

What is a database?

Any database is a tool to organize and store pieces of information. A Rolodex is a database. So is a phone book. The main goals of a database designer are to:

1. Make sure the data stored in the database is accurate and complete.
2. Avoid redundancy (duplicate information). Redundant data wastes space (if you store the same information in two places, it takes twice as much space) and also makes it easy for errors to creep in (if an address is stored in two different places, it's really easy to only update one of them, for example).
3. Make retrieving and analyzing the data easy.

A Rolodex does this by having a business's phone number and address on its card ("Accurate and Complete"), having only one card for each entry (no redundancy), in alphabetical order (easy to retrieve).

Access databases do this by organizing your data in such a way that you store the information in one place, but pull it up anywhere you need it. This way, you only have to change it in one place, and it is automatically updated everywhere.

The parts of an Access database

Tables to store your data. Tables are organized in columns called *fields*, and rows called *records*. A field is a category of information (like Zip Code or Phone Number); a record is a complete set of information for one person/entity in the table.

Queries to find and retrieve the particular data that you want.

Forms to view, add, and update data in tables.

Reports to analyze or print data in a specific layout.

Designing a Database**Step 1: Preliminary Planning**

Decide what your database is for, and roughly block out its organization on paper.

1. What is the main purpose of your database? ("This database will keep track of the customers, orders and sales for my home-based business.")
2. What information is going to be stored in your database?
3. What kinds of information do you need to get out of the database? ("What are our best-selling products? Who are our biggest customers?")
4. Who will your users be? How will each of them use the database? ("Sally will take orders on the phone and enter them. Margie will check the inventory and re-order when it gets low.")

Step 2: Fields

List out all the pieces of information you need in your database. These are going to be your fields.

1. If you already have files or ledgers, list all the pieces of information on them. ("My address book has customers' names, business names, addresses, phone numbers. Our paper order forms have order numbers, dates, product names and numbers...")
2. If you are starting from scratch, write down every piece of information you can think of that you may need.
3. If other people will use the database too, ask them for ideas as well.
4. Make mockups of reports, forms and mailings you plan to use. This will help you think of fields you will need. (For example, if you plan to send email updates, you will need an email address field, and if you want to offer customers the ability to opt out you'll need an opt-out field. If you want sales reports for each county, you will need a county field, and so on.)
5. Break down the information to the smallest useful unit. For example, first names and last names should always be stored as separate fields. On the other hand, several different kinds of information (house numbers, street names and suffixes) are commonly stored in one field (Street Address).
 - a. In general, if you want to sort, search, calculate, or report based on an item of information, you should separate it out.

Step 3: Tables

Sort your fields into logical groups, which will become your tables – for example, customer names and customer addresses both go together in a Customers table. Here is a semi-random list of fields:

Order Number	Customer State	Product Name
Order Date	Customer Zip	Description
Customer First Name	Customer Phone	Customer Courtesy Title
Customer Last Name	Customer Cell	Price
Customer Address	Customer Email	Supplier
Customer City	Product Number	

And here are three possible tables:

Customers Table

Customer Courtesy Title
Customer First Name
Customer Last Name
Customer Address
Customer City
Customer State
Customer Zip
Customer Phone
Customer Cell
Customer Email

Products Table

Product Number
Product Name
Price
Description
Supplier

Orders Table

Order Number
Order Date
[Customer that placed an order
– link to Customers table]
[Product that was ordered – link
to Products table]

Putting all the fields in one table requires entering a lot of redundant information:

StudentID	First Name	Last Name	Address	City	State	Zip	Phone	Class Number	Class Name	Description	Semester Taken	Grade
9	Jones	Catherine	412 Northampton Rd.	Cuyahoga Falls	OH	44221-	(330) 123-4151	CHEM 211	ORGANIC CHEMISTRY I	This course introduces the fundamental pr	Fall 2003	3.5
9	Jones	Catherine	412 Northampton Rd.	Cuyahoga Falls	OH	44221-	(330) 123-4151	CHEM 212	ORGANIC CHEMISTRY II	This course introduces the fundamental pr	Spring 2003	3.8
1	Ball	John	633 Quail Circle	Cuyahoga Falls	OH	44221-	(330) 123-5998	CHEM 111	INTRODUCTORY COLLEGE CHEMISTRY I	Emphasis is placed on the structure of the	Fall 2003	2.5
11	Pollan	Helen	125 Nantucket Rd.	Boston	MA	02134-	(105) 467-8991	CHEM 111	INTRODUCTORY COLLEGE CHEMISTRY I	Emphasis is placed on the structure of the	Fall 2003	2.4
11	Pollan	Helen	125 Nantucket Rd.	Boston	MA	02134-	(105) 467-8991	CHEM 112	INTRODUCTORY COLLEGE CHEMISTRY II	Emphasis is placed on the structure of the	Spring 2003	3.4
4	Boyes	Mickey	542 Quail Circle	Cuyahoga Falls	OH	44223-	(330) 123-4444	HIST 200	TRADITIONAL CHINA	Chinese civilization, thought, and instituti	Fall 2003	3.5
4	Boyes	Mickey	542 Quail Circle	Cuyahoga Falls	OH	44223-	(330) 123-4444	HIST 201	MODERN CHINA	Chinese history from 1644 to the present	Spring 2003	3.4

This one doesn't work either. The users have to keep adding columns to hold new subjects and grades. This is not elegant, plus it makes it very hard to search since any class could be in any of the Subject columns.

StudentID	First Name	Last Name	Address	City	State	Zip	Phone	Subject 1	Grade1	Subject 2	Grade 2	Subject 3	Grade 3
1	Ball	John	633 Quail Circle	Cuyahoga Falls	OH	44221-	(330) 123-5998	CHEM 111	3.4	CHEM 112	3	CHEM 211	3.5
2	Bice	Kay	253 Bobwhite Trail	Stow	OH	44224-	(330) 234-5869	HIST 200	2.7	HIST 201	3.5	HIST 250	3.2
3	Black	Sue	852 Cardinal Circle	Stow	OH	44224-	(330) 234-7445	CHEM 112	3.6	HIST 200	3	HIST 215	3.8

Redundant data and repeated columns are both signs of bad design in the database. We need multiple tables, each containing only information that applies to its subject:

Students											
StudentID	First Name	Last Name	Address	City	State	Zip	Phone	Subject 1	Grade1	Subject 2	Grade 2
1	Ball	John	633 Quail Circle	Cuyahoga Falls	OH	44221-	(330) 123-5998	CHEM 111	3.4	CHEM 112	3
2	Bice	Kay	253 Bobwhite Trail	Stow	OH	44224-	(330) 234-5869	HIST 200	2.7	HIST 201	3.5
3	Black	Sue	852 Cardinal Circle	Stow	OH	44224-	(330) 234-7445	CHEM 112	3.6	HIST 200	3

Classes						
Class Number	Class Name	Description	Grades			
			Student ID	Class Number	Semester Taken	Grade
+	CHEM 111	INTRODUCTORY COLLEGE CHEMISTRY I	1	CHEM 111	Fall 2003	2.5
+	CHEM 112	INTRODUCTORY COLLEGE CHEMISTRY II	4	HIST 200	Fall 2003	3.5
+	CHEM 211	ORGANIC CHEMISTRY I	4	HIST 201	Spring 2003	3.4
+	CHEM 212	ORGANIC CHEMISTRY II	9	CHEM 211	Fall 2003	3.5
+	HIST 200	TRADITIONAL CHINA	9	CHEM 212	Spring 2003	3.8
+	HIST 201	MODERN CHINA	11	CHEM 111	Fall 2003	2.4
+	HIST 215	COLONIAL LATIN AMERICA	11	CHEM 112	Spring 2003	3.4
+	HIST 250	THE EVOLUTION OF WAR				

Because each piece of data is stored in only one place, corrections are easy, and

Because each piece of data is stored in only one place, corrections are easy, and once we create relationships we can write queries (next class) to search and bring together all our information.

Things to consider:

1. You may want to use a field in more than one table. For example, you need the Customer Name field in the Customers table, but you also want to have that information in the Orders table. Instead of duplicating the information, you will create a relationship between the tables and pull the customer's name into the Orders table.
2. Signs of problems with your tables:
 - a. Redundant information: If you find yourself typing the same data into multiple records, that data probably needs its own table. Example: an Orders table does not need complete customer information for each item. Split off the customer information into its own table and link each order to its customer via relationships.
 - b. Lots of empty fields. If some users would always leave particular fields blank, they should not have those fields in their tables; the table should be split into two or more separate ones for each user group. Example: No table should contain fields for both Accounts Receivable and Accounts Payable
3. Do not include calculated fields in your tables. You will perform calculations on the fly in your queries, forms and reports.

Step 4: Decide on a Primary Key

A primary key is a field that uniquely identifies each record. (You can also create a *composite key* – a set of fields that functions as a unique identifier. We will do this in Class 2.) The most common example is an ID number; if my employee number is 277, no other employee can have the same number.

These are the characteristics of a good primary key field:

1. It will be different for each record in the table.
2. It cannot be left blank.
3. It should be something that won't change.

If a table already has a field like this (for example, your products may already have a code number that would make a good primary key), select this field.

If the table does not have a good field to use, add an ID field like "Customer ID" or "Employee Number".

Bad primary keys: anything that 1) is likely to be duplicated, or 2) is likely to change. Names are terrible primary keys since it's very easy to imagine a situation in which there are two customers with the same name, for example. Phone numbers, even though they are unique, are also bad because they frequently change.

Step 5: Create the database in Access

After you have planned on paper, create the database in Access. These are the steps we will follow:

1. Create and save the database in Access

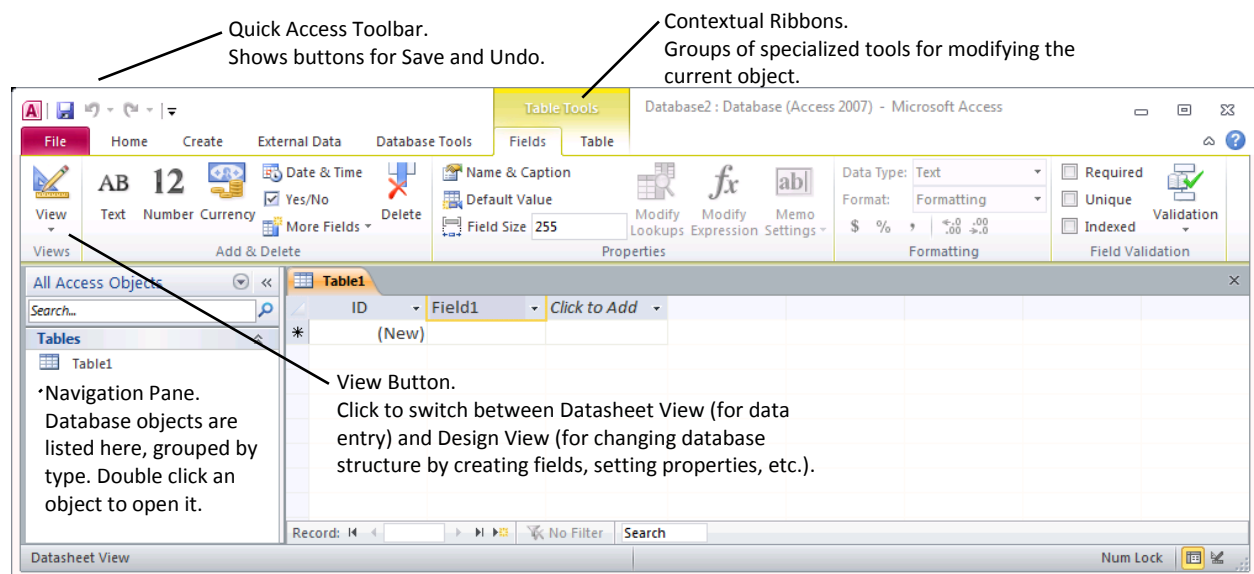
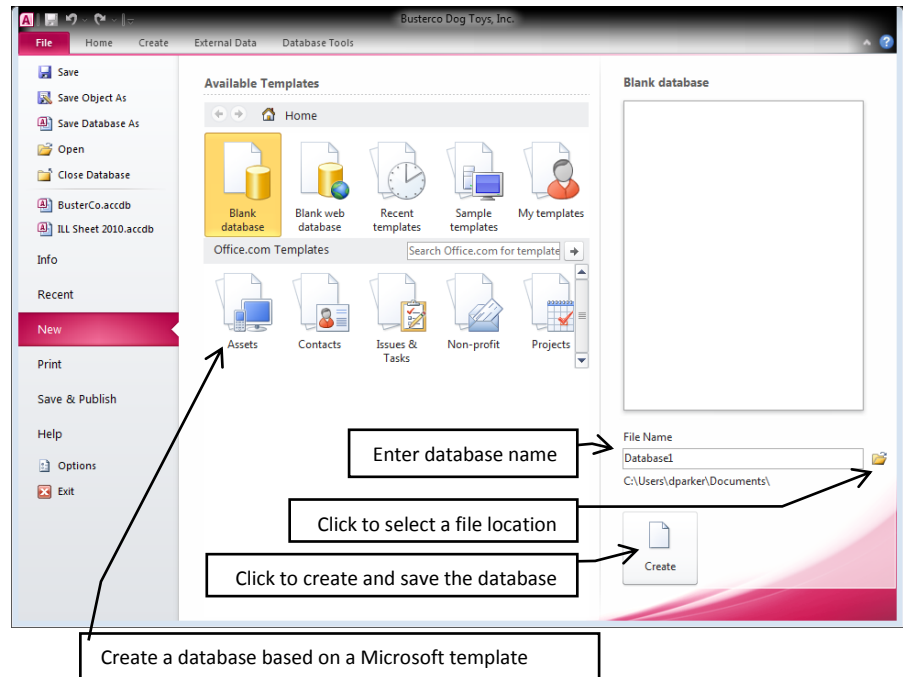
2. Create tables, then set up fields in each table, setting the desired properties for each
3. Create relationships between tables
4. Set up data integrity protection
5. Create forms to facilitate data entry
6. Create queries to ask questions of your data, perform calculations
7. Create reports to properly showcase the results of your queries, group data, and print

Create a new blank Access database

Open Microsoft Office Access 2010. Access opens in “Backstage View”, ready to name and save a new database:

Use the controls at the lower right of the screen to enter a database name, select a location and create the database.

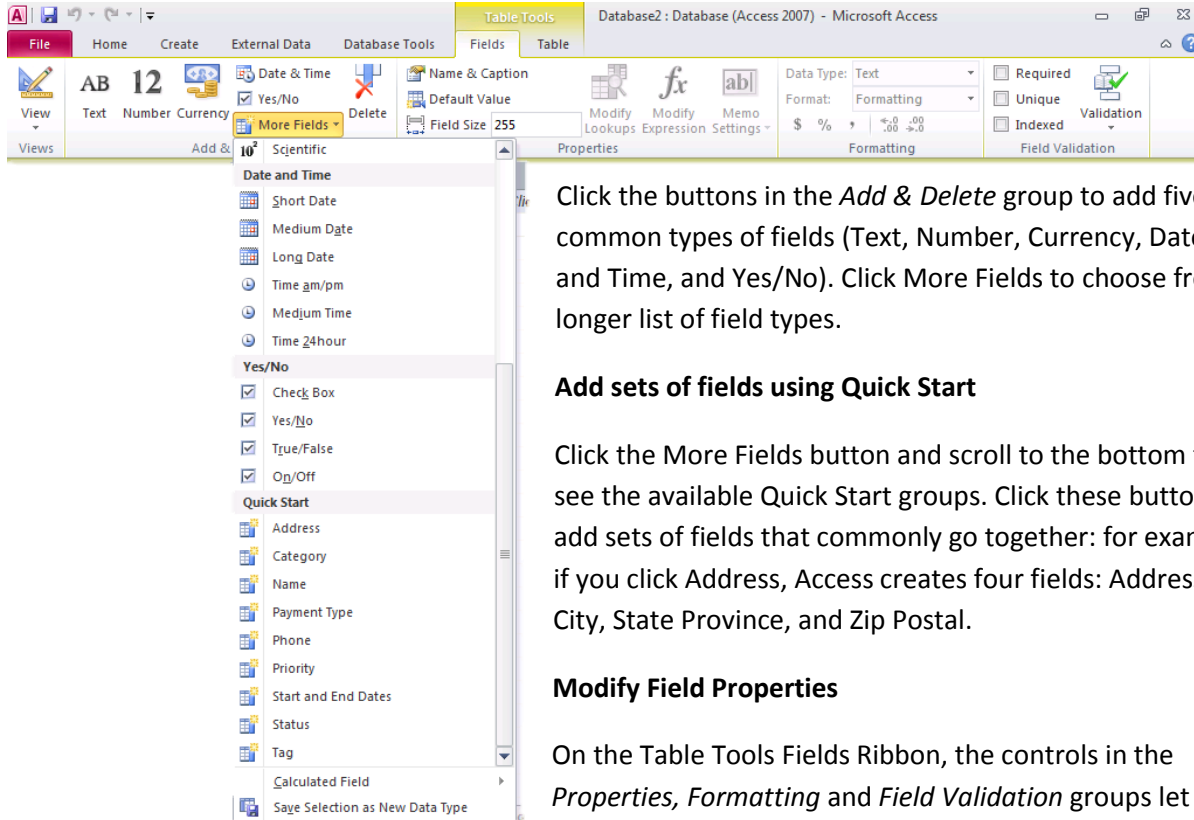
Microsoft Access opens the database and creates a new blank table:



The table is displayed in “datasheet view” (normally used for entering, sorting, filtering, and looking at the data). Click the Save icon () on the Quick Access Toolbar and name the table.

Quickly add fields

The new Table Tools Fields ribbon in Office 2010 simplifies the process of setting up tables directly in Datasheet View.



Click the buttons in the *Add & Delete* group to add five common types of fields (Text, Number, Currency, Date and Time, and Yes/No). Click More Fields to choose from a longer list of field types.

Add sets of fields using Quick Start

Click the More Fields button and scroll to the bottom to see the available Quick Start groups. Click these buttons to add sets of fields that commonly go together: for example, if you click Address, Access creates four fields: Address, City, State Province, and Zip Postal.

Modify Field Properties

On the Table Tools Fields Ribbon, the controls in the *Properties*, *Formatting* and *Field Validation* groups let you determine what kind of data can be typed in the field, how

it will look, etc. Field properties, formatting and validation are discussed in detail on page 8.

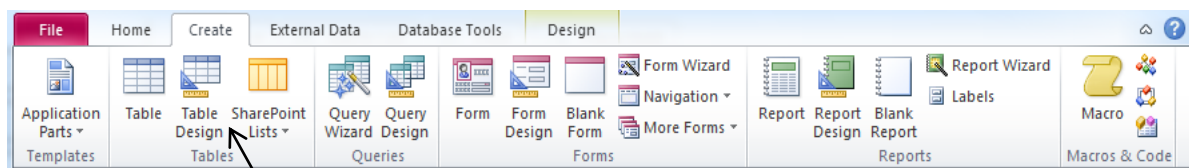
About Table Design View

Table Design View lets you create your own fields by hand and define all of their available properties. In older versions of Access this was the only way to set field properties.



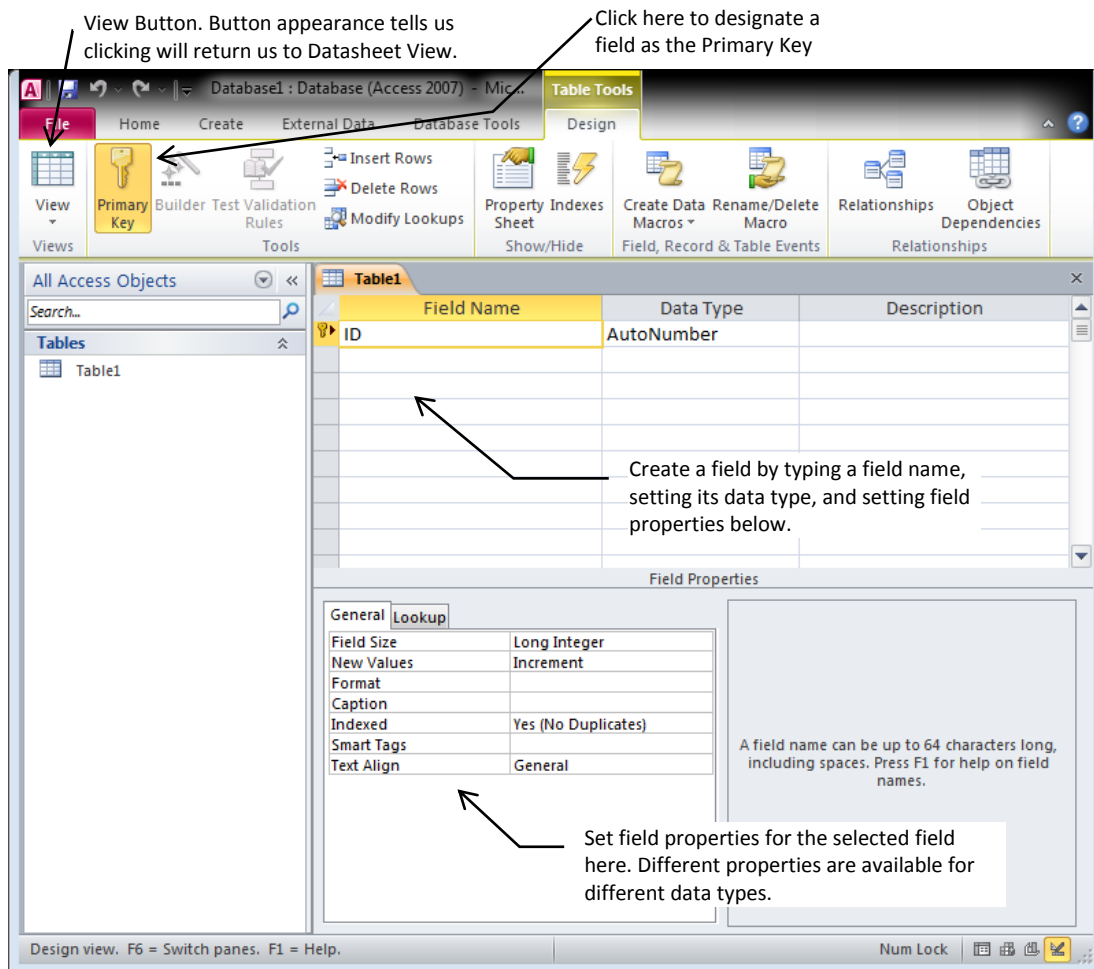
If you are in an existing table, enter Design View by clicking the View button at the left side of the Home Ribbon. [The View Button changes its appearance depending on what view it will take you to. The button shown at left always takes you to and object's Design View.]

To create a new table and go directly to Design View, click the Create tab to view the **Create Ribbon**:



Click to create a table in Design View

and click the Table Design button in the *Tables* group. In Design View, the Table Tools Design Ribbon will be displayed.



Create Table Fields in Design View

- Type a (short, unique and meaningful) name for the field in the Field Name column.
- Select a data type using the drop down arrow in the Data Type column. This will determine the kinds of information your users will be able to enter in the field.
- Type a description if desired. This is optional, but can help you remember the purpose of a field.
- Set Field Properties. This lets you further refine what the users will be able to type in the field.

Data Types

The following data types are available in Access 2010:

Data Type	Used to store	Limitations/Restrictions
Text	Alphanumeric data (text and numbers)	Up to 255 characters of text. Default data type; most common. Use for names, addresses, email,

Data Type	Used to store	Limitations/Restrictions
Memo	Alphanumeric data (text and numbers)	Larger amounts of text – equivalent to about 14 pages of single-spaced text
Number	Numeric values	These are numbers that can be used in math.
Date/Time	Dates and times from the year 100 through 9999	Numbers displayed as dates and/or times.
Currency	Monetary values	Numbers formatted with currency symbols and two decimal places by default.
AutoNumber	Unique number automatically generated by Access when you create a new record	Stores data as 4-byte values; typically used in primary keys.
Yes/No	Boolean (true or false) data.	Use when there are only two choices.
OLE Object	Older way to incorporate images, documents, etc.	In most cases use Attachment fields instead.
Hyperlink	Web addresses	Store links to Web sites, sites or files on an intranet or Local Area Network (LAN), and sites or files on your computer.
Attachment	Any supported type of file	Attach images, spreadsheet files, documents, charts, etc., to the records in your database, much like you attach files to e-mail messages. View and edit attached files.
Calculated	New in Access 2010. Contains results of a calculation.	The calculation can only refer to other fields in the same table.
Lookup Wizard	Not a data type; a tool for creating lookup lists in either Text or Number fields.	Allows users to choose entries from a typed-in list or a list in another table.

Field Properties


Field properties in Access 2010 include:

- **Field Size:** Specify the maximum size for data stored as a Text, Number, or AutoNumber data type. Smaller limits save computer memory, but be sure your largest data item will fit.
 - Number field sizes include Byte (whole numbers from 0-255), Decimal (up to 28 digits after the decimal point), Integer (positive or negative numbers; no decimals), Long Integer (same as integer, but twice the storage space), Single and Double.
- **Format:** Choose from a drop-down list to display numbers, dates, currency in various styles
- **Decimal Places:** For Number and Currency fields; specify the number of decimal places to display.
- **Input mask:** For Text, Number, Date/Time and Currency fields. Displays placeholder characters to guide data entry.
- **Caption:** Alternate name for a field that will be shown in table column headers, query results tables, and field labels in forms and reports.
- **Default Value:** Automatically enter a value for all new records.
- **Validation Rule:** An expression limiting values that can be entered in field.
- **Validation Text:** The “error message” displayed when a Validation Rule is broken.

- *Required*: If the property is set to Yes, Access requires users to enter data in this field for every record.
- *Allow Zero Length*: Lets you store a blank value in a required field
- *Indexed*: If you index your fields, searching and sorting will go faster; appending, deleting and updating will go slower (because the index must be changed too.) If Yes, there are two additional options: Duplicates OK or No Duplicates. If you select No Duplicates on a first name field, there can be only one person named Bill. (Primary Keys are always indexed, No Duplicates.)

Set an input mask

Input masks help reduce data-entry errors by prompting the user with placeholder characters. For example, users might see ##### when they click on a zip code field, so they would know to enter a five-digit number.

1. Start the wizard by clicking the build button () beside the property box. You will be prompted to save the table.
2. Select the desired mask. Click Next.
3. On the next screen, change the placeholder character if desired. Click Next.
4. On the next screen, choose whether to store the formatting symbols supplied by the mask such as the parentheses and hyphen in a phone number. Click Next, then Finish.

Set a default value in a field

In the Default box in the Field Properties pane, type a value you want to automatically appear on each record. Examples: type **OH** in the State field; type **Date()** in a date field. (This is a built in function that supplies the current date). When users need to enter a different value in the table they just type over the default one.

Create a validation rule


In the Validation Rule box in the Field Properties pane, type a rule. (Text must be in quotes; numbers are typed without quotes.) Access will prevent users from entering a value in this field that does not match the criteria.

Set validation text

Validation text is a custom “error message” which appears if a user violates a validation rule. In the Validation Text box (just below the Validation Rule box in the Field Properties pane) type the desired text. This text will be displayed whenever someone types incorrect data in the field. Examples:

Sample Validation Rule	<1	>0	“A” Or “B” Or “C” Or “D” Or “F”.
Sample Validation Text	Number entered must be less than 1.	Contributions must be greater than zero.	Type letter grade, with no + or –.

Practice Project:

Open Microsoft Access and create a blank database. (Office 2003: Click the New button [] on the taskbar, then choose Blank Database on the task pane.) Save the database on a flash drive (recommended) or the hard drive and call it "NEOhio Outreach".

Create the following two tables for this database, using Design View: Projects and Donors. Use the field names and data types listed below:

Projects Table

Create two fields:

Project ID (make it an Autonumber field, and set this field to be the primary key)

Project Name (make it a Text field; limit field size to 20 characters)

Switch to Datasheet View and enter the data at right, then close the table.

Project ID	Project Name
1	Food Bank
2	Clothes Closet
3	Utilities Fund
4	Operating Fund

Donors Table

Create eight fields:

Donor ID: Autonumber; set this field to be the primary key.

Last Name: Text, limit to 30 characters

First Name: Text, limit to 30 characters

Address: Text, limit to 50 characters

City: Text, limit to 30 characters

State: Text, limit to 2 characters

Zip: Text, limit to 10 characters, apply Zip Code input mask

Phone: Text, limit to 14 characters, apply Phone Number input mask

Donor ID	Last Name	First Name	Address	City	State	Zip	Phone
Access will automatically assign Donor ID numbers. Whatever you get is OK.	Collins	Helen	125 Northampton Rd.	Cuyahoga Falls	OH	44223	(330) 123-4568
	Crist	Pat	426 Quail Circle	Cuyahoga Falls	OH	44223	(330) 123-8569
	Underwood	Wayne	125 Squirrel Pl.	Cuyahoga Falls	OH	44221	(330) 123-4578
	Harbridge	Laurel	236 Raccoon St.	Cuyahoga Falls	OH	44223	(330) 123-5699
	Wayne	John	253 Bobwhite Trail	Stow	OH	44224	(330) 234-5869
	White	Betty	5214 Cardinal Circle	Stow	OH	44224	(330) 234-7412
	Green	Bill	412 Bobwhite Trail	Stow	OH	44224	(330) 234-8411
	Smith	Ted	854 Cardinal Circle	Stow	OH	44224	(330) 234-1222
	Boyes	Mickey	542 Quail Circle	Cuyahoga Falls	OH	44223	(330) 123-4444
	Malone	Jim	852 Quail Circle	Cuyahoga Falls	OH	44221	(330) 123-7777
	Black	Sue	852 Cardinal Circle	Stow	OH	44224	(330) 234-7445
	Frazer	Jim	354 Bobwhite Trail	Stow	OH	44224	(330) 234-7666
	Jones	Catherine	412 Northampton Rd.	Cuyahoga Falls	OH	44221	(330) 123-4155
	Stapleton	June	785 Squirrel Pl.	Cuyahoga Falls	OH	44223	(330) 123-4455
	Ball	John	633 Quail Circle	Cuyahoga Falls	OH	44221	(330) 123-5998