



**Esri International User Conference | San Diego, CA**  
**Technical Workshops | July 12, 2011**

# **Getting Started with ModelBuilder**

Leah Saunders



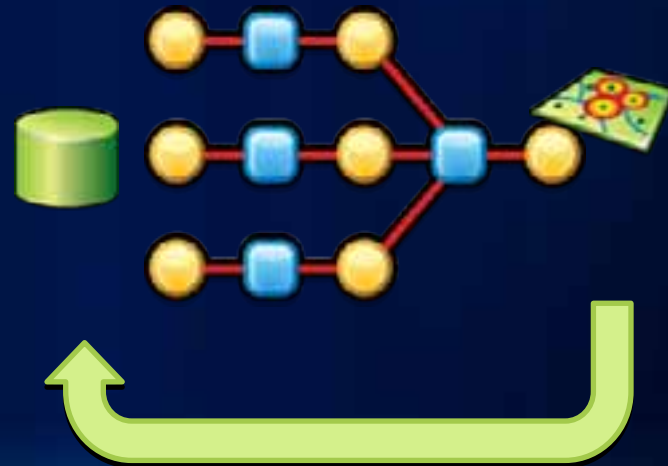
# Agenda

- **Geoprocessing overview**
- **Getting started with ModelBuilder**
- **Creating model tools**
- **Tips for designing and sharing models**
- **Additional resources**

# Geoprocessing Overview

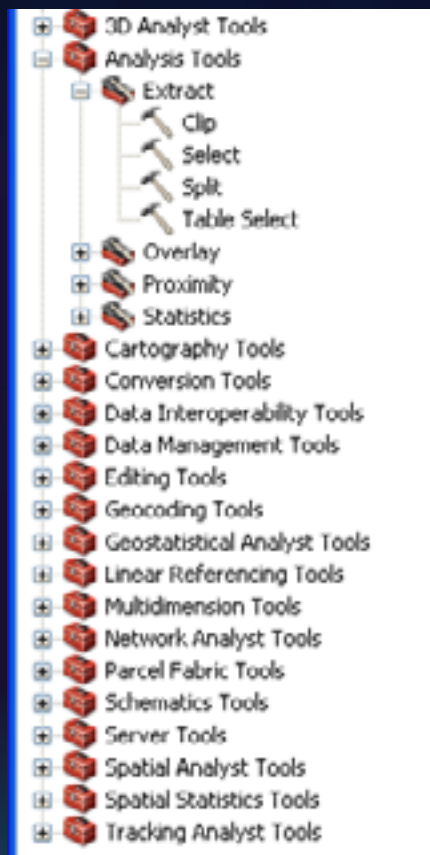
# What is Geoprocessing?

- The ArcGIS *system* for managing and manipulating data
  - Solve real-world spatial problems
  - Model processes and systems
  - Ask questions; get results

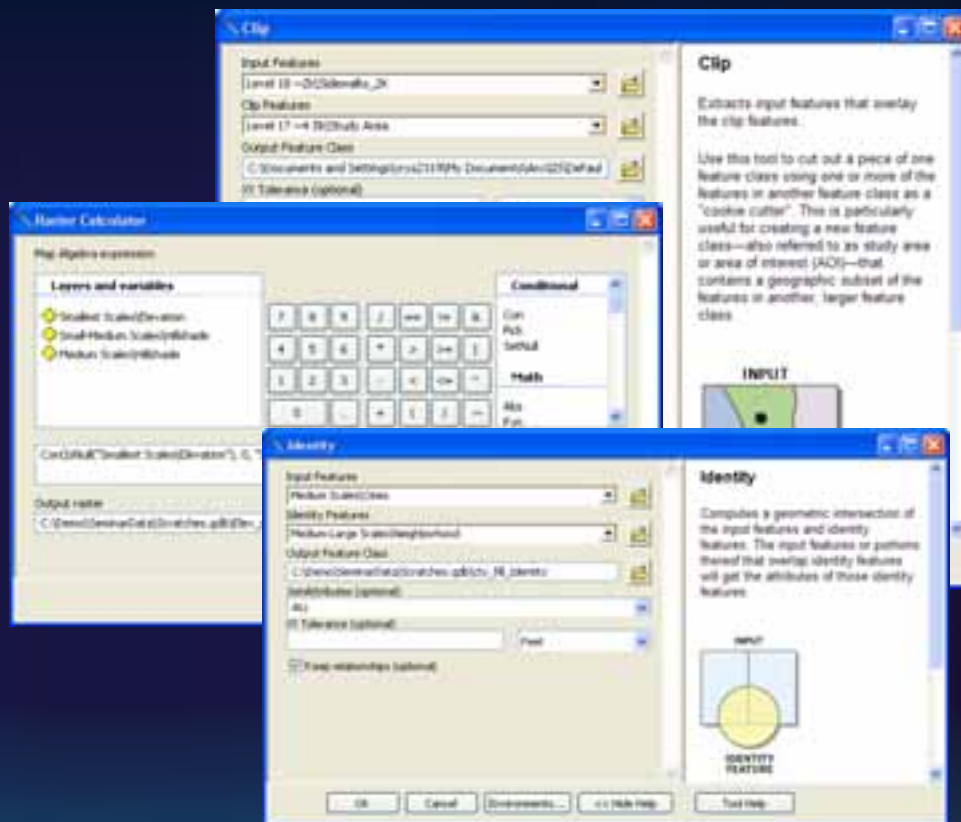


# The Geoprocessing Language

## Toolboxes

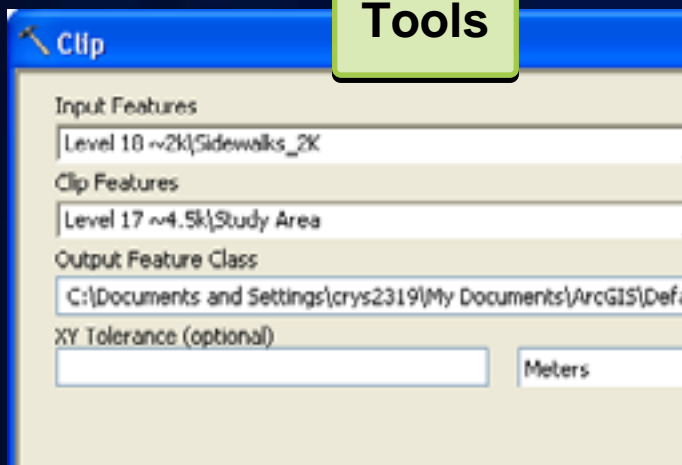


## Tools

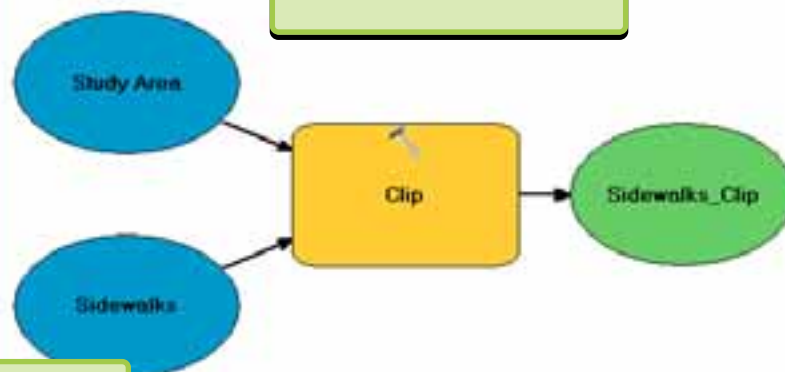


# The Geoprocessing Framework

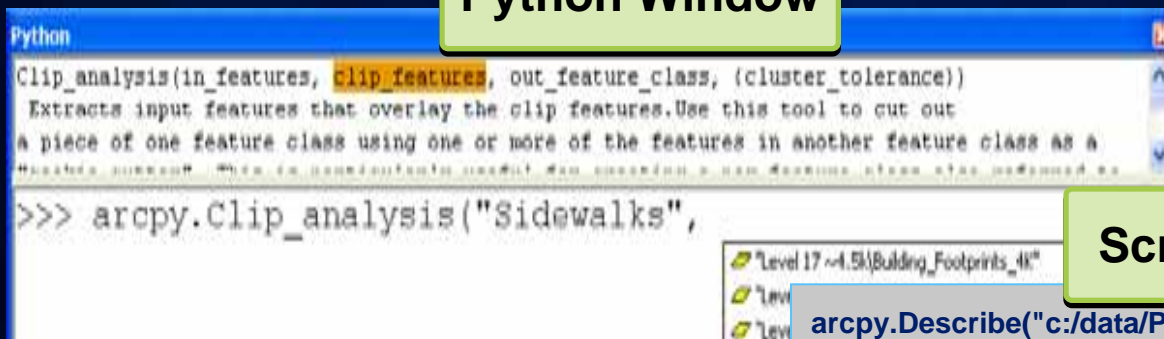
## Tools



## ModelBuilder



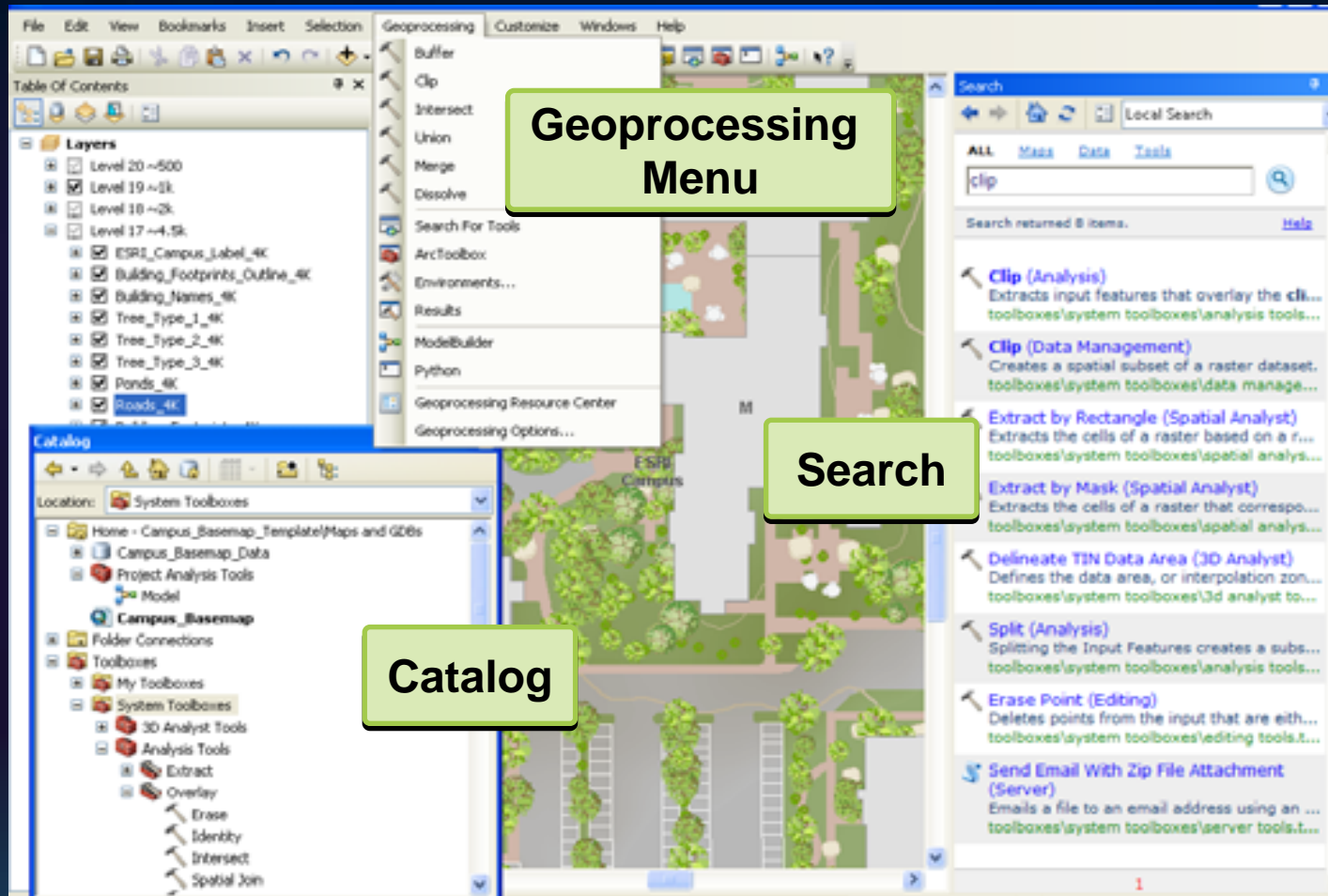
## Python Window



## Scripts

```
arcpy.Describe("c:/data/Portland.gdb/Sidewalks")
arcpy.Clip_analysis("Sidewalks", "Study Area",
"c:/data/output.gdb/SidewalkClip")
```

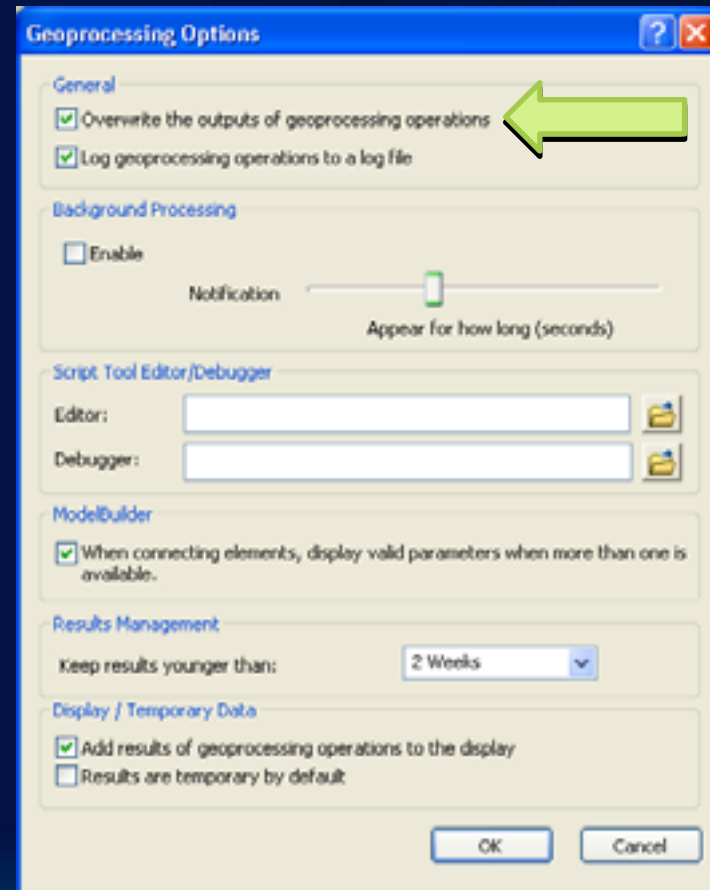
# Finding Tools





# Geoprocessing Options

- Open **Geoprocessing menu > Geoprocessing Options**
- Settings to control defaults and behavior for geoprocessing
- **Tip:** Enable “*Overwrite the outputs of geoprocessing operations*” to allow interactive re-running of Models and tools

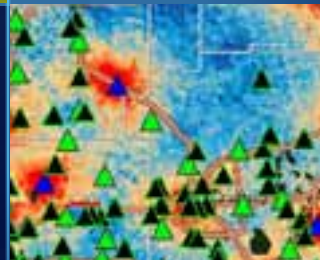
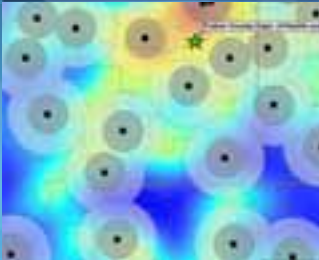




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Fulton County Dept. of Health and Wellness/District 3, Unit 2, 04

# Demonstration: An Example



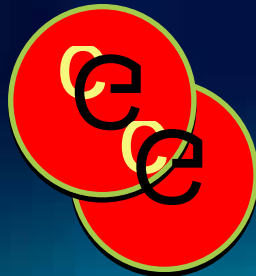
# Workflow for Demonstration

- **Goal:** Prioritize schools for emergency shelter planning.  
**Problem:** Which schools are in more vulnerable areas?
  - Schools are used as Emergency Shelters. We need a list of schools that can potentially serve as shelters for citizens in times of need. Schools in vulnerable areas are not ideal locations for a shelter.

Step 1: Buffer  
HAZMAT Routes



Step 2: Buffer  
Hazardous Facilities



Step 3: Overlay with  
Flood Hazard areas



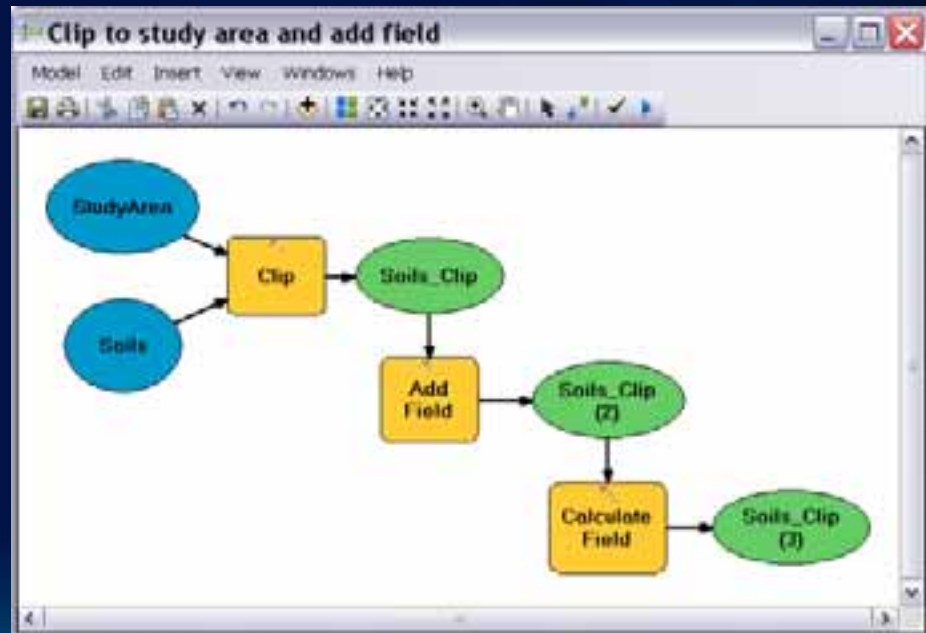
Step 4: Find schools  
*NOT* in those areas



# Getting Started with ModelBuilder

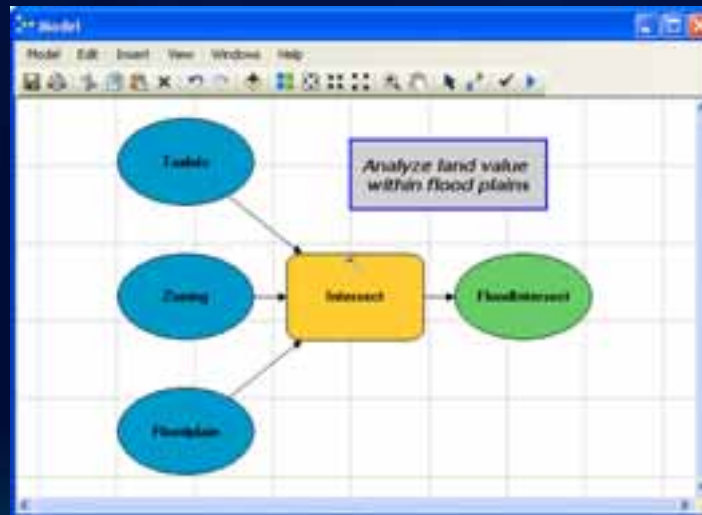
# What is ModelBuilder?

- Visual *programming language*
  - Without writing code
- Tool for encapsulating workflows
  - Reusable
  - Sharable



# Why use ModelBuilder?

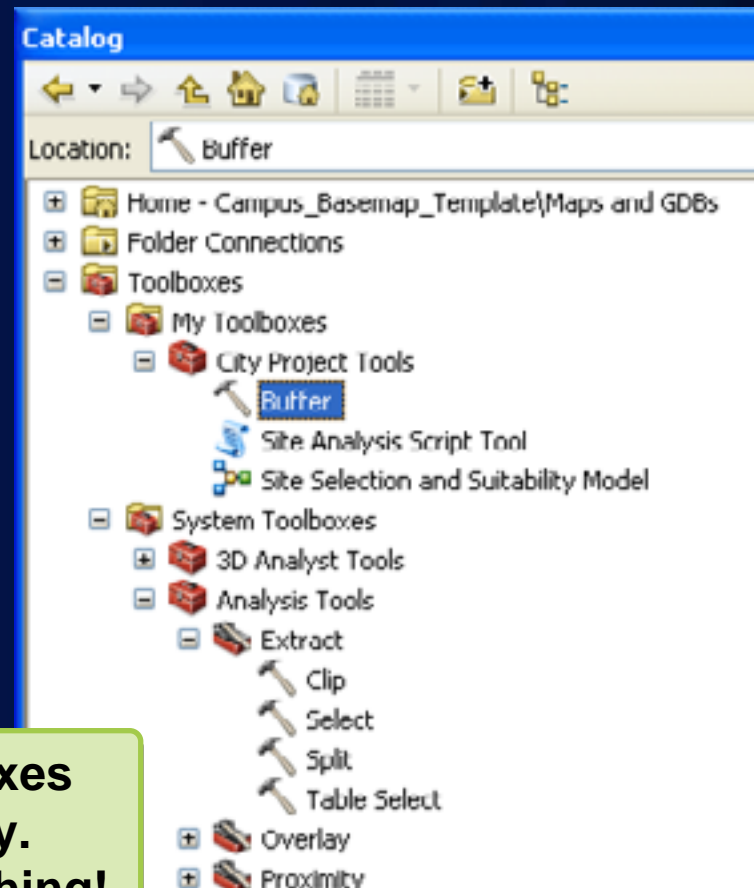
- Automate and manage geoprocessing workflows
- Run complex succession of processes as one tool
- Plug in additional tools and parameters as needed
- See a visual representation of analysis operations



# Types of Toolboxes

- **System toolboxes**
  - Installed with ArcGIS
  - *Read-only*
- **Custom toolboxes**
  - User created
  - Stored in a folder (*.tbx file type*) or a geodatabase

**System toolboxes  
are read-only.  
This is a good thing!**



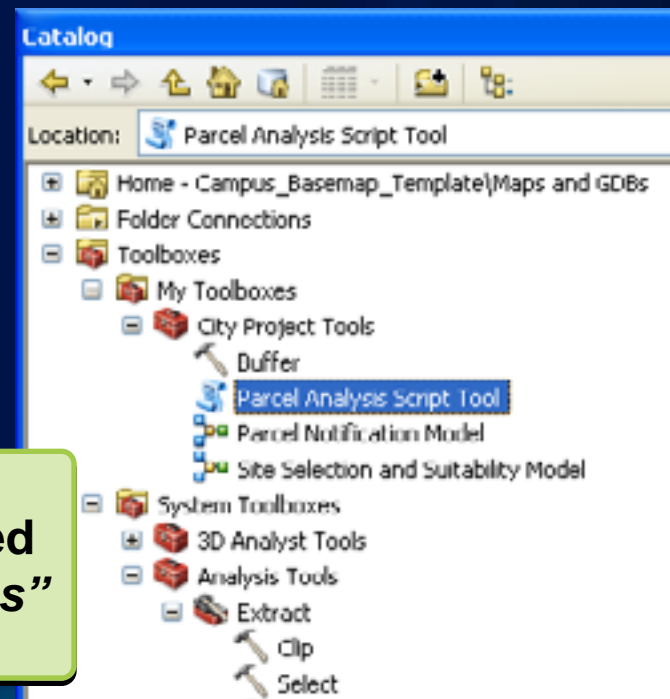
# Creating a New Model

1. ModelBuilder button on ArcMap Standard toolbar launches ModelBuilder with a new, *unsaved* model



Models are created or saved in *custom* or “*My toolboxes*”

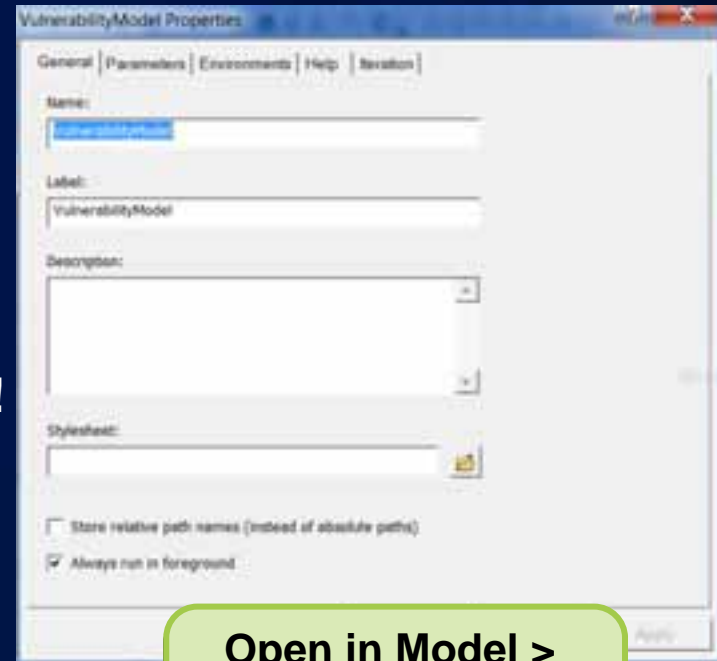
2. Inside a **Custom toolbox** > **right click** > **New Model**





# Model Properties

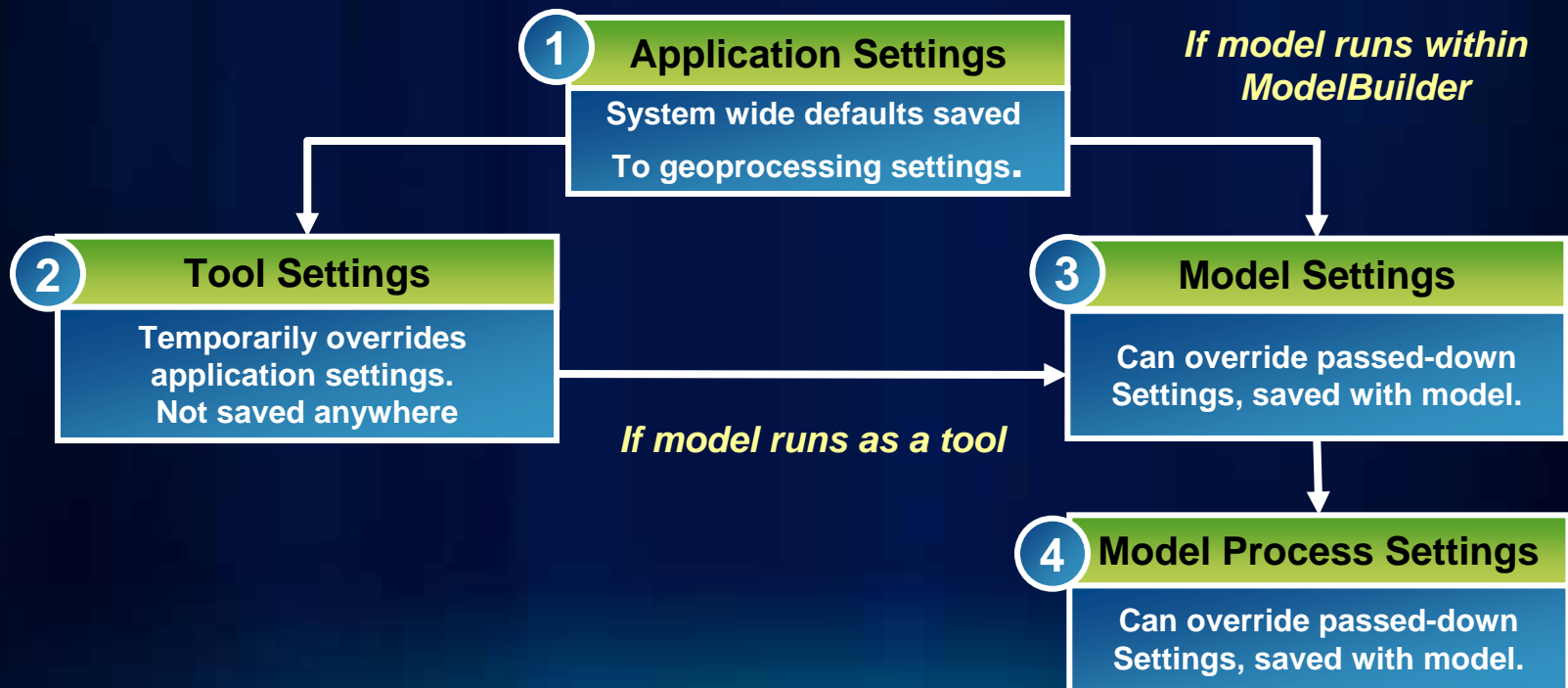
- **Name**
  - Cannot have spaces
- **Label**
  - How it appears in Toolbox
  - Can include spaces
  - Tip: Succinct, but meaningful!  
(i.e. “Model\_1”?)
- **Description**
  - Good practice for sharing
- **Relative paths**
  - Great practice for sharing



Open in Model >  
Model menu >  
Model Properties

# Environments: Settings

- Settings can be set at different “levels”
- Environments are passed down to tools and processes
- At each level, you can override the passed-down environment settings



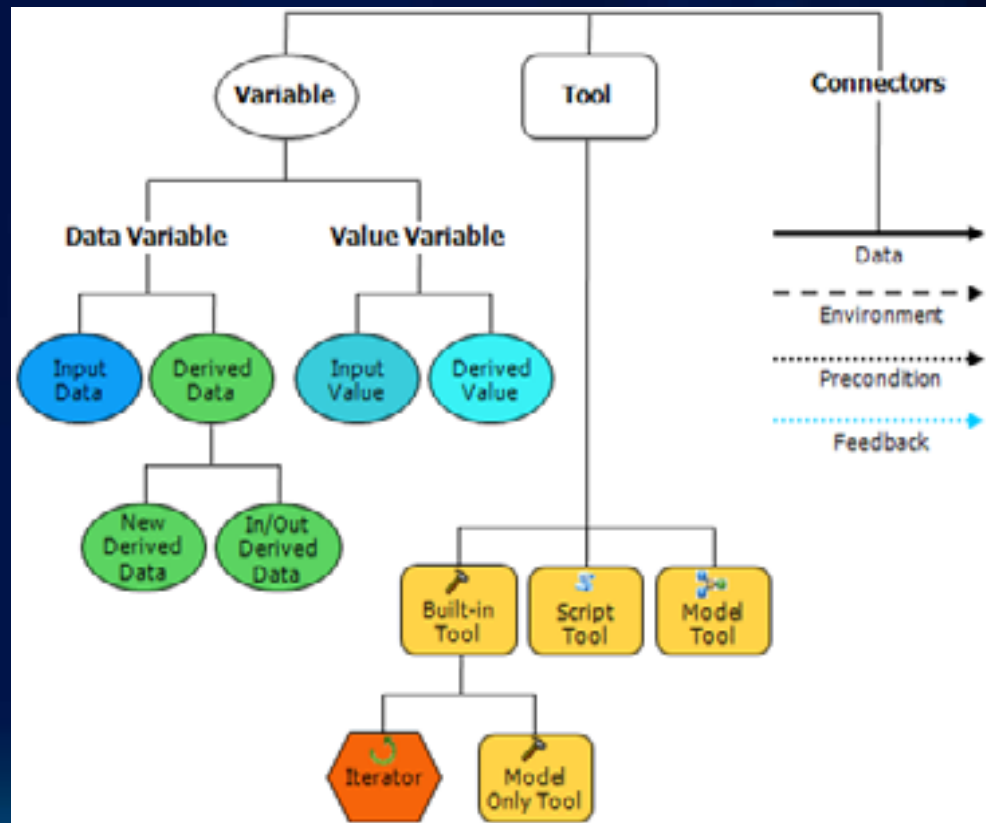
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# Demonstration: Creating a Model

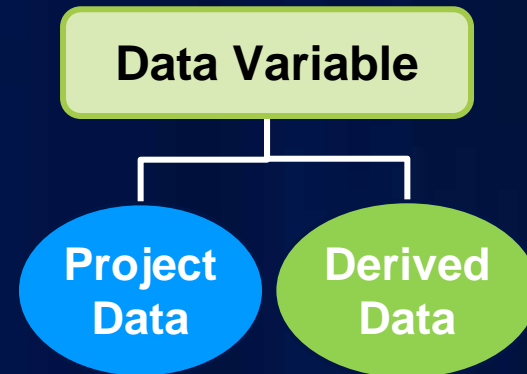
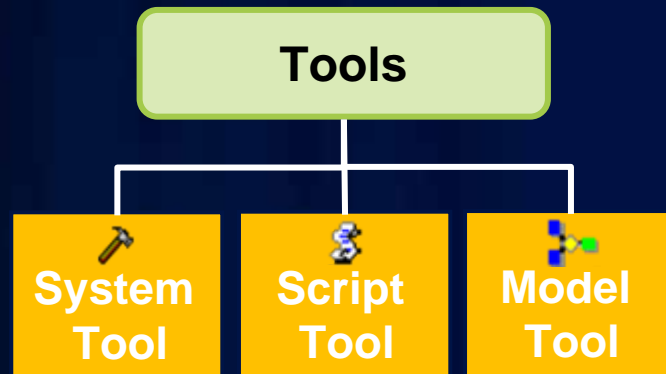


# Model Elements

- There are three basic types of elements:
  - Tools
  - Variables
  - Connectors



# Adding Tools and Data to a Model



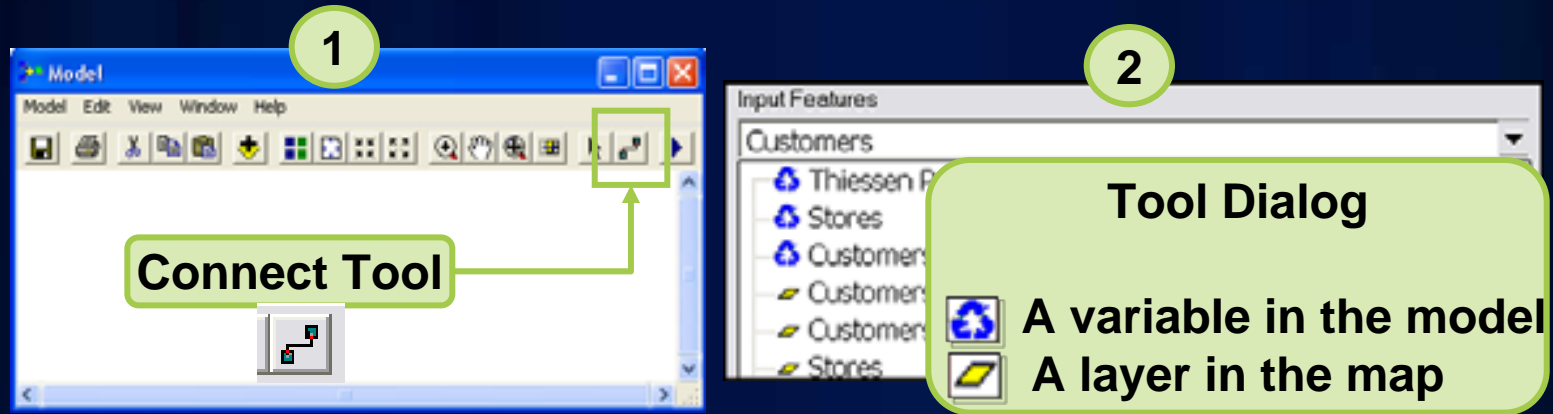
## Tools

- Drag and drop from Catalog
- Drag and drop from Search
- Drag and drop from Toolbox
- Use Add button in ModelBuilder
- Use Insert menu in ModelBuilder

## Data

- Drag and drop from TOC
- Drag and drop from Catalog
- Drag and drop from Search
- Fill in dialog
- Use Add button in ModelBuilder
- Use Insert menu in ModelBuilder

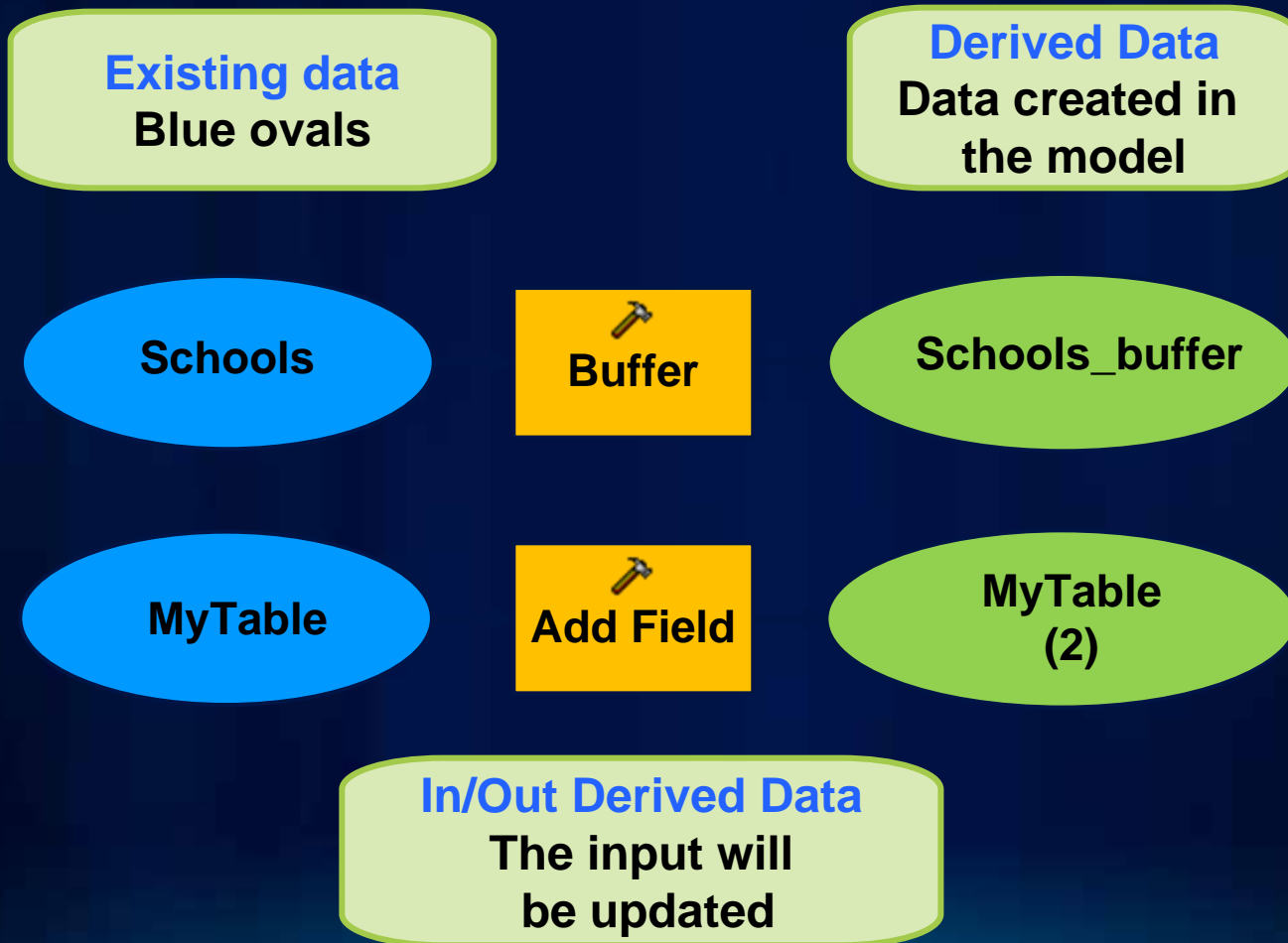
# Two Ways to Connect Elements



*To connect processes, link the output of one process to the input of another using the Connect tool*



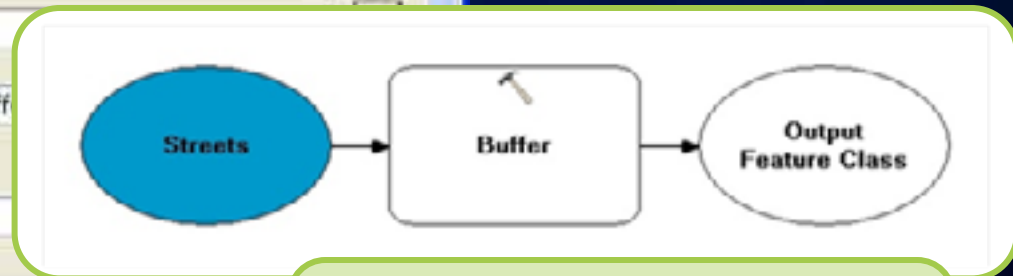
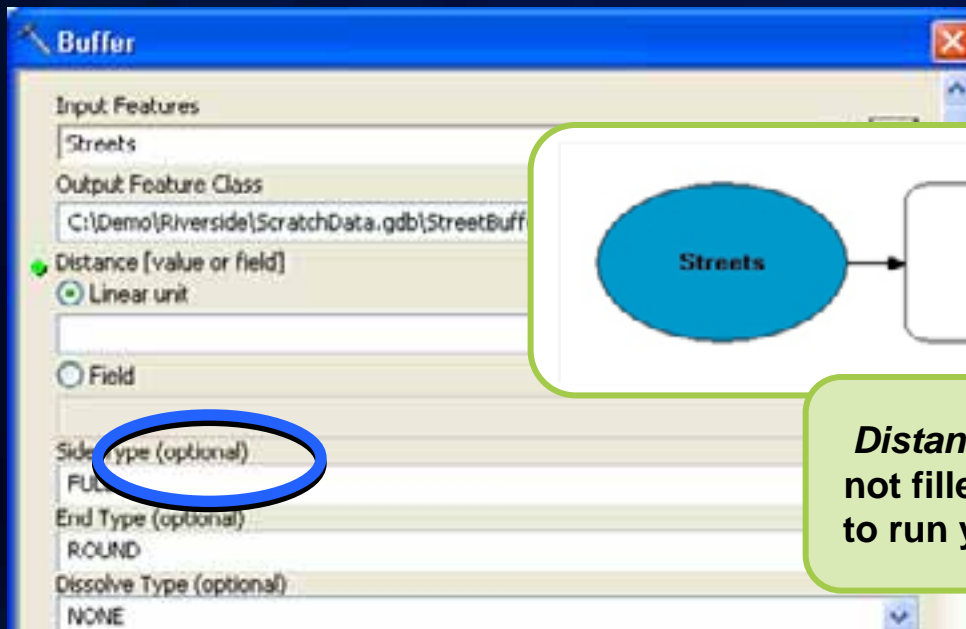
# Derived Data is Created by Processes





# Tools and Parameters

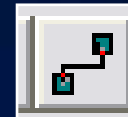
- Inputs and outputs of a tool
- Required and Optional parameters
  - Required must be filled out before tool process can execute in the model



*Distance* (required parameter) is not filled out; the tool is not ready to run yet and is “empty” colored

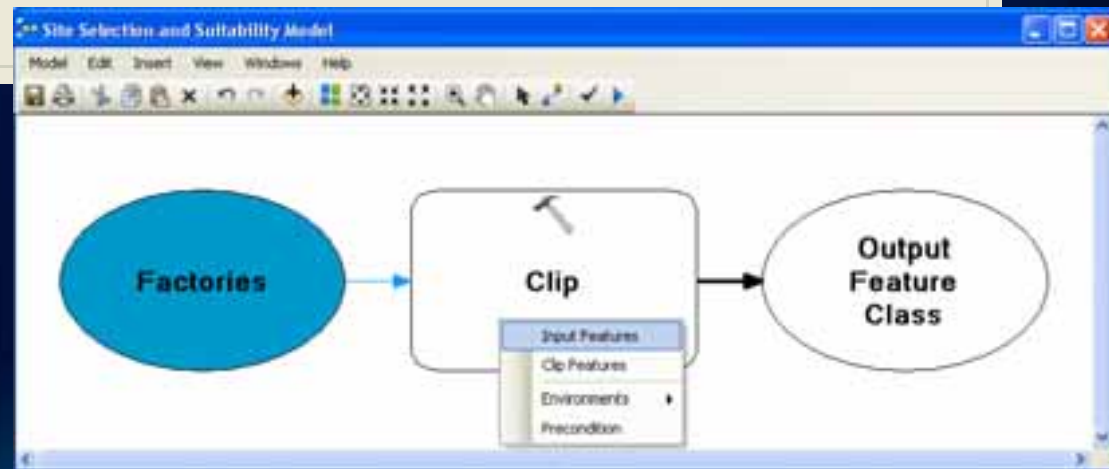
# Connect Tool *Tip*

- Enable **Geoprocessing menu > Geoprocessing Options > ModelBuilder** to display valid parameters
  - By default, a list of valid parameters appears when connections are made

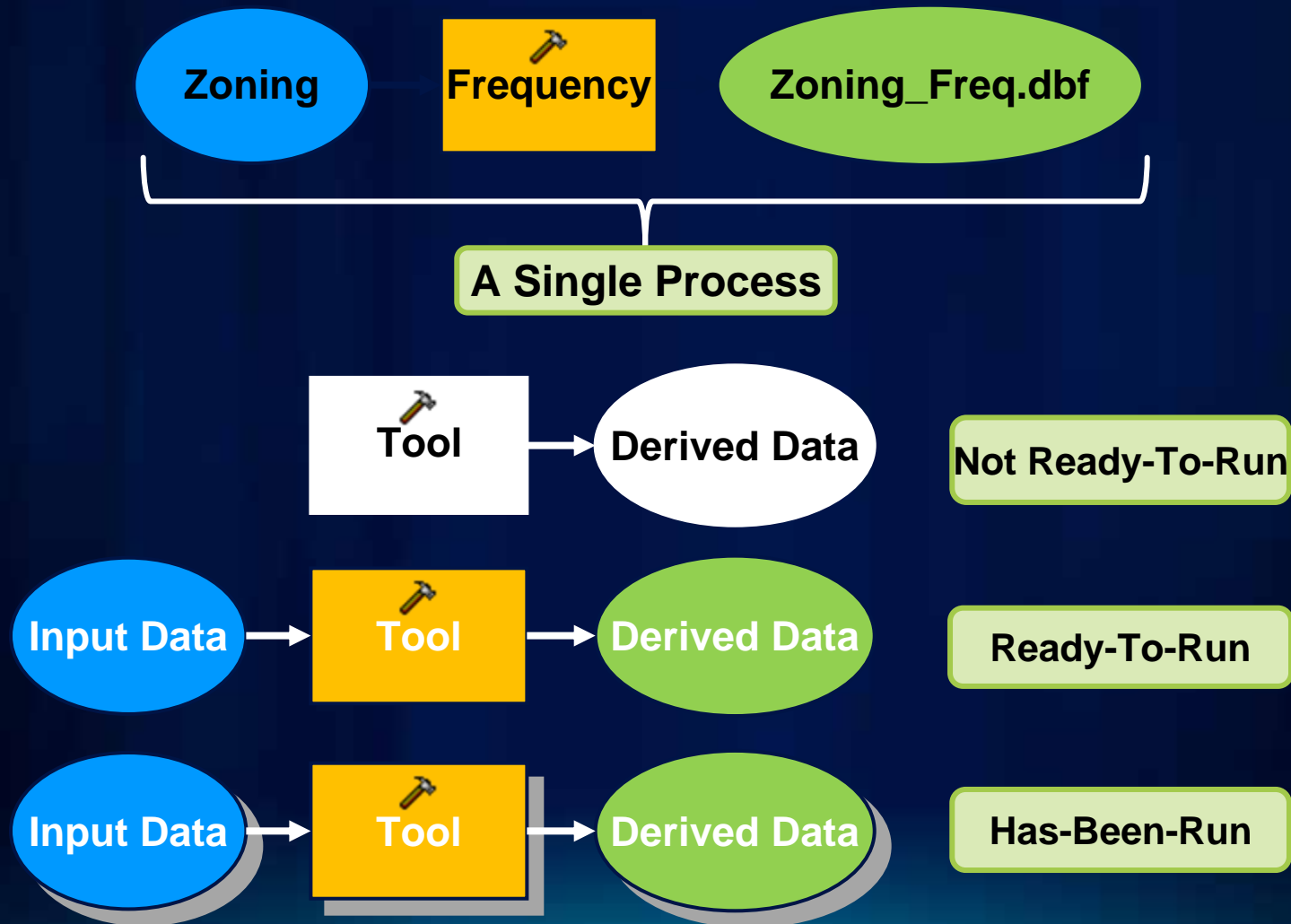


## ModelBuilder

- ☒ When connecting elements, display valid parameters when more than one is available.

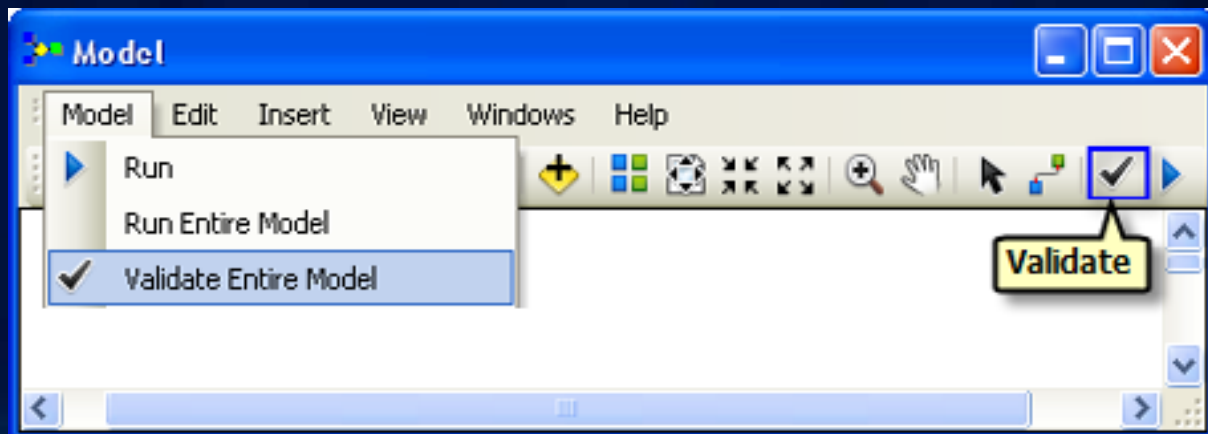


# Model Process States



# Validating

- Verifies all data elements and parameter values are valid
- Success: Returns model from *Has-Been-Run* to *Ready-to-Run* state
- Unsuccessful: Model elements may turn to *Not-Ready-to-Run* state



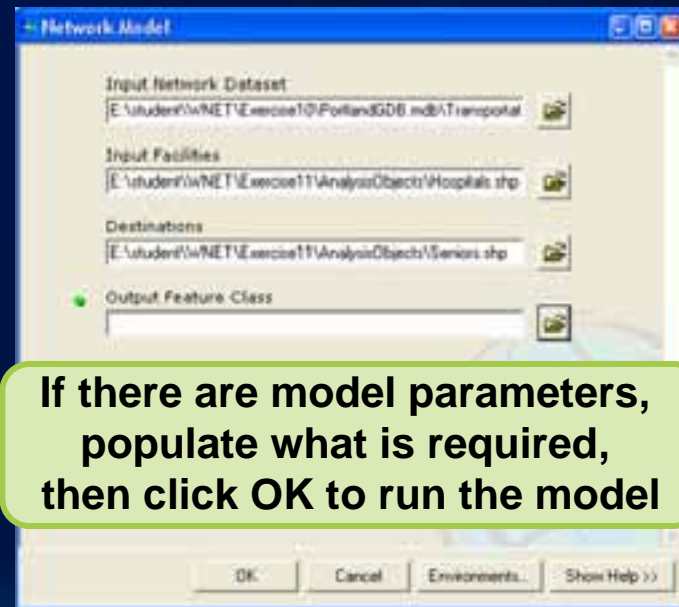
# Creating Model Tools

## What Does This Mean?!



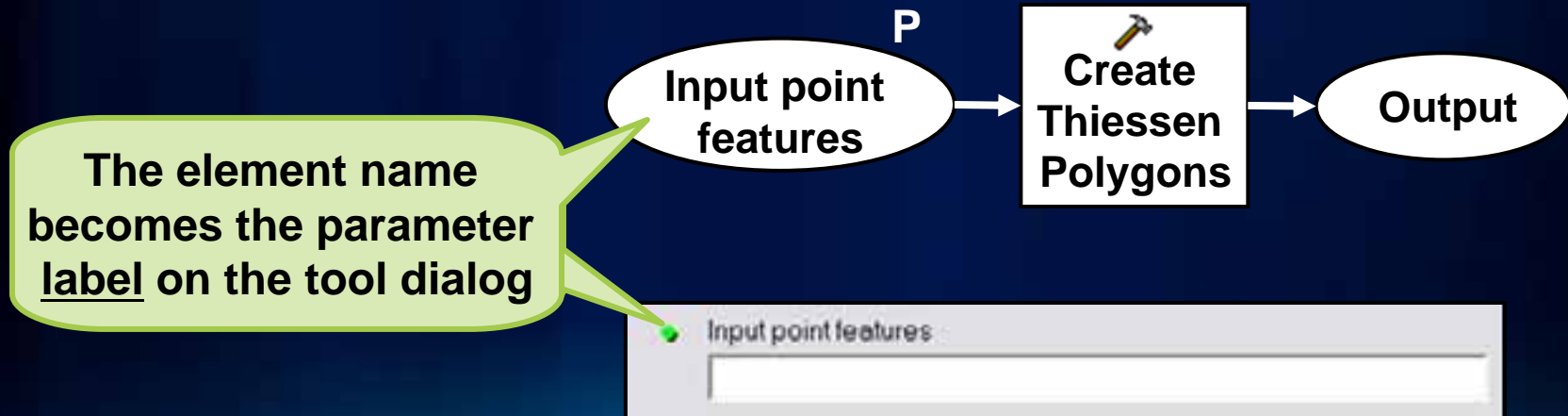
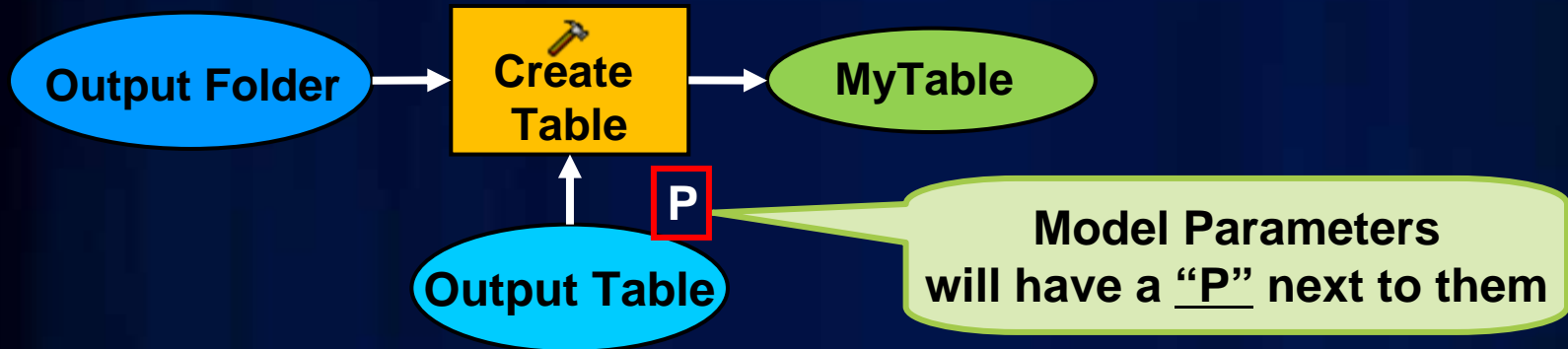
# Running a Model as a Tool

- “**Double-clicking**” or **Right-click > Open** a model from its toolbox opens the model tool dialog
- **These ARE models:**



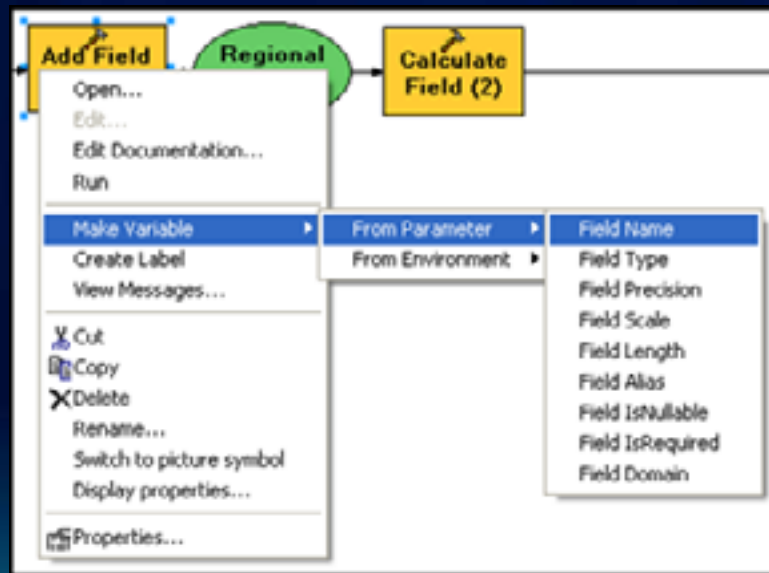


# Parameters



# Creating Variables from Tool Parameters

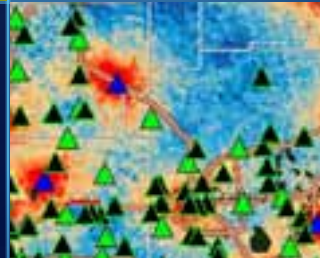
- ModelBuilder will create a *variable* for all input datasets
  - You decide which tool arguments to expose as variables
  - Any variable can be made a model parameter
- Right-click on tool: Make Variable > From Parameter
  - Then set variable as a model parameter



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# Demonstration: Creating a Model Tool

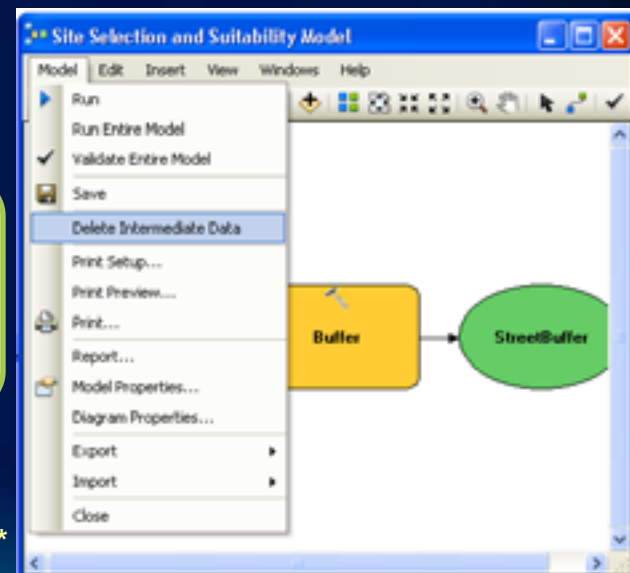


# **Tips for Designing and Sharing Models**

# Intermediate Data

- Derived data in a model is set to Intermediate by default
  - Excludes “final” output
- Is not automatically deleted\*
  - Manually delete from Model menu > Delete Intermediate data

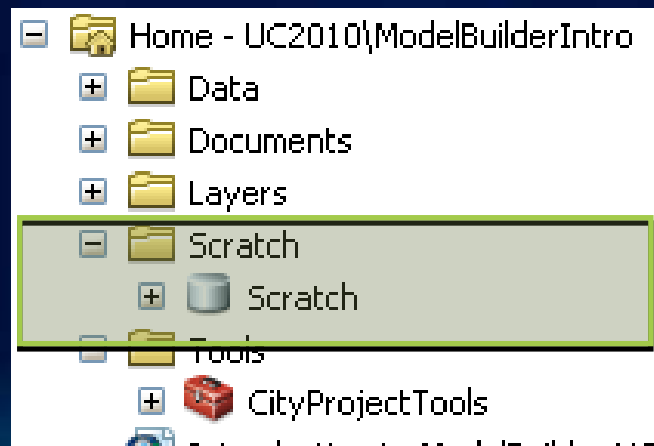
**Right click derived  
data and check/uncheck  
Intermediate**



***\*\*There are exceptions, see Tips for running models slide\*\****

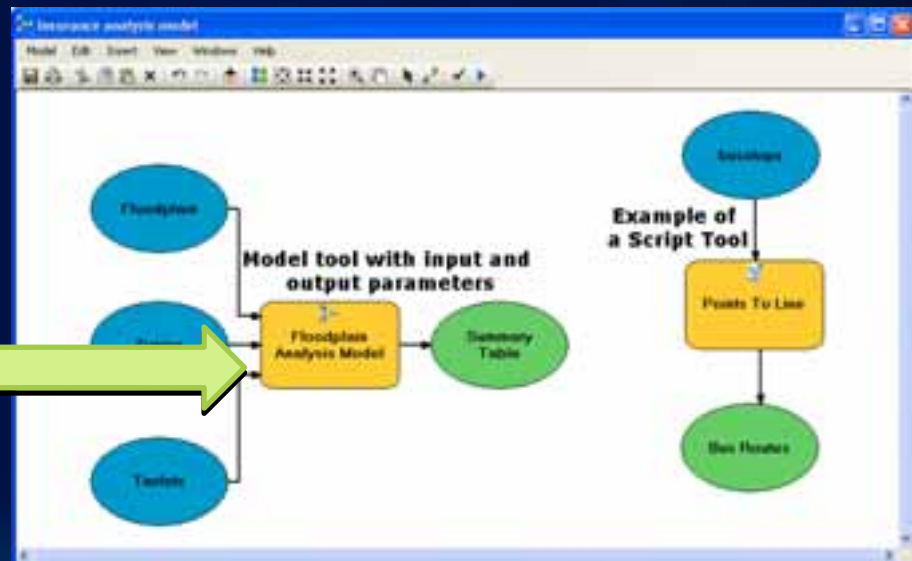
# Tips for Managing Intermediate Data

- Don't:
  - Write to ArcSDE geodatabase
  - Remote data or networked drives
  - Clutter your “permanent” results databases
- Do:
  - Use *Scratch* workspace wisely



# Models Added as Tools to Other Models

- Models can be added to another model
  - Break down complex models into smaller, perhaps more manageable sub-processes
  - Collaborate with a team where domain experts can work on their model



# Tips for Running Models

- Running models from *ModelBuilder*:
  - Intermediate data is not automatically deleted
  - *Add to display* enabled outputs are added to Map
  - No Background Geoprocessing – always runs in foreground
- Running models from *Model tool*:
  - Intermediate data is deleted on completion
  - Only parameters are added to display
  - Option to run in foreground (*Model menu > Model properties dialog*) to disable/enable background geoprocessing

☒ Always run in foreground



# Design Models to be Sharable

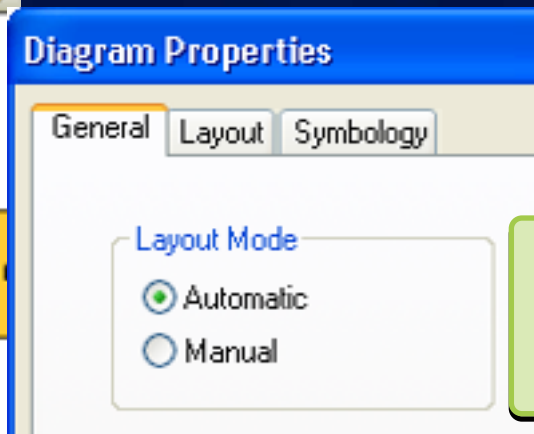
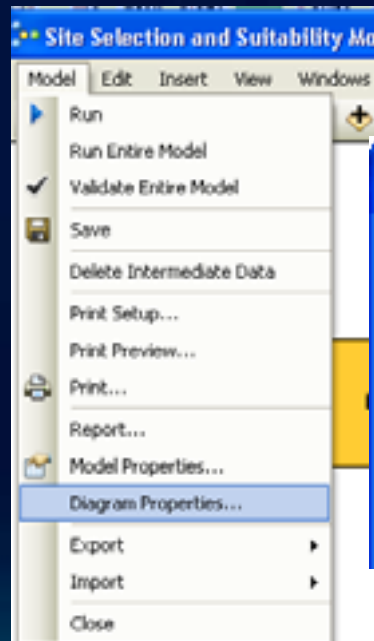
- **Flexible**
  - Not data-dependent, good folder structure
  - Environments, Relative paths, etc..
  - Parameters & variables
  - Read: **Tips for distributing tools**
- **Clear and easy to read**
  - Layout is simple and logical
  - Labels added for clarity
  - Elements renamed and not cryptic
- **Documented**
  - Item descriptions (*New at ArcGIS 10*)
  - Help documentation

# Modifying the Layout

- **ModelBuilder provides the ability to:**
  - **Modify arrangement of elements manually by repositioning and resizing**
  - **Change the name of elements**
  - **Apply labels and other text**
  - **Change symbols of elements**
- **Does not affect how models run; only their appearance**

# Layout Mode: Automatic

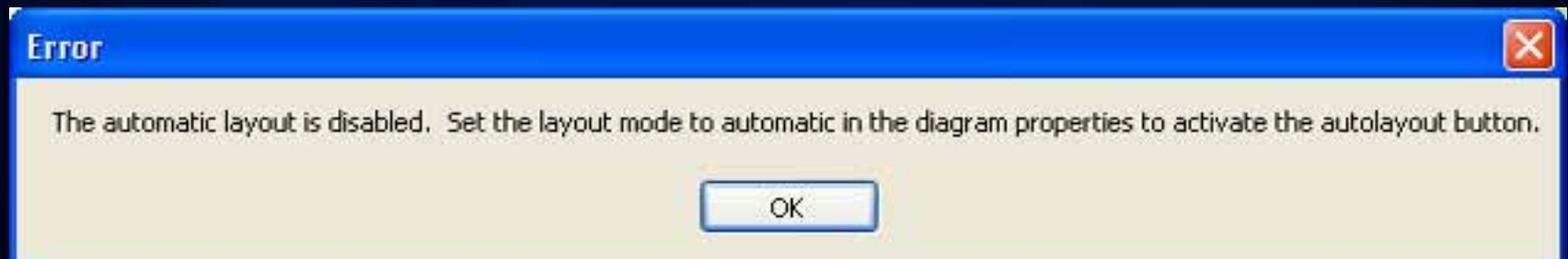
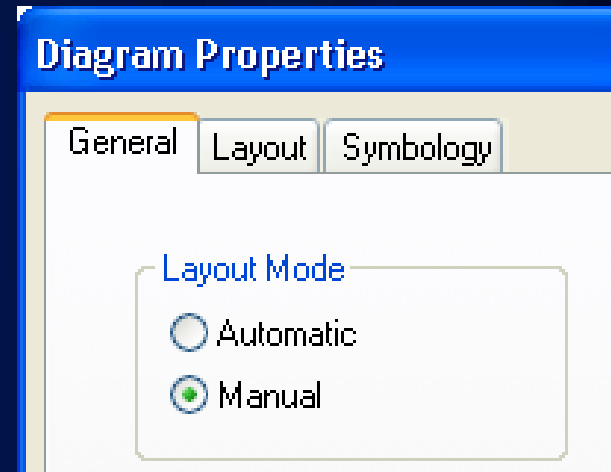
- **Automatic Layout mode:**  
enables Auto Layout button
  - Arranges model elements using settings under the Layout tab



**This is the default mode**

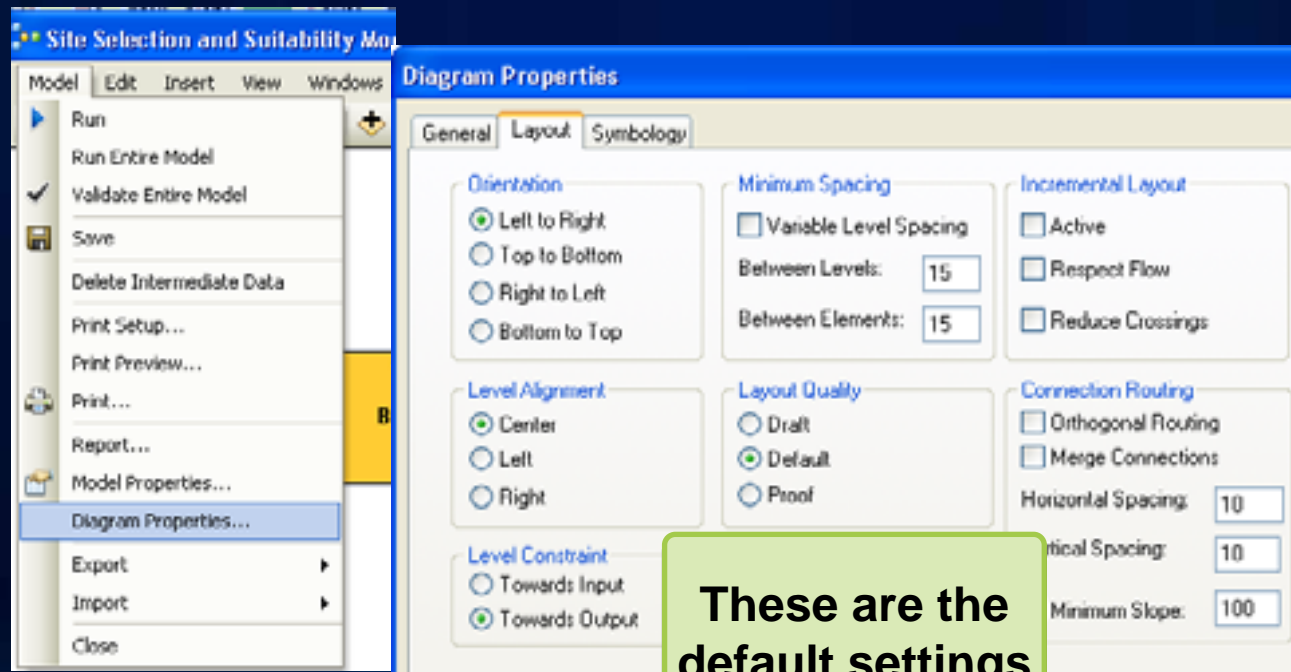
# Layout Mode: Manual

- Manual Layout mode:  
disables **Auto Layout**  
button
  - Auto-arranging will not occur
  - This message appears:

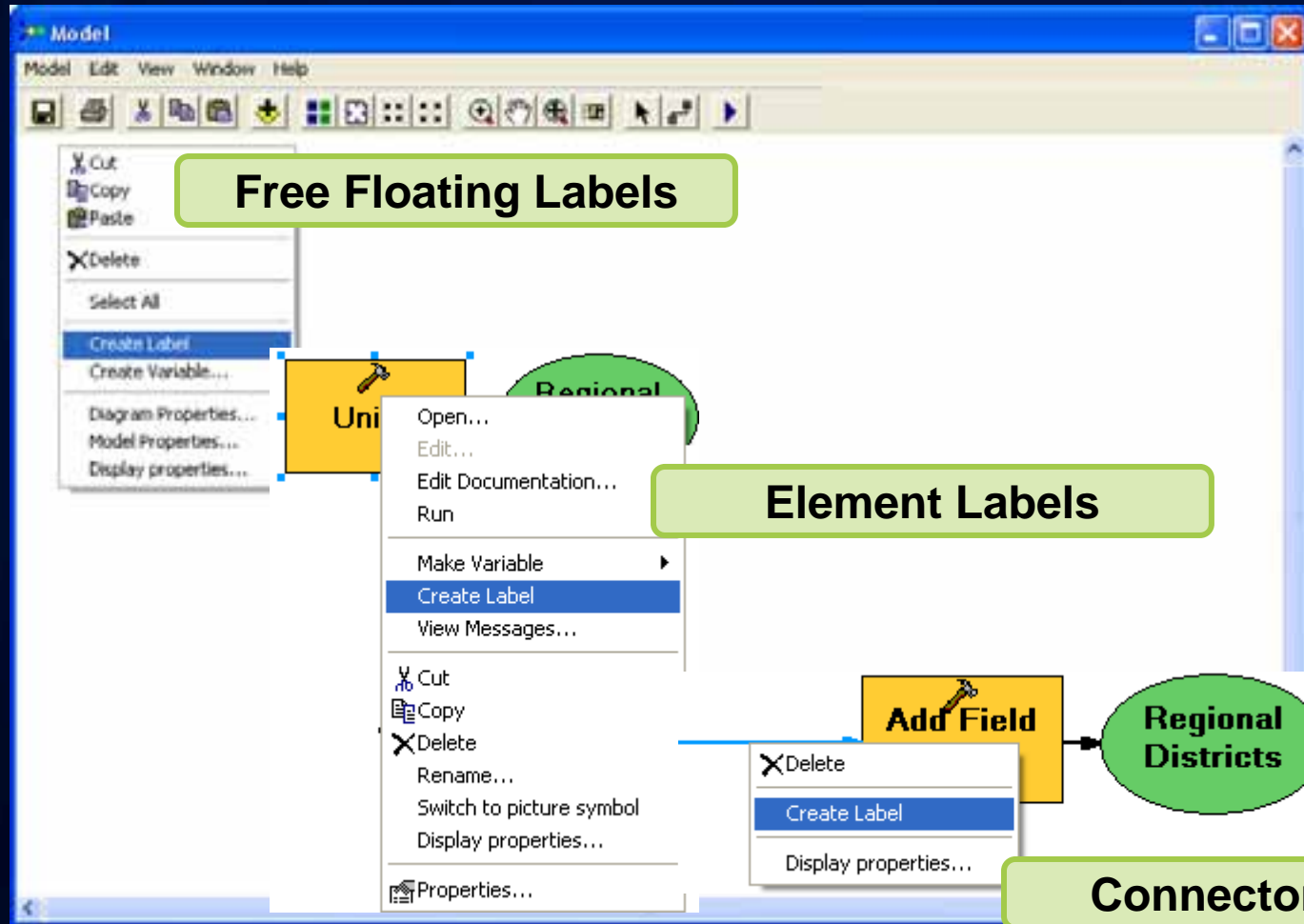


# Layout Options

- Orientation of processes, Spacing between elements/connectors, Connector styles
- Clicking **Auto Layout** button applies these options

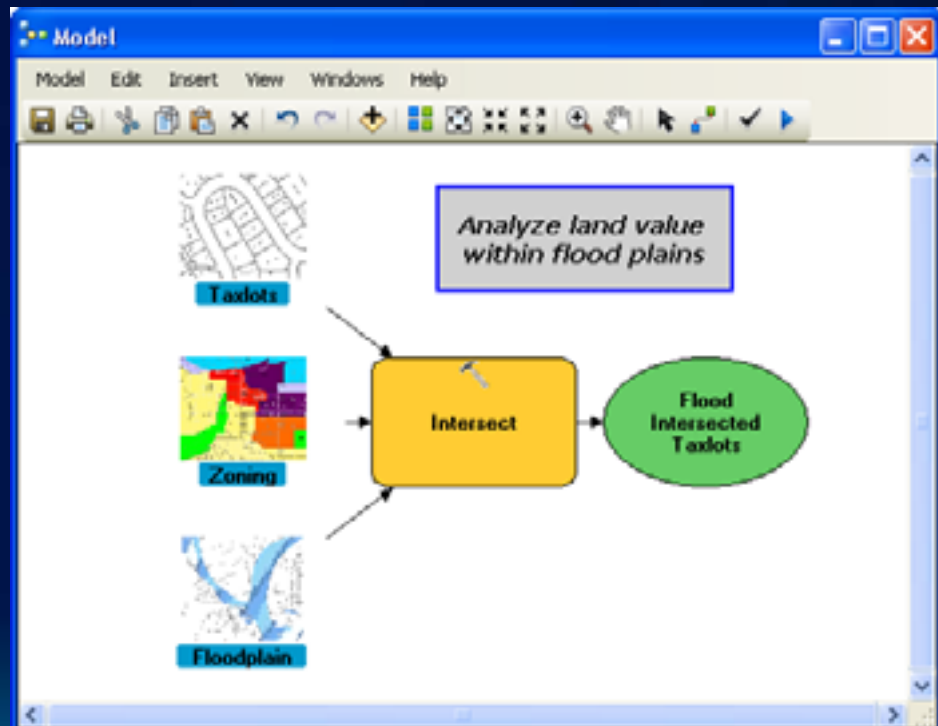
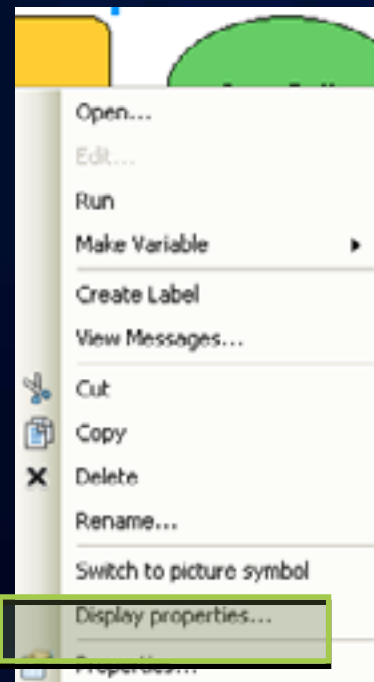


# Documenting: Labels



# Pictures for Elements

- You can use graphic files for tool and variable elements
  - *Right click model elements > Switch to picture symbol*









**Learning more...**

# ArcGIS Online Help

Professional  
Library

Geoprocessing  
Book

Geoprocessing  
with ModelBuilder

The screenshot displays the ArcGIS Resource Center for Desktop 10. The top navigation bar includes the ArcGIS logo, a search bar, and links for 'FIND RESOURCES' and 'CONTACT SUPPORT'. The main heading is 'Resource Center' with a sub-heading 'ArcGIS | Desktop 10'. A left sidebar lists the 'Professional Library' contents, including 'Welcome to the ArcGIS Help Library', 'What's New in ArcGIS 10', 'Essentials Library', and 'Professional Library'. Under 'Professional Library', there are links to 'What's in the Professional Library', 'Data Management', 'Mapping and Visualization', 'Geoprocessing', and 'Geoprocessing with ModelBuilder'. The 'Geoprocessing with ModelBuilder' section is expanded, showing links to 'What is ModelBuilder?', 'A quick tour of ModelBuilder', 'Essential ModelBuilder vocabulary', and 'Tutorials'. The main content area is titled 'What is ModelBuilder?' and includes a breadcrumb trail: 'Resource Center > Professional Library > Geoprocessing > Geoprocessing2.x'. Below the title, it states 'Last Modified 5/5/2010'. The text describes ModelBuilder as an application for creating, editing, and managing workflows. Below the text, a diagram titled 'Clip to study area and add field' illustrates a workflow. The diagram shows two input variables, 'StudyArea' and 'Soils', feeding into a 'Clip' tool. The output of 'Clip' is 'Soils\_Clip', which then feeds into an 'Add Field' tool. The output of 'Add Field' is 'Soils\_Clip (2)', which finally feeds into a 'Calculate' tool.

**Professional Library**

**Geoprocessing Book**

**Geoprocessing with ModelBuilder**

**What is ModelBuilder?**

Resource Center > Professional Library > Geoprocessing > Geoprocessing2.x

Last Modified 5/5/2010

ModelBuilder is an application you use to create, edit, and manage workflows that string together sequences of geoprocessing tools of one tool into another tool as input. ModelBuilder can also be a programming language for building workflows.

**Clip to study area and add field**

Model Edit Insert View Windows Help

StudyArea

Soils

Clip

Soils\_Clip

Add Field

Soils\_Clip (2)

Calculate

# Geoprocessing Resource Center

<http://resources.arcgis.com/content/geoprocessing>

The image shows two overlapping screenshots of the ArcGIS Resource Center website. The background screenshot displays the 'Geoprocessing' section, which includes a sidebar with links to Automation, Modeling and Analysis, Tools and Framework, and Developing. The main content area features a description of geoprocessing and a 'Geoprocessing Model and Script Tool Gallery' section. The foreground screenshot provides a closer view of the gallery, showing various tool thumbnails such as 'Buffer', 'Weighted Attribute Overlay', and 'Cost Distance Matrix'. It also includes a 'Sort By' dropdown menu with options like 'Highest Rated' and 'Most Downloaded', and a 'Version Filter' with options for 'All', '10.0', and '9.3'.

**Geoprocessing**

Geoprocessing is for everyone that uses ArcGIS. Whether you're a new or advanced user, geoprocessing is likely an essential part of your day-to-day work with ArcGIS. The fundamental purpose of geoprocessing is to provide tools for performing analysis and managing your geographic data. The modeling and analysis capabilities geoprocessing provides make

Geoprocessing buffers and polygons. Geoprocessing workflows that

Learn more about

Learn more about

Learn more about

**Geoprocessing Model and Script Tool Gallery**

Add an Entry (Sign In)

**Sort By**

- Highest Rated
- Most Downloaded
- Most Viewed
- Most Comments
- Recently Added
- Recently Updated

**Version Filter**

- All
- 10.0
- 9.3

**Check-list for submitting models to gallery**

## Learning more...at the Conference

- **Getting Started with ModelBuilder**
  - Repeated - Wednesday from 1:30PM - 2:45PM, Room 5A/B
- **Building Tools with ModelBuilder**
  - Wednesday from 10:15AM – 11:30AM, Room 14B
  - Thursday from 3:15PM – 4:30PM, Room 4

**Come visit us in the Spatial Analysis Showcase**

# Learning more...beyond the Conference

- **Instructor-led training**
  - Updated ArcGIS Desktop I, II, III courses for ArcGIS 10 on the schedule
- **Live seminars (and recordings):**
  - <http://training.esri.com/campus/seminars/index.cfm>
- **Books**
  - **Getting to Know ArcGIS ModelBuilder**
    - This book covers all ModelBuilder topics from beginner to advanced.



**Session Evaluation:**  
**[www.esri.com/sessionevals](http://www.esri.com/sessionevals)**



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