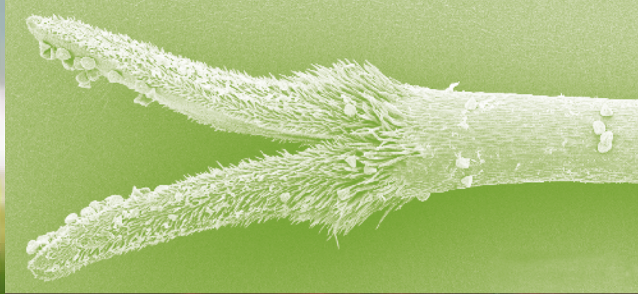
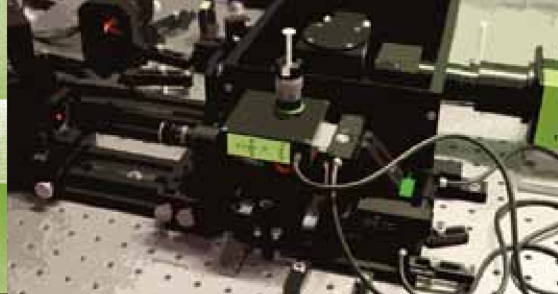
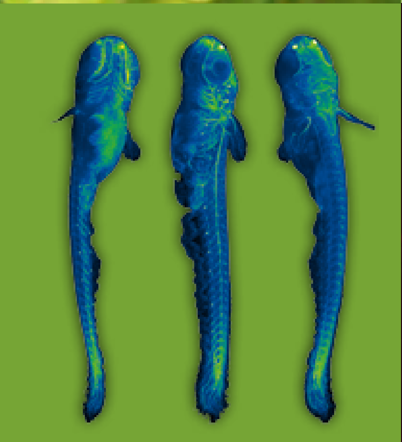
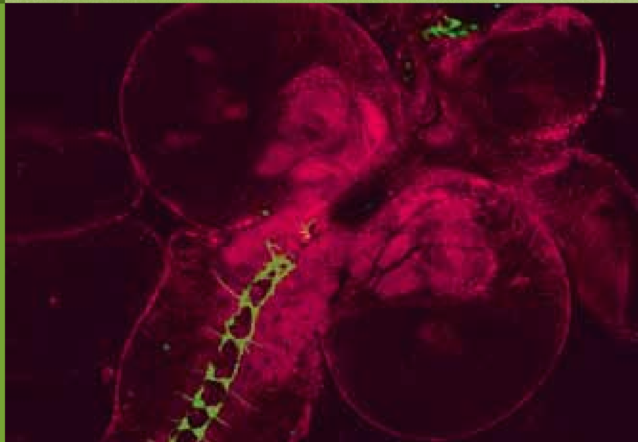

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