



# Evaluation Data Report

Investigative Workshop: *Mathematical Models  
of Metabolism and Body Weight Regulation*

July 12-15, 2011

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# *Mathematical Models of Metabolism and Body Weight Regulation Workshop*

## Evaluation Data Report

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## Background

### Introduction

This report contains evaluation data for a NIMBioS Investigative Workshop entitled “*Mathematical Models of Metabolism and Body Weight Regulation*” (Metabolism workshop), which took place at NIMBioS July 12-15, 2011. NIMBioS Investigative Workshops are relatively large (30-40 participants), focus on a broader topic or a set of related topics than Working Groups, attempt to summarize/synthesize the state of the art and identify future directions, and have potential for leading to one or more future Working Groups. Participants may include post-docs and graduate students with less experience in the particular topic than those participating in Working Groups.

The Metabolism workshop comprised 36 participants, including co-organizers Kevin D. Hall (NIDDK, National Institutes of Health), Steven B. Heymsfield (Global Director, Scientific Affairs, Obesity, Merck & Co., Inc.), and Diana M. Thomas (Assoc. Professor of Mathematical Sciences, Montclair State Univ.).

### Workshop Description

The mechanisms regulating human body weight are extraordinarily complex, and the ongoing obesity epidemic makes it imperative that we improve our understanding of these processes. In the engineering and physical sciences, there is a long history of using mathematical models and computer simulations to better understand the behavior of complex systems. This approach is now becoming more widely used in the biological and clinical sciences and a small but important field is emerging that uses mathematical and computational methods to address key questions about human metabolism and body weight regulation. This work is highly interdisciplinary and researchers entering this field are posed with communication challenges arising from the disparate backgrounds of researchers in mathematical and medical sciences. While this challenge is typical of truly interdisciplinary research, a second unique challenge arises from the intense media coverage of obesity and weight loss that often misinforms as much as it educates. The goal of this workshop is to bring together researchers in the fields of obesity and metabolism with investigators expert in mathematical and computational modeling to facilitate communication and collaboration between these researchers. The workshop will provide background on the physiology of human body weight regulation, highlight some of the recent progress applying such methods to modeling human metabolism, food intake, and body composition, and pose open mathematical modeling problems originating from metabolism and

body weight regulation research. We believe that it will act as a catalyst for future research on this important topic.

With more than two-thirds of the United States considered overweight and more than one-third categorized as obese, understanding mechanisms behind weight gain, loss, and maintenance is a major national goal. Mathematical modeling of the metabolism and body weight regulation is an important and growing subfield of obesity research which serves to understand these mechanisms. Models aid in understanding changes in body composition during weight loss or gain, the degree of individual adherence to a diet or exercise plan, and long-term effects of changes in diet and exercise on an individual's weight. Currently, mathematical models developed in collaboration by the PIs and clinicians are being used to develop strategies for dietary interventions during illnesses such as cancer, foster participant adherence to target diet and exercise protocols, and help understand differences between surgical interventions, drug interventions, and dietary interventions to achieve desired weight change. Mathematical models have been applied to understand how metabolic rate varies among animal species and the contribution of reduced physical activity and increased food consumption to our current obesity epidemic. The central theme of this workshop is to provide a formal venue to bring together researchers in nutrition, physiology, and mathematics to circulate the latest advances and pose open challenges in the field.

# Evaluation Design

## Evaluation Questions

The evaluation of the workshop was both formative and summative in nature, in that the data collected from respondents was intended to both gain feedback from respondents about the quality of the current workshop and also to inform future similar meetings. The evaluation framework was guided by Kirkpatrick's Four Levels of Evaluation model for training and learning programs (Kirkpatrick, 1994<sup>1</sup>). Several questions constituted the foundation for the evaluation:

1. Were participants satisfied with the workshop overall?
2. Did the meeting meet participant expectations?
3. Do participants feel the workshop made adequate progress toward its stated goals?
4. Do participants feel they gained knowledge about the main issues related to the research problem?
5. Do participants feel they gained a better understanding of the research across disciplines related to the workshop's research problem?
6. What impact do participants feel the workshop will have on their future research?
7. What changes in accommodations, group format, and/or content would participants like to see at future similar meetings?

## Evaluation Procedures

An electronic survey aligned to the evaluation questions was designed by the NIMBioS Evaluation Coordinator with input from the NIMBioS Director and Deputy Director. The final instrument was hosted online via the University of Tennessee's online survey host mrlInterview. Links to the survey were sent to 32 registered workshop participants on July 18, 2011 (co-organizers and NIMBioS affiliates were not included in the evaluation). Reminder emails were sent to non-responding participants on July 25 and 28, 2011. By August 4, 2011, 28 of the participants had given their feedback, for a response rate of 87%.

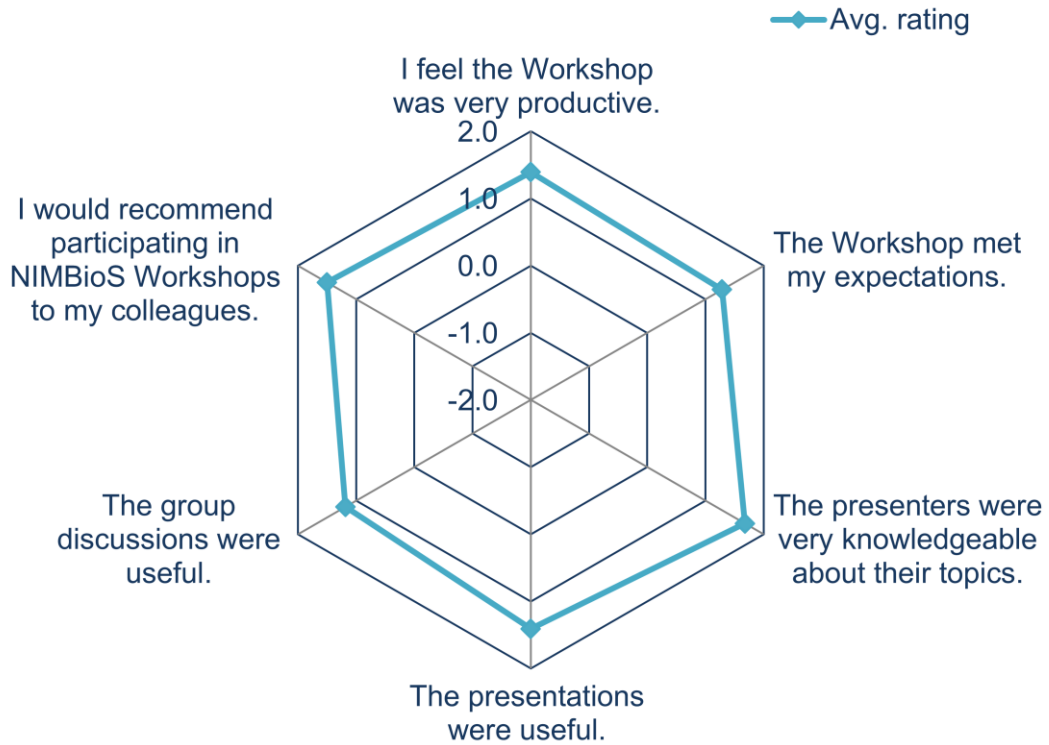
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<sup>1</sup> From Kirkpatrick, D.L. (1994). *Evaluating Training Programs: The Four Levels*. San Francisco, CA: Berrett-Koehler.

# Evaluation Findings

## Overall Satisfaction

Figure 1. Satisfaction with various aspects of the workshop



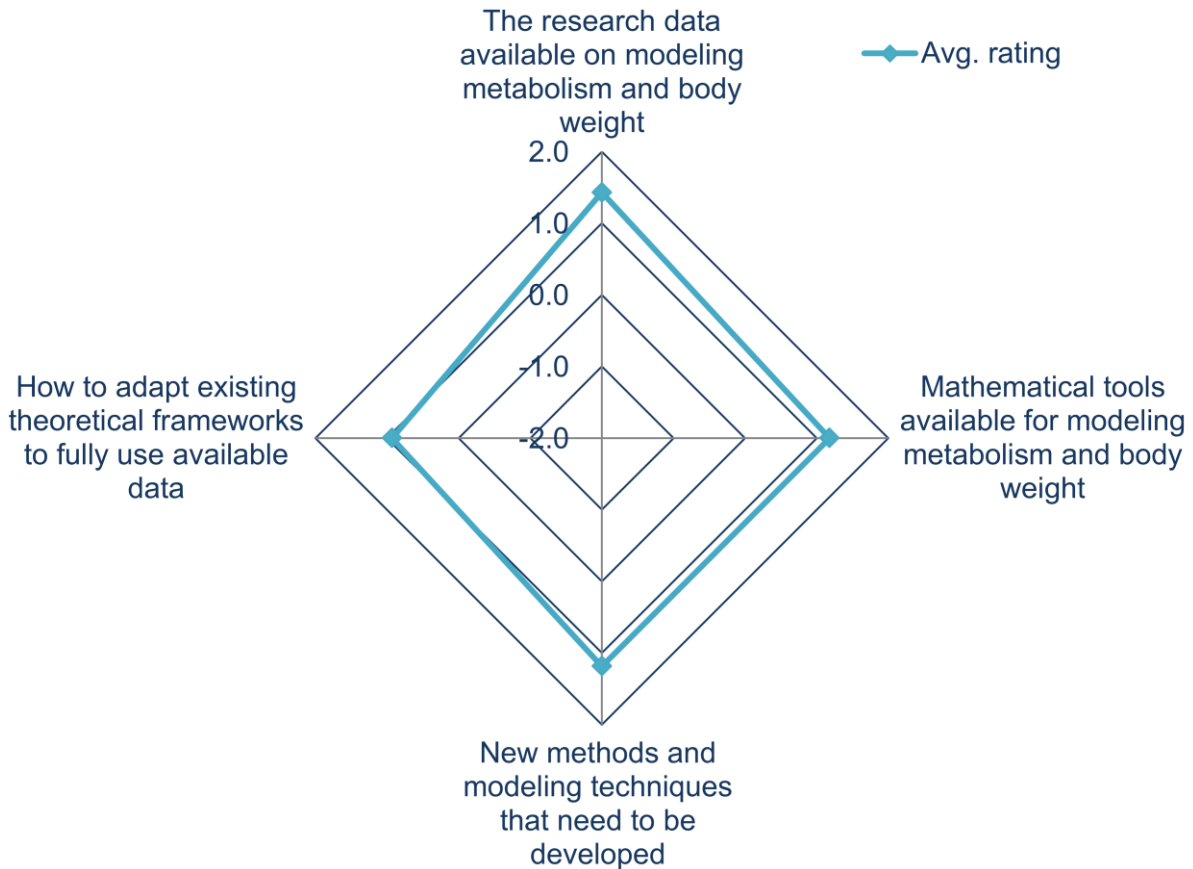
Scored on a 5-point Likert scale from -2 to 2 for “strongly disagree” to “strongly agree”

## Workshop Content and Format

### Participant Learning

Figure 2. Participant learning

*As a result of attending this workshop, I have a better understanding of:*



Scored on a 5-point Likert scale from -2 to 2 for “strongly disagree” to “strongly agree”



**Figure 3. Do you feel that participating in the workshop helped you better understand the research going on in disciplines other than your own regarding metabolism and body weight reduction?**



### **Comments**

*It was a really nice working group and workshop - intellectually free and a forum devoid of institutional boundaries that sometimes hinder collaboration or exchange of ideas. Thank you NIMBioS.*

*The workshop had a good mix of mathematicians and biologists. My research in this area has been stalled for a couple of years. As a result of the workshop, I have several new ideas and have made contacts that I believe will help with the development. Thanks to NIMBioS and Diana Thomas.*

*Seeing the work that has already been done discussed by scientists gave me a better understanding of the difficulties one encounters when building useful models.*

*The workshop helped me to understand the current and future applications of phenomenological body weight models. Unfortunately, the workshop failed dearly at the metabolism level. As a consequence, it is very difficult to know the molecular and metabolism integrative mechanisms responsible for the body weight regulation.*

*I had hoped for some discussion of modeling of energetics at the cellular level, but for the most part that was not an important focal point for this group. Nonetheless, the whole animal/human level modeling was quite useful.*

*Attending this NIMBioS workshop was extremely informative and I truly hope future collaborations/publications stem from the experience. Thank you very much for hosting a terrific workshop!*

*This was one of the best events I have ever attended!! I found the interactive discussion time very valuable and especially liked the variety of disciplines represented. The information presented was very accessible to me (at a topic*

level) and although I am not a mathematician, the approaches discussed seemed very rational.

The presentations and discussions brought up several new ideas, which I hope to be able to pursue in my (or my younger students') future research.

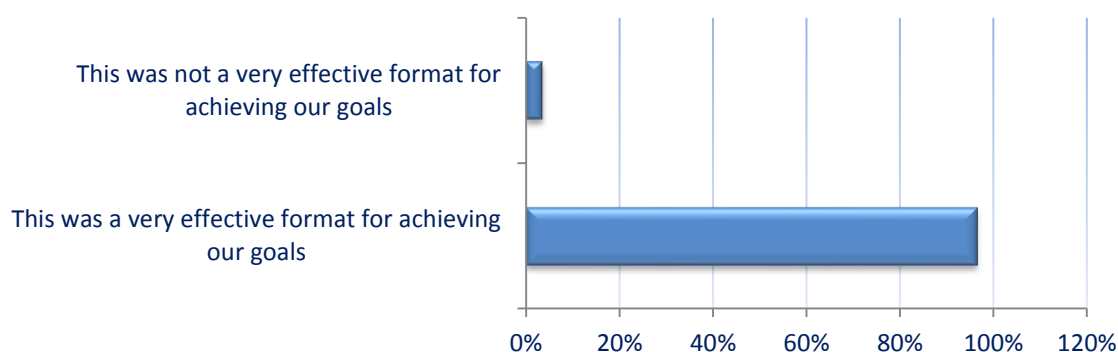
I am much more involved in intracellular metabolic modeling, but as a physiologist I remain keenly interested in whole human metabolism. I think, as I said at the meeting, we need to begin tackling the multi-scale modeling that would link molecular cell biology to physiology.

The workshop was very productive. I am proposing this topic (obesity/weight loss) as the interdisciplinary research theme in my university.

It was very important to understand the perspectives of different disciplines that have in common the analysis of a given issue.

## Workshop Format

Figure 4. Effectiveness of workshop format



### Format could be improved if:

No comments

## Most Useful Aspects of Workshop

Ample time for group discussions staging most of the talks in the first part of the program having meals at the venue.

The smaller group that it was facilitated conversations. Brought people together who we would otherwise never had much of a chance to meet and have some TIME to talk. Like Kevin Hall.

Discussions.

*Small group interactions around focused on topics presented.*

*Discussion of open problems in the field, and possible ways of starting to work on them. Good networking opportunities.*

*Brainstorming sessions (break-out sessions).*

*Everyone collaborating face to face.*

*Flexible nature of the workshop allowed adequate time for questions and discussions.*

*The talks provided a very good survey and introduction to the topic. The speakers knew each other well and had long standing collaborations. This facilitated the discussion between the groups.*

*Hearing about the clinical difficulties and steps taken to overcome these in getting data appropriate for metabolism modeling.*

*To hear about different modeling approaches.*

*The multidisciplinary approach to biological problems.*

*For me, it was an interdisciplinary character of the meeting and, of course, an opportunity to see personally many people of those whom I knew only from their publications before.*

*Meeting with researchers with significant experience in the field and meeting people with different academic backgrounds.*

*The well composed mix of mathematicians and biologically oriented health researchers, the relaxed atmosphere, the lively interactive discussions.*

*The mix of different disciplines present.*

*The opportunity for interdisciplinary discussion.*

*The presentation of the history, major research topics and the open questions in the field.*

*Getting a feel for the state of the art.*

*Understand the state of art and open questions in the field.*

*Presentations that led to discussions.*

*Presentation topics and discussion.*

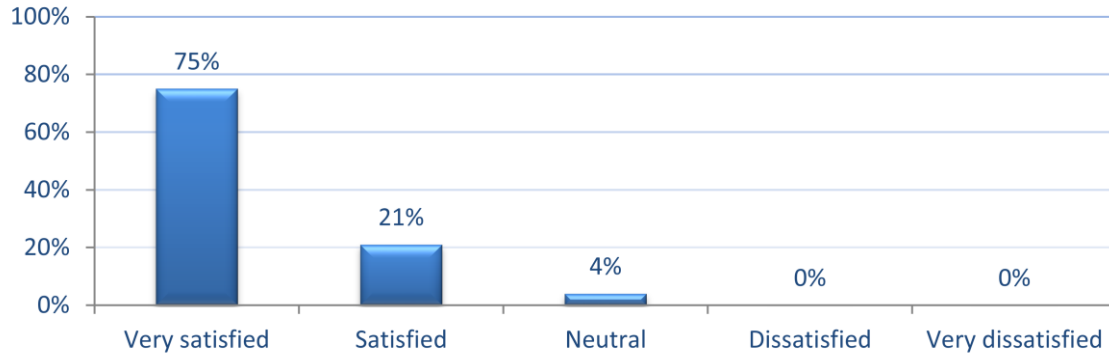
*The variety of topics and fields represented.*

*Interactions with other investigators.*

*Interaction with experts in mathematical modeling and metabolism.*

## **Communication**

**Figure 5. How satisfied were you with the opportunities provided during workshop presentations and discussions to ask questions and/or make comments?**



## **Comments**

*Gather and distribute mini bios at the beginning of the workshop.*

*Get everyone to draw a mechanistic diagram representing his or her views on how body weight is regulated. Put these diagrams up on the wall and let conversations build up around them.*

*A more structured approach- for example, a chair and discussants who keep the sessions on track and facilitate communication.*

*Have a chairperson to coordinate discussion.*

*Time-keeping was a bit of a problem. It would be helpful to have the Q&A stay more or less on topic and move the more fluid discussions to a greater number of breakout groups.*

*More short presentations as mentioned.*

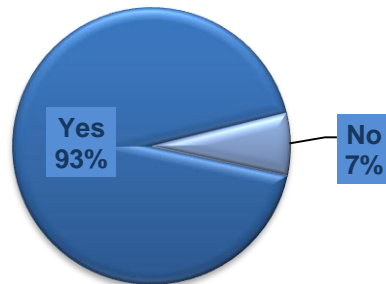
*Upgrading of the poster presentations as mentioned in another comment!*

*I thought it was very good.*

*I think communication channels were sufficient with the email list of all participants and the sharing of documents in wiggio.com.*

## Progress Toward Goals

Figure 6. Do you feel the workshop made adequate progress toward finding a common language across disciplines for research on the workshop's topic?



### Comments

*It was adequate in the sense that our purpose was not to set up standard of practice guidelines, but rather to at least begin learning each other's languages and theoretical approaches. I feel this was an important first step. However, follow up work should happen soon and perhaps a smaller group could convene to develop a position paper on this very important topic.*

*Dr. Thomas gave an excellent introductory talk which created the framework for the 2 disciplines to merge.*

*It's always hard for non-mathematicians to follow a mathematical talk, but the ones I spoke to still got something out of them. Overall I was very impressed by the mix of disciplines represented and by the high quality of interdisciplinary discussion.*

*There was lots of cross discipline discussion between the formal presentations and during the scheduled discussion groups.*

*I learned for example what an 'attractor' is and how 'game theory' may be applicable to biological problems. More can be done in securing a common language, but it should also be recognized that this sort of truly cross-disciplinary activities needs time to develop in a natural way, i.e. in ways where both parties find it useful.*

*I think this aspect may have been more helpful for the modelers as compared to the clinical trialists.*

*More time is needed for translation across the disciplines.*

*I think this sort of thing takes a few such workshops over a couple of years to gel.*

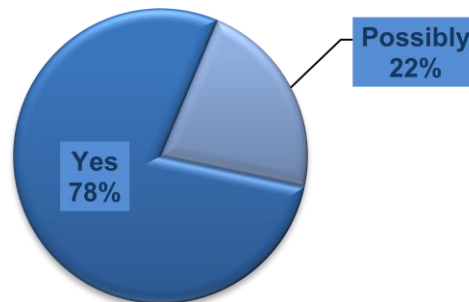
*The presenters from different disciplines had already established long-term collaborations. They knew each other well and had a common language. If the organizers would have challenged themselves and invite people working on the subject away from their areas of research, the workshop could have been more useful for the field. At the moment, it was only useful to maintain well-established collaborations.*

*Some progress, adequate for the length of the workshop*

*Absolutely!*

## ***Impact on Future Research Plans***

**Figure 7. Do you feel that the exchange of ideas that took place during the workshop will influence your future research?**



### ***Comments***

*I was especially benefitted by the introduction of past work outside my topic area and recent advances I learned about while at NIMBioS.*

*I will have a broader view of what can be achieved by mathematical modeling of the biological and population processes that I am working with.*

*I have new ideas now.*

*The exchange of ideas gives an insight on what are the priorities on defining accurate models for body weight regulations.*

*You never know.*

*I might try to do some modeling in the field (which is new to me but related to my own research), see answer to previous question.*

*There are clear open opportunities to develop mechanistic model of body weight regulation, including multiscale models integrating the molecular information with the macroscopic measurements.*

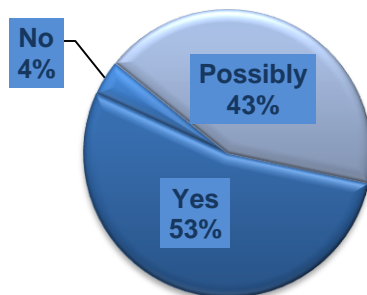
*Models are only as good as the data that support them. Collecting data is what I do, so the workshop has changed how I look at the process of measurement.*

*Perhaps not immediately but it will definitely influence my future plans.*

*Absolutely! Thank you!*

## **Impact on Future Collaborations**

**Figure 8. Did you develop plans for collaborative research with other workshop participants?**



## **Comments**

*I discussed working together with another mathematician on mathematical modeling of accelerometer data. I also discussed working together on modeling of hormonal effects of weight gain with another participant.*

*As is usually the case, there are issues of how to fund such endeavors, but I feel that a good basis was established for me.*

*As an applied mathematician, I find it difficult to get the data that I need for my modeling. I also must seek out biologist researchers to sure that my modeling is consistent with biological realities. I have found resources for both as a result of the workshop.*

*One of the course participants from mathematics was particularly interested in modeling the way the obesity epidemic has developed and includes trans generational reinforcement mechanisms.*

*My research is only tangentially related to the workshop, but I did make many contacts and I have one very tentative joint project that came out of the workshop.*

*A few contacts...we will see.*

*I need to follow up on a couple of discussions.*

*We initiated a discussion for a potential collaboration, and intend to follow up electronically over the next several weeks.*

*I need to follow up on some great ideas!*

*At the moment, I don't see how this will be possible.*

*Now I have plans to jointly modeling changes of body composition in pathologic states*

*Planning to develop a paper based on effect of weight gain during HIV treatment.*

*As an independent consultant, I can only work on projects brought to me by clients, but there was enough interest in non-steady state tracer kinetics that someone may do so.*

*Modeling of glucose and insulin in humans to understand beta cell function.*

## **Suggestions for Future workshops**

*Give all participants 5-10 min to explain their experience and interest for the theme of the workshop.*

*Would be great if we could have attended more than one breakout session because the topics were terrific.*

*I liked the poster presentations. However, I think a more suitable space for this particular activity would be beneficial.*

*Nothing comes to mind, other than more concrete plans to formalize a working group to establish a standard for language and data format.*

*I would want to discuss cellular mechanisms of body weight regulation.*

*The participants would have benefit of having most of the papers discussed in the presentations beforehand. I was surprised that most of the speakers primarily presented experimental results and models published between 2000-2007. Although I knew some of these papers, I will have personally benefited more if I would have the opportunity to reading these papers beforehand. The organizers didn't maintain a tight schedule. Although this makes the discussion relaxing and open, most of us have hectic academic careers. I was expecting to*



*have conference calls with my home institution at specific times, which I needed to reschedule. There was a clear divide between the speakers and participants. Most of the speakers have long standing collaborations. As a participant I didn't feel that I belonged to the workshop.*

*I really enjoyed the entire workshop.*

*It is perhaps too much to expect that new concrete collaborative activities can grow out such workshop, and hence there may be set aside too much time for this. The establishment of the network is what works, and it may be very helpful in future projects. The posters are of utmost importance, providing the ideal basis for flexible individualized communications about the research with external partners, and fulfilling in contrast to brief oral presentations all the needs of master class teaching; much more focus should be given to the posters, and 20-minute discussants among the speakers should be allocated beforehand.*

*Would have been great to have the mathematicians discuss their specific interests in a more expanded form than their basic introduction given on this first day.*

*Breakout groups being concurrent - since interest may overlap. The report format was a good solution but may be each group could have worked each day since there was time*

*A more diverse group on the physiology side of the "equation".*

*I would build in more time for focused working group discussion/breakout session...preferably one each day. Would also tighten up the last day to provide more focus.*

*The workshop did not have a proper chairperson to introduce speakers and moderate discussion. This was lacking.*

*The presentations were very structured and the breakouts were not. Breakouts tend to be better when specific problems are assigned to groups.*

*Breaks in the day (outside), and convening in the evening, maybe at the hotel.*

*The participants mini bio should be compiled and distributed (e copy okay) before or at the beginning of the workshop. That way it is not necessary to wait for the presentations to see if someone has the expertise of interest.*

*I suggest making the workshop shorter in duration.*

*All the talks went over, sometimes by a lot. It made the first day or two somewhat exhausting. Also, I didn't feel the poster session was taken seriously at all.*

## Additional Comments

*I appreciate the opportunity to participate...overall, I considered it quite well done and am impressed with what NIMBioS has put together.*

*The NIMBioS staff and administration are doing a fantastic work.*

*Talks could have been longer. Most of the speakers went over time and some went really over time. It would have been better if talks were longer and the schedule was better enforced.*

*Thanks to the coordinators for everything - it was great!!*

*Thank you!*

*Hope to be involved in a future workshop such as this one.*

# Appendix

Mathematical Models of Metabolism and Body Weight Regulation

Workshop Evaluation Survey

## Mathematical Models of Metabolism and Body Weight Regulation

### Workshop Survey

Thank you for taking a moment to complete this survey. Your responses will be used to improve the workshops hosted by the National Institute for Mathematical and Biological Synthesis. Information supplied on the survey will be confidential, and results will be reported only in the aggregate.

Please check the appropriate box to indicate your level of agreement with the following statements about this workshop: (Very satisfied, Satisfied, Neutral, Dissatisfied, Very dissatisfied)

- I feel the workshop was very productive.
- The workshop met my expectations.
- The presenters were very knowledgeable about their topics.
- The presentations were useful.
- The group discussions were useful
- I would recommend participating in NIMBioS workshops to my colleagues.

Please check the appropriate box to indicate your level of agreement with the following statements. As a result of participating in this workshop, I have a better understanding of: (Strongly agree, Agree, Neutral, Disagree, Strongly disagree)

- The research data available on metabolism and body weight regulation
- Mathematical tools available for modeling metabolism and body weight
- New methods and modeling techniques that need to be developed
- How to adapt existing theoretical frameworks to fully use available data

Do you feel participating in the workshop helped you better understand the research going on in disciplines other than your own?

- Yes
- No
- Comments:

Do you feel the workshop made adequate progress toward finding a common language across disciplines for research on the workshop's topic?

- Yes
- No
- Comments:

Do you feel that the exchange of ideas that took place during the workshop will influence your future research?

Yes  
No  
Possibly  
Comments:

Did you develop unanticipated plans for collaborative research with other workshop participants?

Yes  
No  
Possibly  
Comments:

What do you feel was the most useful aspect of the workshop?

What would you have changed about the workshop?

How do you feel about the format of the workshop?

This was a very effective format for achieving our goals  
This was not a very effective format for achieving our goals ->  
The workshop format would have been more effective if:

How satisfied were you with the opportunities provided during workshop presentations and discussions to ask questions and/or make comments?

Very satisfied  
Satisfied  
Neutral  
Dissatisfied  
Very Dissatisfied

Please indicate any suggestions you have for facilitating communication among participants during the workshop:

Please use this space for additional comments: