Scriptapedia 3.05

Acknowledgements

Scriptapedia is a collaborative effort to make group model building in system dynamics more transparent, accessible, and shared around the world. A number of individuals have been integrally involved in developing and leading this effort (in alphabetical order): David F. Andersen (University at Albany New York), Annaliese Calhoun (Washington University in St. Louis), Peter S. Hovmand (Washington University in St. Louis),Timothy Hower (Washington University in St. Louis), Etiënne Rouwette (Radboud University Nijmegen), Eric Steins (Kirwan Institute for the Study of Race and Ethnicity), George P. Richardson (University at Albany New York), and Krista Rux (Washington University in St. Louis).

Funding for *Scriptapedia* was partially provided by the Centers for Disease Control and Prevention through the Brown School Violence and Injury Prevention Center (1R49CE001510), National Institutes of Health (HHSN 276200900017C); and, the Social System Design Lab at the Brown School of Social Work, Washington University in St. Louis.

Citing *Scriptapedia*

Content from *Scriptapedia* should be appropriately cited when used in publications and derivative works. The suggested format for citing *Scriptapedia* is:

> Hovmand, Peter S., Etiënne A. J. A. Rouwette, David F. Andersen, George. P. Richardson, Annaliese Calhoun, Krista Rux, and Timothy Hower. 2011. Scriptapedia 3.04. Place Published. http://www.systemdynamics.org/other_resources.htm/scriptapedia (accessed <date accessed>).

License

Table of Contents

Best Practices

Hopes and Fears

Description:	Process elicits hopes and fears around group model building
Context:	At the beginning of a group model building project.
Primary nature of group task:	Divergent
Time:	Prep time: none Time during session: 30 minutes Follow-up time: none
Materials:	• Two different colors of office paper (8.5 x 11) with enough for multiple sheets for each participant • Thick markers • Blue "painters" masking tape
Inputs:	None
Outputs from this script:	List of participants hopes and fears
Roles:	*Community facilitator* with good group facilitation skills and knowledge of the local language and topic.
People in the room:	All participants and members of the core modeling team
Steps:	1. Participants are given several sheets of paper in each color. The *community facilitator* explains that they will be writing their hopes and fears for the project, and then sharing them with the group. 2. The *community facilitator* states which color represents hopes and which represents fears. 3. In a round-robin fashion, each participant then reads one fear and one hope. The *community facilitator* takes each hope and fear that the participant has read and posts it on the wall. After each participant has had a chance to share once, the *community facilitator* goes around the room until everyone has shared all of their hopes and fears. 4. The *community facilitator* then tries to identify some of the themes of the hopes and fears. *Recorders* write down the hopes and fears.
Evaluation criteria:	Participants have shared both their hopes and fears for the upcoming project; participants understand the overall themes of the hopes and fears.
Authors:	George P. Richardson and David F. Andersen
History:	None
Revisions:	None
References:	Andersen, D. F., & Richardson, G. P. (1997). Scripts for group model building. *System Dynamics Review, 13*(2), 107-129. Luna-Reyes, L. F., Martinez-Moyano, I. J., Pardo, T. A., Cresswell, A. M., Andersen, D. F., & Richardson, G. P. (2006). Anatomy of a group model-building intervention: Building dynamic theory from case study research. System Dynamics Review, 22(4), 291-320.

Graphs over Time

Description:	Participants produce sketches of key variables over time, which are clustered by the modeling team
Purpose of script:	Framing the problem, initiating mapping, eliciting variables, and input to deciding the reference modes for the study
Primary nature of group task:	Divergent
Time:	Prep time: 10 minutes Time during session: 45-60 minutes Follow-up time: N/A
Materials:	• Camera or other method to capture the graphs • Stacks of 8.5x11 white paper with axis drawn on them • Large blank wall (8'x10') • Fat markers • Glue sticks, blue tack, or tape
Inputs:	None
Outputs from this script:	Candidate variables for the dynamic model or the map
Roles:	• *Modeler facilitator* to work with the group with some experience with SD • *Modeler* listening to what is being graphed and the way people are talking about the graphs who must also be able to conceptualize early seeds of system structure. • *Wall builder* to cluster graphs and talk about themes with little or no experience in SD • *Runner (optional)* to brings the graphs from the *community facilitator* if the group is large • *Recorder* to document the session and photograph the clustered graphs
People in the room:	All members of the core modeling team and participants
Steps:	1. Based on group size, decide whether to break participants into subgroups. In smaller groups N<10, allow individuals to work and present independently. In larger groups N >10, divide participants into groups of roughly N/10. Ask the subgroups to sit together. 2. Modeling team hands out sheets of white paper to each participant 3. Facilitator gives example of how to draw a graph over time. Carefully labeling X axis with "Time", start and end times, and now with a vertical dashed line. Label Y axis with variable name. Sketch the behavior. 4. Facilitator then asks participants to draw one variable over time per piece of paper. Give participants the option of including hoped for behavior, expected behavior, and feared behavior on the same graph. 5. Facilitator and wall-builder walk around and help participants with the task if they need it. (Allow 15 minutes or until the group runs out of steam) 6. Reconvene as large group. a) If N<10, facilitator takes one graph at a time from each participant, holds it up in front of entire group and asks him/her to talk about it. Ask for participants to share the "best stuff" first. Clarify timescale, variable names, etc. b) if N>10, instruct subgroups to share their graphs with each other and choose the ones they think are most important. Facilitator then goes to each subgroup and holds the first graph they have selected up in front of entire group. Subgroup spokesperson talks about graph. Ask subgroups to share the "best stuff" first. Clarify timescale, variable names, etc. 7. Facilitator then hands the graph to the person building the wall. 8. Facilitator repeats steps 6 and 7 with each participant or subgroup, taking one graph at a

	time until all graphs are shown or time has run out. Finish by asking if any participant has something else that really ought to be shown. 9. During steps 7-8, each graph is posted on the wall. Wall builder tries to cluster the graphs meaningfully on the fly, based on themes and variables. 10. Facilitator asks wall builder to explain the clusters of graphs on the wall. Wall builder tries to summarize dynamics that help to characterize the problem that emerges from the participants' graphs. 11. Facilitator enables the participants to talk about the clusters and the characterization of the problem they imply. 12. Consider labeling the clusters based on themes or related variables 13. Potential for modeler to close by highlighting the beginnings of feedback thinking in the dynamic problem.
Evaluation criteria:	• Interesting, self-sustaining group discussion after clusters described by the wall builder • Meaningful clusters are possible to see • Graphs tend to converge to a clear dynamic problem • Some key dynamic variables emerge from reflecting on the graphs and clusters • Modeling team can begin to see key stocks and perhaps important feedback loops • Members of the group appear to have better understandings of the issues of interest to other members
Authors:	George Richardson (gpr@albany.edu), David Andersen (david.andersen@albany.edu)
History:	n/a
Revisions:	n/a
References:	Andersen, D. F., & Richardson, G. P. (1997). Scripts for group model building. *System Dynamics Review, 13*(2), 107-129.

Concept Model

Description:	Using a Concept Model with a group
Context:	Before initiating modeling
Primary nature of group task:	Presentation
Time:	Prep time: Concept Model is insightful and tricky Time during session:25-30 minutes Follow-up time: none
Materials:	• White board and markers (to draw model in stages) • Computer and projector (to project simulation model)
Inputs:	None
Outputs from this script:	• Familiarity with stock and flow and causal icons • Understanding that maps can be quantified and simulated • Understanding that models can be created for the groups' problem(s) • Understanding that the model is owned by the group and can be repeatedly modified and improved
Roles:	• Very experienced modeler to design the Concept Model • Experienced helper to show and run the formal model is useful
People in the room:	All participants who will be involved in the group model building process
Steps:	1. First version of concept model drawn by hand on white board (show tub with faucet and drain to explain stock & flow icons) 2. First (identical) quantified version projected from computer; note it's identical. Simulate and trace the behavior. 3. On white board add one or more elements to the first version to get an amended Concept Model (second version). Project second version from computer; simulate; trace behavior over time. Behavior should be different to get "Behavior is a consequence of structure." 4. Repeat step 3 one more time. 5. Summarize lessons: icons we will use, maps can be quantified and simulated, behavior can be generated endogenously, changing structure changes behavior, maps and models can be repeatedly refined, we can own the model the group creates.
Evaluation criteria:	Participants are talkative, wanting to tell the modeler how the model is wrong and can be improved.
Authors:	George Richardson, 9 Sept 2010
History:	First used in foster care workshops in early 1990s and used repeatedly by Richardson and Andersen for every group model building intervention since. Not widely used (or understood) by others.
Revisions:	Clarity of purposes
References:	Richardson & Andersen, "Teamwork in Group Model Building," SDR 11,2 (1995) Richardson, "Concept Models," International System Dynamics Conference, Nijmegen, July 2006

Ratio Exercise

Description:	This is one of several scripts that are used to help map feedback structure after key stock variables have been identified.
Purpose of script:	• Can be use to Initiating mapping in special cases, but major purpose is • Eliciting feedback loops (especially minor loops) and • Eliciting variables within the chain of causality in the minor loops
Primary nature of group task:	Convergent
Time:	Prep time: Most of the preparation time is spend in going over the candidate stock variables carefully to find pairs of variables that have ratios (or differences that can be named and make sense. Time during session: Once key stock variables have been identified, it takes only a few minutes (10 minutes) to put the stock variables up on a white board for mapping. Follow-up time: required by the recorder (to capture the feedback loops in a photograph or Vensim diagram or by the modeler reflector who may want to incorporate some of the elicited feedback loops into "cleaned up" views of model structure, approximately 30 minutes.
Materials:	• Large erasable white surface (cling sheet wall or white board • White board markers • Recorder will want to capture image in Vensim sketch or with a camera • Modeler reflector may redraw some of the mapped feedback loops on blank overhead slides using a water-soluble or dry-erase marking pen
Inputs:	This script cannot be completed until the group has defined pairs of stock variables whose ratio or difference make sense to the group (e.g., class size, case load, vacancy rate, occupancy rate, etc.)
Outputs from this script:	Using this script it is very possible to get a group to naturally generate feedback loops. The script lead easily and naturally into feedback thinking and the concurrent articulation and mapping of feedback effects.
Roles:	• Once this script gets going, a facilitator with modest experience in SD will in most likelihood be able to lead the group in mapping feedback effects (perhaps more skill is required in recognizing the stock variables and getting the exercise set up. • The modeling team gets lots of good material easily from this script. Modeler skill is need in the "modeler feedback" follow up where the feedback loops elicited by the group are integrated into more complicated "cleaned up" feedback diagrams • The recorder needs to be able to operate a camera or sketch the geometry of feedback loops using software such as Vensim
People in the room:	• The entire modeling and facilitation team is either participating in or watching the development of the feedback loops. This is a gratifying script to use because it so often reliably and quickly populated the public diagram with a dense network of feedback loops • The entire client team typically participates in this exercise. This is, we typically use this as a whole group exercise.
Steps:	1. This script typically develops offline when the modeling team realizes that a strong and clear set of stocks and flows exist to undergird this system and that aging chains of usually service loads (students, patients, clients) can be linked to some resource of stocks (teachers, nurses, caseworkers) so that the pairing of related stocks makes sense. Sometimes the modeling team realizes this quite early on (sometimes they have a strong hunch before the session even begins). 2. Someone, usually the modeler picks out which pair of stocks to work with first. Then the facilitator asks the group to name the ratio or difference (caseload, class size, etc.). The facilitator adds the ratio or difference variable using the exact name that the group has

	suggested (different groups use differing terminology for a similar concept and some groups use differences and some use ratios--occupancy rate versus number of vacancies—so it is important to use their terms. 3. The facilitator maps the ratio (or difference variable) with the incoming arrows marked with "+" or "-" as is causally appropriate. 4. The facilitator asks the question, "what would happen if this ratio were to go to zero or get unusually small" or "what would happen if this ratio were to become very large—how would the system react?" 5. The group then starts to tell feedback stories about how the system reacts when this key ratio (or difference) gets out of what. When loops are completed, the facilitator can trace them out for the group adding appropriate "+" or "-", telling the stories of the loops. These loops are almost always balancing loops. Steps 2 to 5 are repeated with another set of ratios
Evaluation criteria:	• This script will usually fill a white board with lots of feedback loops very quickly • Participants will "get the hang" of what feedback loops are, how they work, and will start to look for them. • A very good map will have feedback paths that connect to other important stocks in the system (other than simple first order loops). These insights that pass through other stocks are especially important.
Authors:	Initial draft by David F. Andersen (David.andersen@albany) on July 1, 2010. Reviewed by George P. Richardson (gpr@albany.edu)
History:	This script was first developed and used by Richardson and Andersen in the 1990s. It is a real "work horse" script, yielding lots of feedback in a reliable fashion. In 2010, this script was listed by Richardson and Andersen in their ScriptsMap.
Revisions:	None
References:	ScriptsMap poster at the 2009 Albuquerque conference. Omege article on ScriptsMaps by DAGR-FACE.

Initial Policy Options

Description:	Eliciting a list of realistic policy experiments the group would like to see investigated and analyzed with modeling and simulation
Purpose of script:	• Framing the problem • Eliciting variables (implicitly, by implication)
Primary nature of group task:	• **Divergent**: activity designed to produced an array of different ideas and interpretations
Time:	Preparation time: at most 5 minutes (assembling paper and markers) Time required to complete steps in script: 30 to 60 minutes Follow up time:
Materials:	• Markers • 8.5x11 (or A4) paper • Glue sticks (blue tack, masking tape) for posting on wall • Wall for posting!
Inputs:	• none
Outputs from this script:	• List of specific candidate policy options to be used to: - Help define the problem(s) - Help set the model boundary - Help set realistic expectations for the direction and outcomes of the meetings - Helps modelers build a model that suits the group's needs
Roles:	• Facilitator • Helper to cluster the policy options on the wall and describe the resulting clusters
People in the room:	• All participants in the group model building effort
Steps:	1. Facilitator sets up task by asking participants to write short phrases naming policies that participants would like to see discussed, modeled and simulated in the course of the work. 2. One policy per page. 3. Could be policies tried in the past or currently, or policies being talked about for the future, or realistic but wild ideas. 4. Participants work in pairs perhaps, to build confidence and share thinking while still keeping the divergent nature of the group task 5. Facilitator collects policy pages one at a time (receiving one page per pair and going on to the next pair to assure complete involvement). Asks pair to talk about their proposed policy option. 6. Helper posts the policy pages on the Wall, clustering them on the fly according to emerging themes 7. Repeat steps 5 & 6 until done, or time runs out. 8. Facilitator asks Helper to describe the clusters, justify the choice of clusters, and talk about "what he sees" in the whole effort.
Evaluation	• The length of the list.

criteria:	• The realism of the list – Does the group see the list as appropriate? • The workability of the list – Does the modeling team see the list as helpful for the model building?
Authors:	To my knowledge, never written up or ascribed to anyone in particular. A widespread script.
History:	Used by Andersen & Richardson, individually and as a team, for years. Could be said to stem from Nat Mass's 1980 observation on a draft of the Richardson-Pugh text (expressed to Richardson) that defining problems dynamically is only part of the story, that many times consultants and modelers have only lists of policy options to use to begin the modeling process.
Revisions:	There are probably some, but the script is so simple that revisions would have been few and probably hard to identify. Clustering could have been a revision early on.
References:	None that I know of.

Promising Practices

Creating a Shared Vision of Modeling Project

Description:	Creating a shared vision of the modeling project
Script Status:	• Best practice: this script has been used many times and in different settings and has consistently produced the intended outputs. • Promising practice: this script has been used a few times with good results, but needs additional refinement and testing
Primary nature of group task:	• **Convergent**: activity designed to clustering and categorizing ideas and interpretations.
Time:	Preparation time: 30-60 minutes Time required to complete steps in script: 60 minutes Follow up time: none
Materials:	• Overhead projector, laptop, and electricity • Camera
Inputs:	• Draft modeling project description
Outputs from this script:	• Revised modeling project description
Roles:	• Facilitator is leading the review and discussion of the modeling project • Recorder is typing changes to the modeling project description • Gatekeeper who is advocating for the organization/community's interest in the model and value of model to the organization/community
People in the room:	• Everyone
Steps:	1. *Recorder* presents the draft modeling project description 2. *Facilitator* leads a discussion of the description and editing changes to the modeling project description to better reflect the focus of the modeling project 3. *Facilitator* helps the group evolve consensus for each section with changes made and the *recorder* tracks changes in the modeling project description. 4. Repeat steps 2 and 3 for each section of the modeling project description, moving onto the next section only after consensus has been reached.
Evaluation criteria:	• People are participating in the discussion, contributing, and indicate understanding of the terms of the modeling exercise, motivation, and purpose • Clarity of document • Consensus on modeling project description
Authors:	Foundation for Ecological Security and Social System Design Lab, November 9, 2010
History:	Created during the Rajasthan Commons Modeling Project
Revisions:	None
References:	None

GMB Process Mapping

Description:	Developing a process map for a group model building project
Purpose of script:	• To plan and develop a shared understanding of the overall group model building process • To identify the number of sessions, how many people and who will be involved in each session • To identify the inputs and outputs for sessions
Primary nature of group task:	• **Convergent**: activity designed to aggregate and merge ideas and interpretations.
Time:	Preparation time: 10 min Time required to complete steps in script: 45 min Follow up time: 10 min
Materials:	• Microsoft Visio • Blank or draft process map with basic phases of project • Data projector
Inputs:	• None
Outputs from this script:	• GMB process map • Descriptions of modeling team and participants for each session
Roles:	• Facilitator familiar with group model building who can introduce scripts, share sample agendas, and different roles in GMB • Facilitator with expertise in group model building familiar with process maps and using Visio to draw process maps • Recorder who is tracking categories of participants and facilitators during the discussion, and then confirming this list with participants at the end • Recorder who is taking process notes on the planning session
People in the room:	• Core modeling team
Steps:	5. Introduce blank process map 6. Explain the criteria for selecting stakeholder tracks. *The criteria for identifying a stakeholder group or track for a group model building session are primarily based on <u>who you want to have in the room</u> developing a particular model. You might want to think about what kind of conversation or dialogue you want to elicit from participants or who you want to be able to attribute the model to. For example, is it important to elicit divergent views on a subject where people might have different experiences? Is it important to be able to say that the model was drawn by consumers or some other stakeholder group?* Note: A common issue in identifying stakeholders is that groups will tend to generate long lists of people involved in the system or focus on recruitment strategies for getting them involved. These tend to be counter-productive starting places because it is often not clear what is being asked of individuals being recruited. 7. Begin by introducing the core modeling team as the first stakeholder track and different phases of modeling. 8. Then try to identify one stakeholder track and begin to identify some sessions. As the sessions are discussed, identify who is in the session in terms of facilitators and participants. 9. Continue to add and change sessions during the discussion with periodic checks to confirm the

	state of the process map. 10. Each session with the same agenda should have the same numerical prefix and be distinguished with a letter suffix (e.g., 6A, 6B, etc. would all indicate multiple sessions using the same agenda; 7, 8, 9, etc. would indicate multiple sessions with different agendas). 11. Identify inputs or outputs that might be needed in the session. 12. Near the end of the session, the recorder keeping track of descriptions of facilitators and participants starts a review by going through each numbered session. As the recorder lists the participants and facilitation team for the session, the facilitator highlights that particular session.
Evaluation criteria:	• There is general agreement and buy-in on the overall plan for group model building among the core modeling team • The core modeling team has a clear idea of how many sessions are involved, when they will happen, and who will be involved • There is an initial sense of who will facilitate the group model building sessions and needs to be involved in the training • The core modeling team has sufficient information to develop an IRB application
Authors:	Peter Hovmand (phovmand@wustl.edu, June 24, 2010)
History:	This approach is based on David Straus's (2002) approach to designing collaborations and group process. The motivation for both using process maps and making the process explicit comes from the tendency to underestimate the amount of planning required to design even relatively short group model building workshops.
Revisions:	None
References:	David Straus (2002). *How to make collaborations work: powerful ways to build consensus, solve problems, and make decisions*. San Francisco, CA: Berrtt-Koehler Publishers, Inc.

Debriefing

Description	This script is used to organize the team's debriefing session after a GMB session.
Context	Immediately after a GMB session.
Purpose(s)	• Provide an opportunity for team members to share initial impressions of the GMB session • Provide emotional support team members • Help the team learn how to improve GMB practice.
Nature of group task	• **Evaluative**: activity designed to evaluate and choose between options and ideas
Time	Preparation time: None Time required to complete steps in script: 30-60 minutes, depending on complexity of session being reviewed Follow up time: None
Materials needed to complete script	• Chairs in a circle
Inputs from other scripts	• Final, detailed version of the Script from GMB session being debriefed
Outputs from this script	• Completed Evaluation instrument(s) • Completed Debriefer Worksheet • List of actions necessary to implement improvements
Modeling team roles required and expertise needed	• Debriefer skilled at facilitating group process, culturally sensitive, and only observing the modeling exercise
Who is in the room?	• All Modeling Team members who participated in session under review
Steps	1. Assemble the participants, announce the start of the debriefing session. 2. Debriefer reviews the process the team will use to conduct the review. 3. Begin with a check-in to see how people are doing. This is important regardless of whether the session went well or badly. 4. Ask the following questions: • How are you feeling about how this GMB session went? • Overall, did we accomplish what the session was designed to do? • What went well during this session? • Were there any rough parts for you? • What did you learn from this session? • How could the session have been improved?
Evaluation criteria	1. Stronger, more cohesive team after the debrief 2. List of ways to improve the process.

Author(s)	Amanda Lavallee (amaylavallee@hotmail.com), Timothy Hower (thower@wustl.edu), and Peter Hovmand (phovmand@wustl.edu), April 6, 2010
History & Basis for Script	Original Script based on current practice and author's work.
Revisions	Revised March 28, 2011 by Peter Hovmand to simplify the questions
References	--

Under Development

Places to Intervene

Description:	Identify potential intervention points
Script Status:	(Choose one and delete the bullets below that do not apply) • Best practice: this script has been used many times and in different settings and has consistently produced the intended outputs. • Promising practice: this script has been used a few times with good results, but needs additional refinement and testing • Under development: this script still needs to be refined and tested
Purpose of script:	• Eliciting potential intervention points
Primary nature of group task:	• **Convergent**: activity designed to produce an array of different ideas and interpretations
Time:	Preparation time: Time required to complete steps in script: Follow up time:
Materials:	• Thick markers • Large sheets of paper, enough for each of the main
Inputs:	• Causal loop diagram or stock-and-flow diagram with sufficient confidence/buy-in from participants to be useful
Outputs from this script:	• Prioritized list of interventions
Roles:	• Modeler facilitator • Community facilitator
People in the room:	• Everyone
Steps:	1. Modeler facilitator introduces the different places to intervene in a system using Meadows 1999 article and illustrates each type of intervention using the previously developed model, which could either be a stock and flow diagram or causal loop diagram.
Evaluation criteria:	(How do you know that the script has been successful? E.g. behavioral changes of participants, learning goals achieved)
Authors:	Peter Hovmand (phovmand@wustl.edu), February 2011
History:	(This can include previous scripts, articles, other types of small group exercises, etc. The history should provide a name and date citation, and retain the entire history of the script, not just the previous version.)
Revisions:	(Briefly describe what changes have been made between this version and earlier versions)
References:	Meadows, D. (1999). *Leverage points: places to intervene in a system*. Hartland, VT: The Sustainability Institute.

Community Snapshot

Description	Participants identify their role within the model
Context	After a causal loop diagram or stock-and-flow diagram has been presented
Purpose(s)	• Conclude session with time for participants to share their thoughts or their roles within the system • Create discussion around the model and the participant's role • Create collaboration among participants • Identify next steps
Nature of group task	**Convergent**: activity designed to aggregate and merge ideas and interpretations.
Time	Preparation time: 5 min Time required to complete steps in script: 30 min Follow up time: N/A
Materials needed to complete script	• White board/flip chart • Markers • Camera
Inputs from other scripts	• Behavior over time graphs • Causal loop diagram
Outputs from this script	• Potential roles for participants • Development of collaborations/connections
Modeling team roles required and expertise needed	• Facilitator/elicitor to work with the group- some experience with SD • Modeler/reflector listening to what is being said based on the model, able to conceptualize discussion of "community snapshot"- expert in SD • Recorder/photographer to document session- no experience needed • Note taker to document discussion around model and their role – some experience with note taking from previous sessions
Who is in the room?	• Modeler • Facilitator • Note-taker • Participants • Core Modeling Team
Steps	1. Refer back to Causal Loop Diagram 2. Discuss the general relationships within the model 3. Discuss individual roles participants have in the model 4. Describe this as a "community snapshot" 5. Where do you see your work represented in the diagram? 6. Based on this diagram, do you see any new strategies that you would want to incorporate into your work?

	7. How is your work connected to others? In the room? Not in the room? 8. Does this capture connections that are new or suprising? 9. Does the diagram suggest possible collaborations that you may have thought of previously but never implemented? Possible collaborations that you haven't thought of previously? 10. What can we take away from this?
Evaluation criteria	Identification of individual roles in the community/model, discussion of the relationships and linkages within the model , identification of potential areas for collaboration, clarification of next steps
Author(s)	Krista Rux (krux@wustl.edu) August 3, 2010
History & Basis for Script	
Revisions	none
References	none

Appendix A: Glossary

Balancing loop	A feedback loop that counteracts a change and moves the system toward some goal (also known as negative feedback loop)
Behavior over time graph	Graph of one or more system variables over time showing the behavior of a system over time
System boundary	Conceptual boundary distinguishing endogenous from exogenous variables in a feedback system
Detail complexity	Number of components in a system
Dynamic complexity	Number of dynamic behavior patterns that a system can produce (e.g., oscillations, overshoot and collapse, etc.)
Endogenous variables	Variables in a model that are influenced by other variables in a model
Exogenous variables	Variables in the model that are strictly causes of other variables and not influenced by other variables in a model
Feedback loop	A causal chain that "feeds back" on itself.
Flow or rates	Movements of conserved quantities from one stock to another stock
Group model building	Process of developing a causal loop diagram or simulation model with participants in the system in a group format
Material boundary	Defines exchanges of conserved quantities (e.g., people, resources) with the environment, and often denoted with a cloud symbol attached to a flow or rate
Mental models	Mental representations of the real system used to solve problems and guide action
Reference modes	Description of the dynamic problem and usually described through a behavior over time graph
Reinforcing loop	A feedback loop that reinforces or amplifies a change (also known as positive feedback loop)
Stocks or levels	Accumulations of flows or rates, define the state of a system
System dynamics	A method for understanding systems and change using the concepts of feedback loops, stocks and flows, and computer simulation

Appendix B: Additional Readings in System Dynamics

Ford, A. (1999). *Modeling the environment: An introduction to system dynamics modeling of environmental systems*. Washington, DC: Island Press.

Forrester, J. W. (1961). *Industrial dynamics*. Waltham: Pegasus Communications, Inc.

Forrester, J. W. (1969). *Urban dynamics*. Cambridge, MA: MIT Press.

Forrester, J. W. (1971). *Principles of systems*. Waltham: Pegasus Communications, Inc.

Levin, G., & Roberts, E. B. (1976). *The dynamics of human service delivery*. Cambridge, MA: Ballinger Publishing Company.

Meadows, D. H. (1980). The unavoidable a priori. In J. Randers (Ed.), *Elements of the system dynamics method* (pp. 23-57). Cambridge, MA: Productivity Press.

Meadows, D. H. (1991). *Global citizen*. Washington, DC: Island Press.

Meadows, D. (1999). Leverage points: places to intervene in a system. Hartland, VT: The Sustainability Institute.

Saeed, K. 1998. *Towards Sustainable Development, 2nd Edition: Essays on System Analysis of National Policy*. Aldershot, England: Ashgate Publishing Company. (available at http://www.wpi.edu/Academics/Depts/SSPS/People/Saeed/Book/)

Senge, P. (1990). *The fifth discipline*. New York, NY: Curency Doubleday.

Sterman, J. D. (2000). *Business dynamics: Systems thinking and modeling for a complex world*: Irwin McGraw-Hill.

Vennix, J. (1996). *Group model building*. New York: John Wiley & Sons.

Vennix, J. (1999). Group model-building: Tackling messy problems. *System Dynamics Review, 15*(4), 379-401.

Warren, K. (2002). *Competitive strategy dynamics.* West Sussex, UK: John Wiley & Sons, Ltd.

Warren, K. (2004). Improving strategic management with the fundamental principles of system dynamics. *System Dynamics Review,* 21(4), 329-350.

Appendix C: System Dynamics Modeling Software and Online Resources

Vensim software (Personal Learning Edition available at no cost) http://www.vensim.com/

IThink/STELLA
http://www.iseesystems.com/

Strategy Dynamics
http://www.strategydynamics.com/

Social System Design Lab
http://www.gwbweb.wustl.edu/research/systemdynamics/

System Dynamics Society (includes links to conference proceedings) http://www.systemdynamics.org/

System Dynamics and Systems Thinking in K-12 Education
http://www.clexchange.org/

MIT Roadmaps
http://web.mit.edu/sdg/www/roadmaps.html

Centers Disease Control Syndemics Network
http://www.cdc.gov/syndemics/index.htm

Appendix D: Roles in Group Model Building

Community Facilitator: Primary responsibility for facilitating the group model building sessions. This is a person who is familiar with the local or substantive knowledge of the problem being modeled and knows the local language and community norms in cross-cultural situations. The substantive expert/facilitator should have strong group facilitation skills, some exposure and training in system dynamics, and have sufficient knowledge of the topic or community to anticipate and mediate conflicts that might arise within the group model building session. This person extends their social capital to help the community accept and work with the modeler facilitator.

Data Manager: Primary responsibility for making sure that the information collected during the exercises including diagrams, group model building scripts, agenda, pictures, notes, electronic versions of diagrams, etc. are collected, appropriated archived and made available.

Debriefer: Primary responsibility for facilitating the discussion after a group model building session. This is a rotating role among the core modeling team. The debriefer follows a semi-structured format asking for people's initial reactions, identifying areas of strength, and identifying areas of improvement for subsequent sessions. The debriefer essentially allows members of the core modeling team to debrief and reflect on group model building sessions in a systematic way for a limited period of time. The debriefer should not be someone who experienced a particularly challenging situation during the group model building.

Gate Keeper: Primary responsibility for making sure that the modeling project is meeting the needs of the client organization or community to the modeling team and communicating the modeling process and results to the client organization or community.

Modeler Facilitator: Primary responsibility for system dynamics modeling and group model building process. This is a person who is trained in systems thinking/system dynamics model with expertise teaching and leading groups in the use of systems/thinking/system dynamics. The person should also have experience facilitating groups and leading group model building sessions. If the goal of the project is to develop a simulation model, it is expected that the modeler/facilitator also be an expert modeler and able to anticipate and address the variety issues that can arise in data and modeling.

Modeler: Primary responsibility for building the system dynamics causal maps, models, and simulations with expertise in system dynamics modeling and software (Vensim, IThink/Stella, etc.), formulating and entering equations, testing and analyzing the model, and running simulations for answer policy questions.

Participants: Primary responsibility for contributing substantive and local expertise to the modeling sessions and effort. The participant plays a key role throughout the sessions in helping to develop problem definitions; identify variables of interests, major stocks and flows, defining; suggesting potential data sources for the model; and, generating policies for intervening in the system.

Process Coach: Primary responsibility for observing the group process with attention to how participants are experiencing the session. This role requires someone who is able to reflect on the group process and accurately identify what is happening for participants based on observing their behavior and language. The process coach also plays an evaluation role and helps provide accurate feedback to the core modeling team about how the

sessions are going. The process coach should be noticing when group dynamics begin to interfere with the process and identify potential solutions.

Recorder: Primary responsibility for taking detailed notes during the modeling session. This person listens carefully to participants and writes downs the words, definitions, and terminology they use to describe causal relationships, variables, and structures, as well as comments and questions asked. After the session, the recorder takes part in consolidating notes and materials from the modeling session to ensure that the model produced captures the full richness of the participants' thoughts and conversations. The recorder should have sufficient training in system dynamics to identify causal structures and stock-flow distinctions, strong note taking skills, and ability to integrate their notes from the modeling session into the final model.

Reflector: Primary responsibility for helping the group reflect on what they have done so far and recognize the issues/insights that have been developed during the modeling. This role requires someone who is familiar and comfortable with the language of system dynamics (e.g. can point out reference modes, stocks and flows that were mentioned, etc.) and has strong listening skills, especially in accurately paraphrasing participants' comments in their own words. The lead recorder is the person who ensures that all materials produced during the session are archived and made available to members of the team. The lead recorder also types up notes that summarize each modeling session and takes part in training other recorders on the team.

Time Keeper: Primary responsibility for managing the time of the group model building session, keeping the group on schedule by starting and ending on time and taking breaks, and ensuring that the overall structure of the session is predictable. When there is a need to adjust the schedule, it is the time keeper's responsibility to become aware of the issues and help negotiate a solution to end on time. It is overall very important to start and end on time as much as possible.

Meeting Convener: Primary responsibility for starting the session, introducing participants to the exercise, making sure that participants understand the purpose of the exercise within the context of their organization or community, and introducing the facilitators.

Meeting Closer: Primary responsibility for bringing the session to close,

Appendix E: Script Template

Description:	(1-2 sentence brief overview)
Purpose of script:	(Delete the bullets below that do not apply) • Framing the problem • Initiating mapping • Eliciting variables • Deciding the reference modes for the study • Eliciting feedback loops • Eliciting stocks • _____
Primary nature of group task:	(Select the primary nature of the group task) • **Divergent**: activity designed to produce an array of different ideas and interpretations • **Convergent**: activity designed to clustering and categorizing ideas and interpretations. • **Evaluative**: activity designed to rank and choose between options and ideas • **Presentation:** activity designed to present information
Time:	Preparation time: Time required to complete steps in script: Follow up time:
Materials:	• (e.g. markers, overhead projector, flip chart) • • •
Inputs:	• (e.g. behavior over time graphs, concept model, or "none" if this is a starter script) • • •
Outputs from this script:	• List specific products such as BOTG, system maps, etc and how these products will be used in the context of the whole project. Deliverables are on physical products • Interim outputs or products of primary interest to modeler • Deliverables of interest to group
Roles:	• (e.g. Facilitator/elicitor- expert in SD) • •
People in the room:	• (list of people who should be in the room, e.g., "gatekeeper", "modeler", "clients") • • •
Steps:	2. (Detailed how-to's explaining sequence of actions and who does them) 3. 4. 5.
Evaluation criteria:	(How do you know that the script has been successful? E.g. behavioral changes of participants, learning goals achieved)
Authors:	(First and last name of persons who wrote or created the script, e.g., "Jane Smith (smith@gmail.com) March 2, 2010")
History:	(This can include previous scripts, articles, other types of small group exercises, etc. The history

	should provide a name and date citation, and retain the entire history of the script, not just the previous version.)
Revisions:	(Briefly describe what changes have been made between this version and earlier versions)
References:	(List any publications or references to additional documentation using this script and cited in the history of the script. For example, if this script is based on another script that was described in peer reviewed research, then mention this under the “History” section with an author/year citation, and provide the full reference here in the references section.)