TURBO PARTS:

Compressor Section:
Any centrifugal supercharger is basically just the compressor section of a turbo, the only difference is that on a turbo, the turbine section of the turbo drives it, in the supercharger application, belts, pulleys and internal gearing drive the compressor. Generally turbocharger compressor sections are smaller than their supercharger cousins. This is due to efficiency and the method powering the compressor. Turbo's spin faster at a given RPM, so the centrifugal supercharger must be larger to compensate for the slower speed.

Turbine Section:
This section is very similar to the compressor section, only backwards. This is because it has the same function...just backwards/reversed from the compressor. There are two main parts. The housing, and the wheel. If the turbine has an internal wastegate, the wastegate also resides here (more on that later). As hot exhaust gasses move out of the exhaust port into the exhaust manifold, they are routed to the turbine housing's scroll (function of a turbo manifold). If you can understand the flow of air through the centrifugal compressor design discussed earlier, it's basically the same, only reversed/backwards. The hot and rapidly moving exhaust find an airflow path through the turbine housing, with the ever decreasing scroll area, they come in contact with the turbine wheel on their way to the center outlet of the housing. They rush through this airflow path and into the exhaust down pipe; they spin the turbine wheel, imparting kinetic energy to spin the turbine. The turbocharger itself is not physically strapped to any rotating part of the engine. This allows different turbo shaft speeds a single engine RPM, which how a turbo systems performance characteristics and tunability come from.

Center Section (bearing section):
The center section is the most complex of the three sections. Inside the center section is the shaft that connects both the compressor and turbine, and where ALL of the cooling and lubrication takes place. The main shaft undergoes a great deal of pressure, RPM/Speed, heat and friction. The center section is engineered to deal with these factors. The most common and also the most basic center sections use what's called "thrust bearings" to keep the shaft spinning, oil flowing from the engine to both lubricate, and coolant flowing to cool the unit. The water-cooling helps reliability helps stabilize/lower temperatures within the center section, and in the oil that flows through the center section, and prevent oil coking in the housing. There are just oil lubricated/cooled units, but you wouldn't want one! The newer design is ball bearing center sections. Ball bearing center is both more durable and more efficient at transmitting power to the compressor wheel, making it better for performance and longevity.

TURBO KIT BASICS:
"Basic" here, is pretty much an oxymoron when dealing with turbos. NOTHING is basic about a turbo "system" as a whole. With as many different things concerning engine operation that need to be addressed, "basic" is really a misnomer. The "basic" turbo system should come with a MANY different parts. Very few "basic systems" effectively address all that you will need, unless your car was originally equipped with a turbo from the factory. Here is a semi complete list, in no particular order (little things like vacuum lines omitted for the sake of simplicity). Also, engine management is not on the list, because It has it's own section, to be dealt with separately.

1- Turbocharger unit
2- exhaust manifold for turbo
3- wastegate (internal or external)
4- blow-off valve (or bypass valve)
5- lines for oil supply and return
6- lines for water/coolant supply and return
7- intercooler
8- piping (from turbo to intercooler, from intercooler to throttle body)
9- Down pipe

Turbocharger:
Having gone through the basic explanation above, one more thing should be mentioned. Ever hear the T3/T4, T04E, T100 designations/names? These refer to the size and basic flow potential of the turbocharger. Garret and other manufacturers created turbo "families", in which all "family members" are of a certain physical characteristic. A T3 compressor section is one that prescribes to a specific characteristic set, such as overall size and design features. Generally speaking, larger numbers and higher letters mean a larger (and sometimes newer) family of turbos, meaning a potential increase in flow ability, power production and possibly even efficiency. The T3/T4 designation is an example of a hybrid turbo; one where a T3 turbine section has been mated to a T4 compressor section. This hybrid attempts to combine the excellent low RPM spool characteristics of the smaller T3 family with the big flow potential of a sizable T4 compressor. It's a "best of both worlds" attempt, which is very successful on smaller displacement, high RPM engines. There are a MANY other considerations to turbo sizing, such as A/R ratio and wheel trim, but those will be covered later. The goal is simply to get a basic understanding of turbocharger function and sizing. If you are buying a kit, the experts who designed the turbo kit or upgrade, likely have already made an excellent choice in turbo size for your specific application.

Turbo Exhaust Manifold:
In order to mount the turbo to the engine, the first step is to route exhaust gasses through it. This is where the special manifold comes in. It's not as simple as just dumping exhaust gasses directly from the exhaust port to the turbo via the shortest route possible. Considerations need to be made for the type of material used, provisions for mounting an external wastegate, exhaust pulse order (firing order), which cylinders should be paired or separated, pipe diameter, pipe length...etc.etc..etc. The simplest and most "crude" design is the log style cast iron manifold. But there's good reason that virtually every car to come off the production lines with a turbo has one like this: it works, and it's durable, and it's cheap to produce. Turbos build up a tremendous amount of heat and pressure in the initial part of the exhaust system (the beginnings of the turbo manifold), and the thick cast iron is perfectly suited to reliable performance in this harsh environment. Space considerations often prohibit the use of nicely tuned tubular equal length exhaust primaries, so for some applications, there's little reason to go through the time and expense of crafting one. There are possibly some finely crafted tubular manifolds available, or that can be made for your application if you want maximum performance and don't mind spending the money, but these are really unnecessary for a typical "basic" street setup. Ugly cast iron manifolds are routinely found on 400-500hp cars.

Wastegate:
A turbo system is self-feeding. As the system creates more boosts, it creates more exhaust flow. This exhaust flow is what powers the turbine, so if left unchecked the turbo system will quickly speed up to insane, out of control speeds. It takes time and a specific amount exhaust flow to start creating boost, but once this point is reached (boost threshold), either exhaust flow to the turbine is regulated, or the system will keep building pressure until something gives, usually a hard part somewhere in the engine, that will take other hard, expensive parts with it. This is why all turbo's need a wastegate.

Controlled by positive pressure/vacuum hose run off either the intake manifold, or turbo inlet/manifold junction, the wastegate is basically a "flap" that opens to allow exhaust flow an easier path around the turbine wheel, rather than through the turbine wheel, to control it's rate of spin, and thus to control boost.

There are two main types of waste gates, internal & external. Both are there to perform the same task, the only difference is location and effectiveness. Internal waste gates are located inside the turbine housing itself, and are only effective at re-routing exhaust gasses around the turbine wheel at low boost levels. They also can impart turbulence to the exhaust flow path. This increases exhaust system pressure and hurts performance. The external wastegate is the true performance choice. External wastegates have provisions made for it's mounting before the turbo on the exhaust manifold. An entirely alternate flow path is created where exhaust gasses skip going through the turbine housing altogether, contributing much less to turbulence in the system. They also tend to be more accurate at controlling exhaust flow and turbo boost; combine these two attributes and you have a recipe for superior performance.

Blow-Off Valve:
A Blow off Valve (or BOV) can be considered the "insurance policy" of a turbo system and it's protector. BOV's control maximum boost levels (insurance), and thus also protect against boost spikes (protector). The job of controlling maximum boost is the primary job of the wastgate, in the event of a big enough overboost/surge, the blow-off valve will vent excess pressures. In technical description a BOV is a spring-loaded puppet valve. It bleeds off and excess pressure that builds up in the intake system. This can occur due to either boost creep or a sudden closing of the throttle body when boosting (during full throttle, high RPM shifts). The BOV that serves dual purposes; prevent serious engine damaging overboosts; to prevent airflow from reversing direction into the turbocharger itself.

When the engine is at full boost and full song, the turbine and compressor are spinning madly and forcing/compressing air to the intake system. The momentum of the turbine and compressor are not easily stopped/slowed on a dime. When the throttle body is suddenly slammed shut (shift to next gear), things tend to get a tad, well, "interesting" in the intake system. There is an immediate pressure spike at the throttle body, that reflects back down the intake tract towards the compressor. If it hits the compressor wheel, it will put great stress on the compressor wheel, which is still spinning madly, pumping air into what is now a closed system (throttle shut). To keep the turbo's RPM up and the pressures in the intake tract down, the blow-off valve vents this excess pressure.

Intercooler:
This is the most important performance part you can add to a forced induction system. It can be worth its price and more in HP. Anytime you compress something, you heat it. Law of Physics. Blowing hot air into the engine is NOT a good thing. (That's why everyone buys a Cold air Intake for their car). For example, an 8-psi forced induction system can produce air inlet temps over 200 degrees Fahrenheit, making the engine into detonation machine. Let's face it, you would want to suck 200 Degree air into your N/A motor, if you could install a CAI and get 70-degree air right? So why do you want 200+ degree air with your turbo? Another side effect of "heat" is the decrease in air density. Density is just he measure of how close the individual atoms are to each other. The greater amount of space between the air molecules of hot air means lower charge air density, meaning the 8-psi of air isn't as potent as it could be. The solution lies in cooling the air. The question is how and where. If outside air is at 70 degrees, there's no easy way to cool it below 70, so you can't cool the intake air before the turbo. But, if the compressed air coming out of the turbo is 200+ degrees, and the outside air is 70 degrees, we've got a cooling solution. So you install an intercooler between the compressor and the throttle body. There are two main types of intercoolers. Air-to-air and water to air. Air to air intercoolers are inexpensive and easy to maintain/repair, but they can be very large and must be in a good airflow path to be effective. Air to air intercoolers are rarely over 80% efficient, meaning the charge temps only get to within 80% of ambient during engine operation. Air to water systems are more compact but also more complex, their biggest advantages lie in placement freedom and efficiency. An air to water intercooler does not need a supply of fresh air and can be well over 100% efficient (when filled with a cooler than ambient liquid), but they do need an external reservoir of coolant and some means to extract heat from that coolant. Traditionally, air to air units are preferred for simplicity, reliability and effectiveness in street cars, while the superior cooling and placement possibilities of air to water systems are most at home in drag vehicles (or ones that only see occasional boosting, where heat soak isn't an issue). There are of course exceptions, and in fact the Jaguar XJR uses air to water intercoolers, but these are few and far between. At any rate, either system is universally a good thing if you plan on running even moderate levels of boost.

Oil Supply:
A lot of people pass this part up when explaining a turbo system, and yet it's one of the main things you will have to deal with on any turbo install. The turbo needs both a supply and return line, where the supply line is generally in the form of a sandwich adapter mounted between the oil filter and engine block. The return line is usually the pain in the ass, since the oil pan of the engine needs to be removed and fitted with provisions for this line to connect to. Some aftermarket oil pans have NPT bungs on them ready for this type of use; I highly recommend you think about buying one of these (which is always a good investment even without the turbo) if you are planning on a serious turbo buildup.