Following is the midterm report per each sub-team.

Cloning Sub-Team plan for Mid-term Report:

Cloning sub team has three teams in it; design team, vector construction team and the cell culture team.

- **Design Team**

The four members of this sub-team have found the three gene systems needed for the oscillator. This was an important task in order for the sub-team to move forward. We are currently working on making primers that would be needed to amplify the DNA once we obtained all the vectors that we have found. Before we are able to complete this task we will have to find a plasmid that we will be able to incorporate our three systems into. Once we have done that we will be able to create what our vector should look like using the clonemanager software.

Some of the difficulties that we have faced have been technical. The whole team had to be shown how to use cloneman and how to format and document our findings. Making time for the whole team has also been difficult and usually only three out of four of us have shown up to most meeting.

The objectives for this team are to make and order the primers to create our final plasmid using clone man, order and obtain all plasmids necessary, and if all that is done than to start working on the construction of the oscillator. The main objective of this sub-team has been to design and start working on the oscillator.

- **Vector Construction Team**

This sub-team is responsible for constructing a vector to be used in the fish cells culture as well as the fish embryos. Currently we are very close to putting different pieces of DNA together, after which they can be tested in the fish cells.

This team has obtained various DNA and has run various tests to check that we have the right DNA. At this point we have the DNA required for the construction of the reporter vector, in some form. Some pieces need further processing before the vector can be prepared.

Since this sub-team needs the most lab work to be performed, other members aside from the first two members had to come in and help. There was some difficulty in trying to get things coordinated and communicated properly, which has been taken care of by the administration team. Now everyone records the lab work they performed and the results from it. We are now hoping to finish up the construction of the reporter plasmid by Nov 6^{th}. The work on the oscillator plasmid will start once the design team has completed their work.

The team started out with just two members where as there was a lot of lab work to be performed. The major obstacle was that majority of the members were not aware of the lab techniques, but arrangements were made to show them the lab techniques, more and more people were willing to help with the work on this team. Once the work had started the problem was in communicating it properly and efficiently so that all the members know what is going on, and that if someone comes into the lab they know what needs to be done. A documentation process has been established to take care of this problem.

- **Cell Culture Team**

The fish cell culture team has been successful in the culturing and maintenance of zf4 cell line. The cells have not grown as fast as we had originally hoped; but that has not stopped us from producing enough cells for transfection. The fish cell culture team is now in the process of finding the proper transfection protocol for zebra fish cells using Lipofectamine 2000. Once this protocol has been refined to enough detail for zf4 cells, the fish cell team will use it for transfection.

The leadership of this sub-team has been changed recently which should make the sub-team more efficient.

Fish Sub-Team plan for Mid-term Report:

The objectives of this sub-team are to create complete breeding protocol for zebra fish and generate protocols for cloning into zebra fish.

The members of this sub-team has cleaned and organized the lab, arranged for fish tanks, along with some breeding equipment, and research on breeding procedures. As a part of their research the members visited the zebra fish lab facilities at the University of Chicago.

Further more a feeding schedule for the fish has been established in order to ensure the timely feeding. Also the mating of the adult fish has been started, and successful research has been carried out to clone into the fish embryos. Improved brine shrimp and paramecium hatching protocols have been established.

More fish needs to be purchased to replace the lost stock. Efforts need to be placed to show successful rising of offsprings into adult fish. Paramecium and brine shrimp production needs to increase, and feeding protocols need to researched and test for the young fish. New feeding schedule will require very early hours (around sunrise)

Also a microinjection apparatus needs to be setup for the cloning, as some level of success needs to be demonstrated in cloning into the fish, given the successful construction of the required vectors.

Earlier in the semester, involvement in the actions of the fish sub-team were concentrated into a small number of highly motivated individuals, with significantly less effort by the rest of the sub-team. Many other subteams, notably the construction/cloning/design team, encountered this problem.

Modeling Sub-Team plan for Mid-term Report:

The modeling group's overall objective has remained unchanged. We still have, as our aim, the production of a mathematical system that will model the behavior of the oscillating genetic network within a system of many cells. Specifically, we plan on using the C++ programming language, in conjunction with MATLAB, to simulate the biological process.

We have already made a C++ program that simulates the behavior of the network within a single cell. The models invented by the prior semesters' teams were executable only in MATLAB and were very slow, which is way this conversion to C++ was necessary. We also investigated various ways to effectively model the multicellular system, with its much greater complexity. With this in mind, we experimented with the Simbiology add-on to MATLAB. After rejecting this, we settled on our current design procedure: an object-oriented C++ kernel to do the brute-force computation and which will then communicates its results with MATLAB, where the data will be processed and put into some sort of easily understood graphical organization. We have begun making progress down this path, primarily with the creation of the C++ kernel.

Our basic tasks are primarily computational. First, we need to finish coding the C++ kernel. Then, we need to integrate this kernel with MATLAB, so that its results can be displayed in a meaningful form. Once we have developed all of these, we will then finally need to use the model to predict under which initial conditions the network will actually engage in oscillating behavior.

Since our task is so singular, and since our sub team is so small, we have a rather egalitarian division of labor, with each person in the group contributing as much time and effort to the single development objective as possible.

So far, the chief barrier we have encountered has been in the effective integration of MATLAB and C++. Though we have tried several methods, none have allowed us to perform the kinds of operations and procedures that we want. We are still working out how to properly deal with this grave obstacle, but it seems that we may need to obtain expert advice in order to overcome it

Administration Sub-Team plan for Mid-term Report:

The objective of the administration team, as always, is to manage the running of the IPRO team. The administration team has focused on organizing both people and resources so that common goals may be reached through group effort.

The administration team has run all group meetings, provided meeting minutes and attendance records, managed all deliverables, and provided tools such as schedules and calendars to sub team leaders that require lab work to be completed in shifts. The administration team has provided help in creating a standard of documentation provided for by all of those that complete laboratory work. Also, the administration team has been involved in improving team functioning by encouraging feedback, providing a means for giving anonymous feedback to any team member or group, and by aiding in finding solutions to any problems that may arise between any team members.

The major upcoming task facing the administration team is the organization of efforts leading to IPRO day. Roles are currently being determined. Potential speakers are being approached, sub team leaders are being asked to provide short PowerPoint presentations describing the semesters work thus far, and information board design is being discussed and the appropriate work is being delegated. The sub team leaders will be giving short presentations, a form of "rough draft" that will lead to the IPRO day presentation, on November 14. By November 21, all speakers will be selected, presentations will be fine-tuned, and the rough draft for all information boards will be in place. After Thanksgiving break, all of these will be crafted into a final presentation. Also, schedules detailing all the work and booth manning that needs to be done in preparation of IPRO day will be solidified by this time. Because the administration team merely provides a framework for other groups to complete necessary tasks, it is difficult to estimate a time requirement for any of these steps.

The administration team is headed by Ryan Witthans, who creates agendas and leads all group meetings. Brian Dunne serves as the Secretary and records and makes available all meeting minutes. Saba Mahmud is the Secretary of Deliverables, making her responsible for keeping the team aware of all IPRO assignment requirements and ensuring that all deliverables get submitted on time. Chris Ward helps collect and organize all information collected from the sub teams into one deliverable document.

There have been a few obstacles encountered by the administration team, most centered on a lack of communication. One serious problem was the lack of team knowledge about deliverables – one person was being left with the responsibility of preparing and submitting the documents. In response to one such assignment (this one), the team meetings have become more open with a statement required from the Secretary of Deliverables detailing all pertinent IPRO assignments. All future deliverables should be completed far in advance. Other than that, the team has faced a lack of communication due to an unfortunate bout of illness faced by a few of the sub team leaders that forced them to essentially disappear from the lab for a short time. This has highlighted the need for broad communication between all individuals, removing the bottleneck effect that can stifle teamwork when essential people are away. This is also being implemented by an effort to increase communication with team emails (about 10 per day) detailing all lab work and requesting any help needed by any individual or sub team.