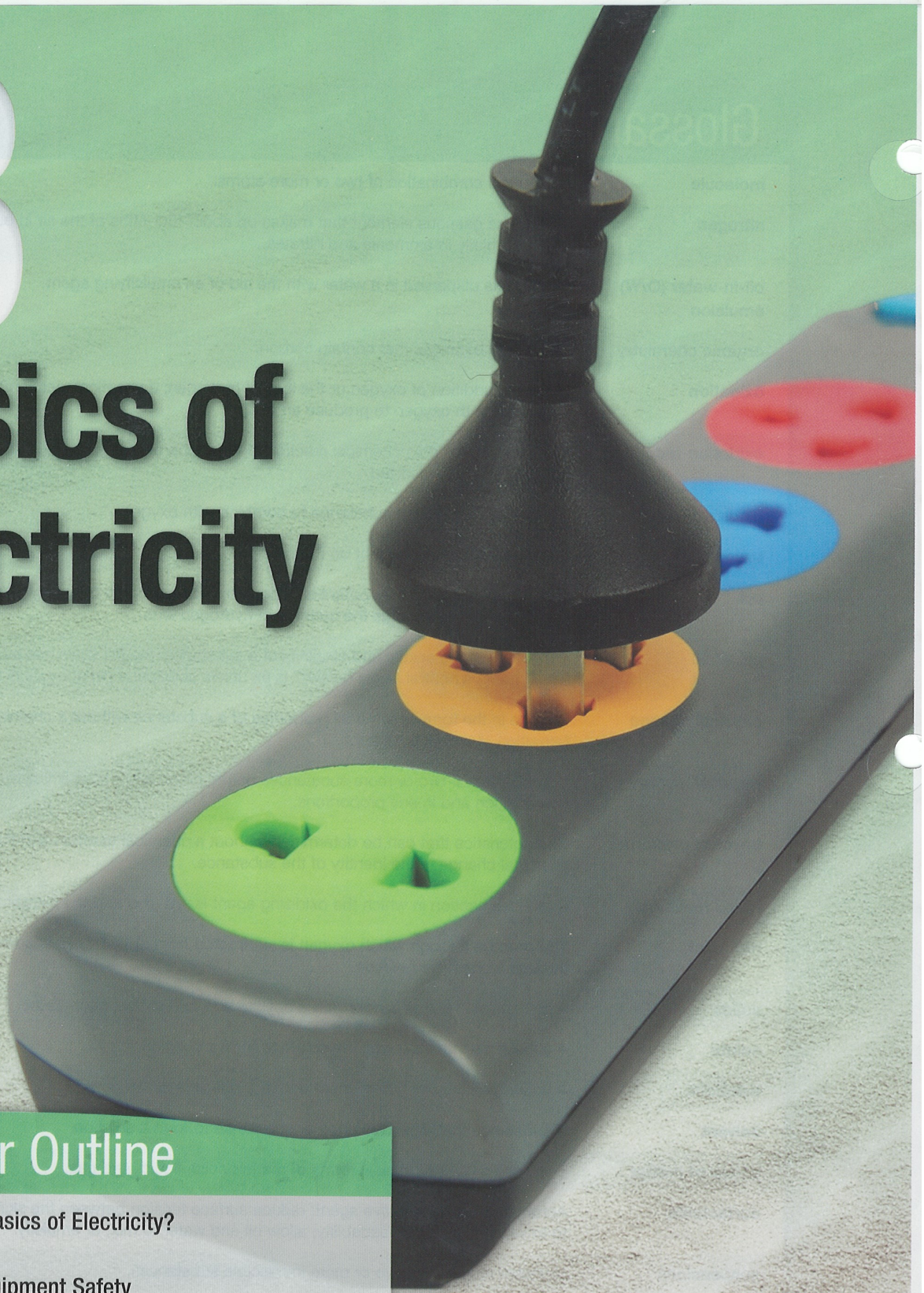
CHAPTER 8

Basics of Electricity



Chapter Outline

- Why Study Basics of Electricity?
- Electricity
- Electrical Equipment Safety
- Electrotherapy
- Light Energy, Lasers, and LED (Light-Emitting Diode)

Learning Objectives

After completing this chapter, you will be able to:

- ☑ **LO1** Define the nature of electricity and the two types of electric current.
- ☑ **LO2** Define electrical measurements.
- ☑ **LO3** Understand the principles of electrical equipment safety.
- ☑ **LO4** Describe the types of electrotherapy and their uses.
- ☑ **LO5** Explain electromagnetic radiation and the visible spectrum of light.
- ☑ **LO6** Describe what the acronym *laser* stands for.
- ☑ **LO7** Describe the colors of light in LED therapy and their benefits for the skin.

Key Terms

Page number indicates where in the chapter the term is used.

active electrode pg. 186

alternating current (AC) pg. 182

ampere (A, amp) pg. 182

anaphoresis pg. 186

anode pg. 186

blue light pg. 193

cataphoresis pg. 186

cathode pg. 186

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invisible light pg. 190

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visible light pg. 190

volt (V, voltage) pg. 182

watt (W) pg. 183

wavelength pg. 190

white light pg. 191

yellow light pg. 193

▲ Figure 8–1
Electricity.

Electricity or electrical current powers all of the devices that we use as estheticians. To use equipment and tools effectively and safely, all esthetic professionals need to have a basic working knowledge of electricity. The more we know and understand about electricity and its functions in skin care, the better we can ensure positive outcomes in our services and treatments. Additionally, we can prevent potential electrical problems in the salon, spa, or medical facility (**Figure 8–1**).

Why Study Basics of Electricity?

Estheticians should study and have a thorough understanding of the basics of electricity as it is a component of many service devices and so that technicians practice proper safety precautions and procedures and do not endanger either themselves or their clients.

- Most facial devices operate with electricity.
- It is important to understand how electricity functions so that you can use your devices safely and appropriately.
- It is important to have a good basic education in electricity as esthetics devices routinely undergo upgrades and improvements, and you will be able to transfer that knowledge to newer versions more easily.

Did You Know?

Electricity travels very fast: 186,000 miles (299,338 km) per second. If you traveled that fast, you could go around the world eight times in the few seconds that it takes you to turn on a light switch.

Did You Know?

One lightning bolt has enough electricity to service 200,000 homes.

Electricity

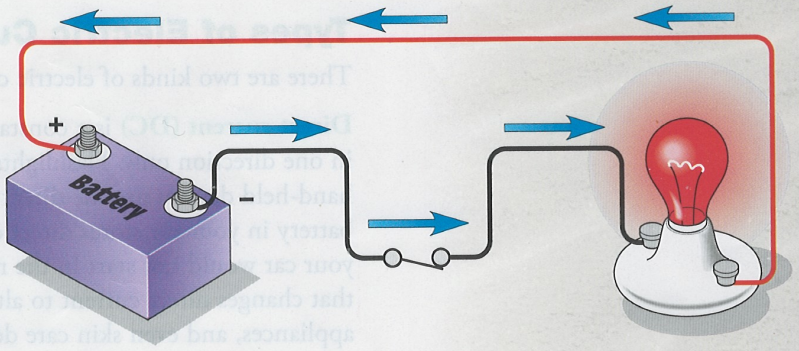
Lightning on a stormy night is an effect of electricity. If you plug a poorly wired appliance into a socket and sparks fly out, you are also seeing the effects of electricity. You are not really "seeing" electricity, but its visual effects on the surrounding air. Electricity does not occupy space or have physical or chemical properties; therefore, electricity is not matter. If it is not matter, then what is it? **Electricity** (ee-lek-TRIS-ih-tee) is the movement of particles around an atom that creates pure energy. Electricity is a form of energy that, when in motion, exhibits magnetic, chemical, or thermal effects.

An **electric current** (ee-LEK-trik KUR-unt) is the flow of electricity along a conductor in a complete circuit. All materials can be classified as conductors or nonconductors (insulators), depending on how easily an electric current can be transmitted through them.

A **conductor** (kahn-DUK-tur) is any material that easily conducts electricity. This means that electricity will pass through the material easily. Metals are good conductors, and copper is a particularly good conductor used in electric wiring and electric motors. Water makes a good conductor. This explains why one should not swim in a lake

during an electrical storm, since the electrical current can pass though the water and electrocute the swimmer.

An **insulator**, also known as **nonconductor** (nahn-kun-DUK-tur), is a substance that does not conduct electricity. Rubber, silk, wood, glass, and cement are good insulators. Electric wires are composed of twisted metal threads (conductor) covered with rubber (insulator). A **complete electric circuit** (SUR-kit) is the path of negative and positive electric currents moving from the generating source through the conductors and back to the generating original source or to the ground (Figure 8–2).



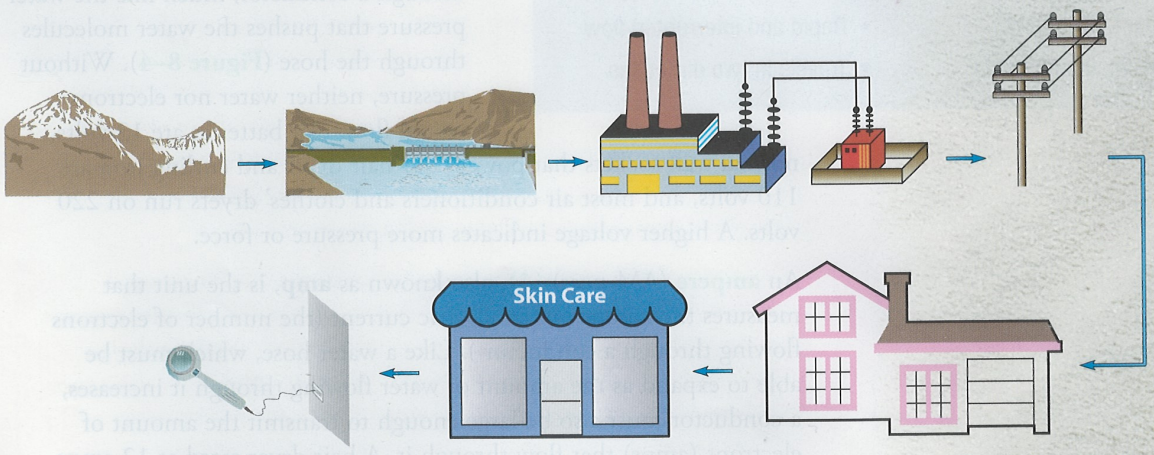
▲ Figure 8–2
A complete direct current (DC) electric circuit.

Did You Know?

Hydropower (water-powered) plants today make up our country's largest renewable energy source. Hydropower plants rely on a dam that holds back water and creates a large lake known as a reservoir. The water comes from melting snow from the mountains, traveling via groundwater, creeks, streams and rivers, and of course, rain.

When large doors on the dam open, water flows from the reservoir into a pipe. As the water flows into the pipe it builds up pressure, which turns a turbine (a big disc with blades) attached to a generator. As the turbine blades turn, so do a series of magnets inside the generator. Giant magnets rotate past copper coils, producing alternating current by moving electrons. The alternating current (AC) is converted to a higher-voltage current by a transformer. Going out of the power plant are large wires that become power lines, and the electrical current that is passing through the lines supplies the community with electricity (Figure 8–3).

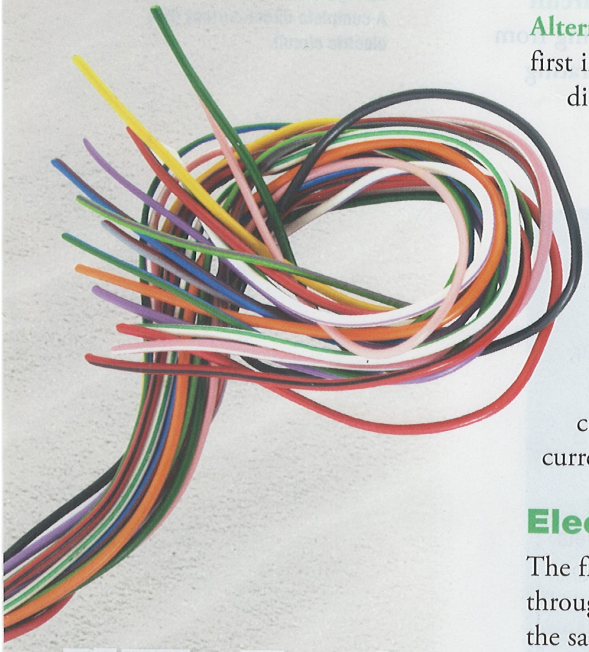
▼ Figure 8–3
Electricity flow chart.



Types of Electric Current

There are two kinds of electric current.

Direct current (DC) is a constant, even-flowing current that travels in one direction only. Flashlights, cellular telephones, and cordless hand-held devices use the direct current produced by batteries. The battery in your car stores direct current electrical energy. Without it, your car would not start in the morning. A **converter** is an apparatus that changes direct current to alternating current. Today, some cars, appliances, and even skin care devices contain converters which allow us to use them without the use of an electrical wall outlet.



Alternating current (AC) is a rapid and interrupted current, flowing first in one direction and then in the opposite direction. This change in direction happens 60 times per second. All devices that use a **plug**, a two- or three-prong connector at the end of an electrical cord, to connect an apparatus into a wall outlet such as corded hair dryers, flat irons, magnifying lamps, and microdermabrasion devices are using alternating current. Alternating current is produced by mechanical generators.

A **rectifier** (REK-ti-fy-ur) is an apparatus that changes alternating current to direct current. Cordless electric clippers and mobile phone chargers use a rectifier to convert the AC current from an electrical wall outlet in a building to the DC current needed to recharge their batteries. ☑ L01

Electrical Measurements

The flow of an electric current can be compared to water flowing through a garden hose. Individual electrons flow through a wire in the same way that individual water molecules flow through a hose.

Did You Know?

THE DIFFERENCE BETWEEN ALTERNATING AND DIRECT CURRENT

Direct Current (DC)	Alternating Current (AC)
• Constant, even flow	• Rapid and interrupted flow
• Travels in one direction	• Travels in two directions

A **volt (V)**, also known as **voltage**, is the unit that measures the pressure or force that pushes the flow of electrons forward through a conductor, much like the water pressure that pushes the water molecules through the hose (**Figure 8–4**). Without pressure, neither water nor electrons would flow. Car batteries are 12 volts, normal wall sockets that power your hair dryer and curling iron are 110 volts, and most air conditioners and clothes' dryers run on 220 volts. A higher voltage indicates more pressure or force.

An **ampere** (AM-peer) **(A)**, also known as **amp**, is the unit that measures the amount of an electric current (the number of electrons flowing through a conductor). Like a water hose, which must be able to expand as the amount of water flowing through it increases, a conductor must also be large enough to transmit the amount of electrons (amps) that flow through it. A hair dryer rated at 12 amps

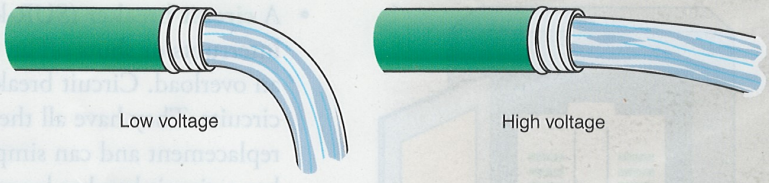
must have a cord that is twice as thick as one rated at 5 amps to handle the extra amperage, otherwise, the cord might overheat and potentially could start a fire. A higher amp rating indicates a greater number of electrons and a stronger current (Figure 8–5).

A **milliampere (mA)** (mill-ee-AM-peer) is one-thousandth ($\frac{1}{1000}$) of an ampere. The current for facial and scalp treatments is measured in milliamperes; as reference, an ampere current would be too strong and would damage the skin or body.

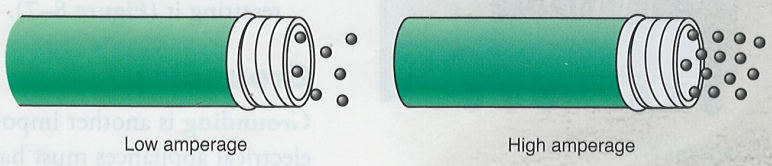
An **ohm (O)** is a unit that measures the resistance of an electric current. Current will not flow through a conductor unless the force (volts) is stronger than the resistance (ohms).

A **watt (W)** is a measurement of how much electric energy is being used in 1 second. A 40-watt light bulb uses 40 watts of energy per second.

A **kilowatt (K)** is 1,000 watts. The electricity in your house is measured in kilowatts per hour (kwh). A 1,000-watt (1-kilowatt) hair dryer uses 1,000 watts of energy per second. ☑ L02



▲ Figure 8–4
Volts measure the pressure or force that pushes electrons forward.



▲ Figure 8–5
Amps measure the number of electrons flowing through the wire.

Did You Know?

Wattage does not define the brightness of a light bulb; it refers to the amount of electricity consumed while the bulb is being used. Newer bulbs that are more efficient can produce more light using less electricity.

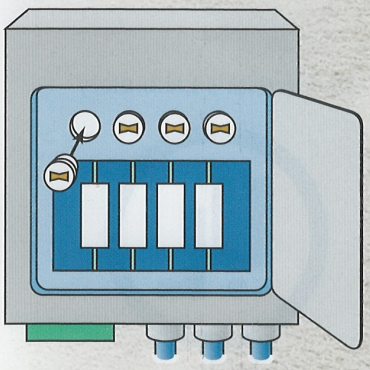
Electrical Equipment Safety

When working with electricity, you must always be concerned with your own safety as well as that of your clients. All electrical equipment should be inspected regularly to determine whether it is in safe working order. Poor electrical connections and overloaded circuits can result in an electrical shock, a burn, or even a serious fire.

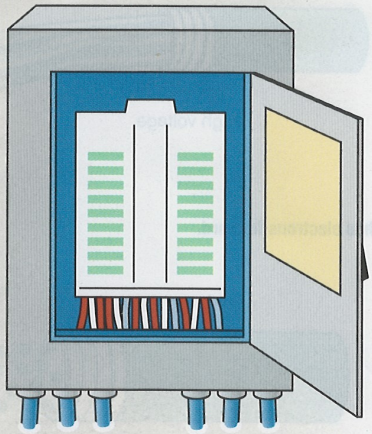
Safety Devices

A wire that is not large enough to carry the electrical current passing through it will overheat and possibly cause a fire. There are two electrical safety devices that you may encounter when working in a salon, spa, or medical facility. They are called a fuse and a circuit breaker.

- A **fuse** (FYOOZ) prevents excessive current from passing through a circuit. It is designed to blowout or melt when the wire becomes too hot from overloading the circuit with too much current. This occurs when too many appliances or faulty equipment are connected to an electricity source. This mechanism will automatically shut off your device or appliance. To re-establish the circuit, disconnect the appliance, check all connections and insulation, insert a new fuse, then reconnect the appliance (Figure 8–6).



▲ Figure 8–6
Fuse box.



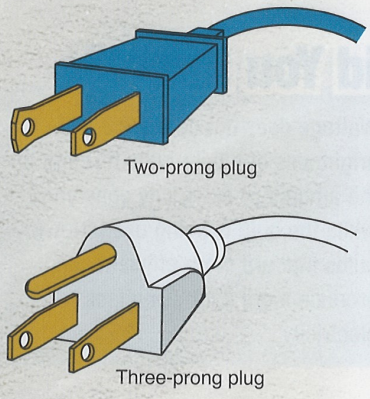
▲ Figure 8–7
Circuit breaker.

- A **circuit breaker** (SUR-kit BRAYK-ar) is a switch that automatically interrupts or shuts off an electric circuit at the first indication of an overload. Circuit breakers have replaced fuses in modern electric circuits. They have all the safety features of fuses but do not require replacement and can simply be reset. For example, your hair dryer has a circuit breaker located in the electric plug that is designed to protect you and your client in case of an overload or short circuit. When a circuit breaker shuts off, you should disconnect the appliance and check all connections and insulation before resetting it (**Figure 8–7**).

Grounding

Grounding is another important way of promoting electrical safety. All electrical appliances must have at least two electrical connections. The *live* connection supplies current to the circuit. The *ground* connection completes the circuit and carries the current safely away to the ground. If you look closely at electrical plugs with two rectangular prongs, you will often see that one is slightly larger than the other. This guarantees that the plug can be inserted only one way, and it protects you and your client from electrical shock in the event of a short circuit.

For added protection, some appliances have a third, circular, electrical connection that provides an additional ground. This extra ground is designed to guarantee a safe path for electricity if the first ground fails or is improperly connected. Appliances with a third circular ground offer the most protection for you and your client (**Figure 8–8**).



▲ Figure 8–8
Two-prong and three-prong plugs.

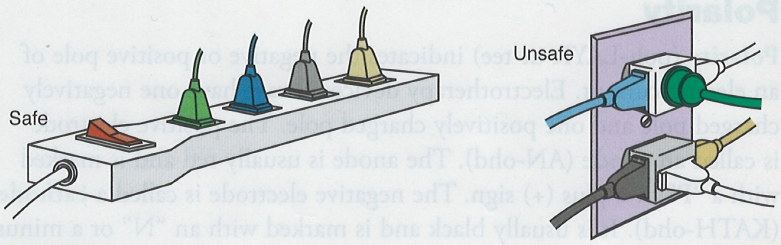
Guidelines for Safe Use of Electrical Equipment

Careful attention to electrical safety helps to eliminate accidents and to ensure greater client satisfaction. The following reminders will help ensure the safe use of electricity.

- All the electrical appliances you use should be UL certified (**Figure 8–9**).
- Read all instructions carefully before using any piece of electrical equipment.
- Disconnect all appliances when not in use.
- Inspect all electrical equipment regularly.
- Keep all wires, plugs, and electrical equipment in good repair.
- Use only one plug to each outlet; overloading may cause the circuit breaker to pop. If more than one plug is needed in an area, use a power strip with a surge protector (**Figure 8–10**).
- Unplug electrical devices or connections that get hot.

Underwriter's Laboratory

▲ Figure 8–9
UL symbol as it appears on electrical devices. Always check for the UL symbol.



▲ Figure 8–10
Safe and unsafe use of outlets.

- You and your client should avoid contact with water and metal surfaces when using electricity; do not handle electrical equipment with wet hands.
- Do not leave your client unattended while he or she is connected to an electrical device.
- Keep electrical cords off the floor and away from people's feet; getting tangled in a cord could cause you or your client to trip.
- Do not attempt to clean around electric outlets while equipment is plugged in.
- Do not touch two metal objects at the same time if either is connected to an electric current.
- Do not step on or place objects on electrical cords.
- Do not allow an electrical cord to become twisted; this can cause a short circuit.
- Disconnect appliances by pulling on the plug, not the cord.
- Do not attempt to repair electrical appliances unless you are qualified.
- If you have a problem with electrical wiring or an electrical device or appliance tell your supervisor immediately, take the device in for repair, or call a qualified electrician or repair representative to resolve the issue. ☑ L03

CAUTION!

Underwriter's Laboratory (UL®) certifies the safety of electrical appliances. Electric mitts, facial masks, and other tools that are UL approved are certified to be safe when used according to the manufacturer's directions. Always look for the UL symbol on electrical appliances, and take the time to read and follow the manufacturer's directions.

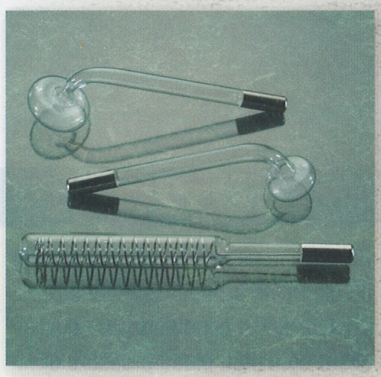
CAUTION!

Never tamper with wiring or electrical plugs to get them to fit into a receptacle for purposes that they were not designed.

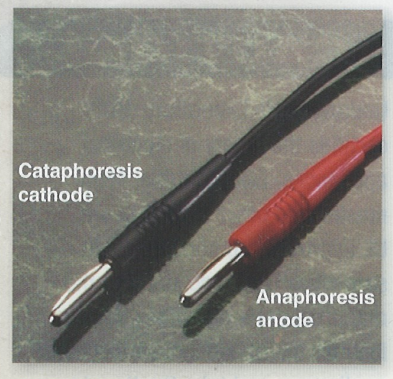
Electrotherapy

Electrical facial treatments are commonly referred to as **electrotherapy**. These treatments are often called **modalities**. Each modality produces a different effect on the skin.

An **electrode**, or **probe**, is an applicator for directing the electric current from the device to the client's skin. It is usually made of carbon, glass, or metal. Each modality (except for Tesla high frequency) requires two electrodes—one negative and one positive—to conduct the flow of electricity through the body (Figure 8–11).



▲ Figure 8–11
Electrodes come in a variety of shapes.



▲ Figure 8–12
Cathode and anode.

Polarity

Polarity (poh-LAYR-ut-tee) indicates the negative or positive pole of an electric current. Electrotherapy devices always have one negatively charged pole and one positively charged pole. The positive electrode is called an **anode** (AN-ohd). The anode is usually red and is marked with a "P" or a plus (+) sign. The negative electrode is called a **cathode** (KATH-ohd). It is usually black and is marked with an "N" or a minus (–) sign (**Figure 8–12**). If the electrodes are not marked, ask your instructor, salon manager, or supervisor to help you determine the positive and negative poles.

Modalities

The primary modalities used in esthetics today are galvanic current, microcurrent, and Telsa high-frequency current.

Galvanic Current

Galvanic current (gal-VAN-ik KUR-unt) is a constant and direct current (DC). It has a positive and negative pole and produces chemical changes when it passes through the tissues and fluids of the body.

Two different chemical reactions are possible, depending on the polarity (negative or positive) that is used (**see Table 8–1**). The **active electrode** (AK-tiv ih-LEK-trohd) is the electrode used on the area to be treated. The **inactive electrode** (in-AK-tiv- ee-LEK-trohd) is the opposite pole from the active electrode. Note that the effects produced by the positive pole are the exact opposite of those produced by the negative pole.

Iontophoresis (eye-ahn-toh-foh-REE-sus), also known as **ionization,** is the process of introducing water-soluble products into the skin with the use of electric current.

Cataphoresis (kat-uh-fuh-REE-sus) refers to infusing a positive (acid) product into the skin with the use of electric current, and **anaphoresis** (an-uh-for-EES-sus) is the process of infusing a negative (alkaline) product into the skin. **Desincrustation** (des-inkrus-TAY-shun) is a form of anaphoresis and is a process used to soften and emulsify grease deposits (oil) and blackheads in the hair follicles. This process is frequently used to treat acne, milia (small, white, bead-like mass), and comedones (blackheads and whiteheads).

Microcurrent

Microcurrent is an extremely low level of electricity that mirrors the body's own natural electrical impulses. Microcurrent can be used for iontophoresis, firming, toning, and soothing skin. Additionally, it can aid in the healing of tissue, such as in the case of acne, as it is technology that works with the body's own natural processes.

Newer microcurrent devices use polarity within one set of probes, which are applied by the esthetician, that allows the client to relax rather than actively participate in the service or treatment (**Figure 8–13**).

Did You Know?

Galvanic current is named after a doctor named Luigi Galvani who was born in Italy and lived there until his death in 1798.

CAUTION!

Do not use negative galvanic current on skin with broken capillaries or pustular acne conditions, or on a client with high blood pressure or metal implants.

EFFECTS OF GALVANIC CURRENT	
POSITIVE POLE (ANODE)	**NEGATIVE POLE (CATHODE)**
Cataphoresis	**Anaphoresis**
• Produces acidic reactions	• Produces alkaline reactions
• Closes the pores	• Opens the pores
• Soothes the nerves	• Stimulates and irritates the nerves
• Decreases blood supply	• Increases blood supply
• Contracts blood vessels	• Expands blood vessels
• Hardens and firms tissues	• Softens tissues

▲ Table 8–1 **Effects of Galvanic Current.**

Additionally, microcurrent does not travel throughout the entire body, but rather serves the specific area being treated.

Microcurrent can be effective in the following ways:

- Improves blood and lymph circulation
- Produces acidic and alkaline reactions opens and closes hair follicles/pores
- Increases muscle tone
- Restores elasticity
- Reduces redness and inflammation
- Minimizes healing time in acne lesions
- Improves barrier functions of the skin
- Increases metabolism

When used in treatments for aging-skin, the results may be a softer, firmer, more hydrated appearance of the skin (**Figures 8–14** and **8–15**). As with all electrical equipment, microcurrent should not be used

CAUTION!

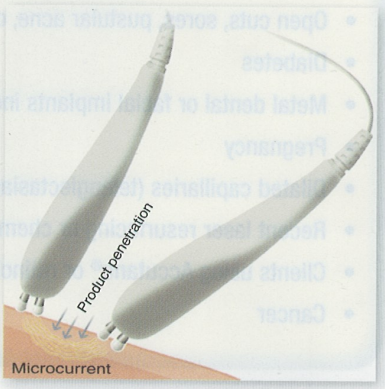
As with all electrical current devices, microcurrent should not be used on clients with the following health conditions: pacemakers, epilepsy, cancer, pregnancy, phlebitis, or thrombosis. Microcurrent should also not be used on anyone currently under a doctor's care for a condition that may be contraindicated. If you are unsure about treating a client, refer them back to their physician to obtain consent.

Did You Know?

In the past, Faradic- and sinusoidal-current devices, which used alternating and interrupted current to produce a mechanical reaction without a chemical effect, were used in both scalp and facial treatments. These devices caused a visible muscular contraction and have been replaced with newer technology. Devices which visibly contract muscles may be considered a Class 2 or above and out of the scope of practice for the esthetician.

Courtesy of David Suzuki, BioTherapeutic.

▲ Figure 8–13
Microcurrent probes.



Courtesy of David Suzuki, BioTherapeutic.

▲ Figure 8–14
Iontophoresis with microcurrent.

Courtesy of David Suzuki, BioTherapeutic.

▲ Figure 8–15
Ionizing with microcurrent.

on people with pacemakers, epilepsy, cancer, pregnancy, phlebitis, thrombosis, or on anyone currently under a doctor's care.

CAUTION!

Tesla high-frequency current should not be used on clients who are pregnant; suffer from epilepsy (seizures) or asthma; or have high blood pressure, a sinus blockage, a pacemaker, metal implants, or body piercings from the waist up. The client should avoid any contact with metal—such as chair arms, jewelry, and metal bobby pins—during the treatment. A burn may occur if such contact is made.

Tesla High-Frequency Current

Tesla high-frequency current, also known as **violet ray**, is a thermal or heat-producing current with a high rate of oscillation or vibration. It is commonly used for both scalp and facial treatments. Tesla current does not produce muscle contractions, and its effects can be either stimulating or soothing depending on the method of application. The electrodes are made from either glass or metal, and only one electrode is used to perform a service. Here are some benefits of using Tesla high-frequency current:

- Stimulates blood circulation
- Increases elimination and absorption
- Increases metabolism
- Improves germicidal action
- Relieves congestion

CAUTION!

As with all facial services and treatments, it is important to take a full history before performing electrotherapy. If you are unsure about whether you should perform a service on a client, ask them to check with their physician to obtain a signed written consent form from their physician and put it in the client file for documentation. If your client has any of the following conditions, it is not advisable to treat them with electrotherapy:

- Pacemaker/heart conditions/high blood pressure
- Taking multiple medications
- Mental health disorders
- Epilepsy
- Bleeding disorders
- Open cuts, sores, pustular acne, or abrasions
- Diabetes
- Metal dental or facial implants including braces, pins, or plates
- Pregnancy
- Dilated capillaries (telangiectasias, or spider veins)
- Recent laser resurfacing or chemical peel (check with physician)
- Clients using Accutane® or retinoids (check with physician)
- Cancer

REGULATORY **AGENCY ALERT**

Always make certain that you are in compliance with your state's recommendations for licensing and use of electrical current devices.

There are two methods for applying high-frequency current.

- ***Direct surface application.*** The esthetician holds the handpiece, where the glass electrode is inserted, and applies it directly to the client's skin, moving it slowly over the entire face for stimulation (Figure 8–16). When applying and removing the electrode from the skin, you must hold your finger on the glass electrode to prevent sparking. Remove your finger once the electrode has been placed on the skin. Apply the electrode to areas for healing acne and disinfecting.
- ***Indirect application.*** The client holds the tube electrode (with the metal coil inside) while the esthetician massages the face with her hands (Figure 8–17). At no time should the esthetician hold the electrode. To prevent shock, turn on the current only after the client has firmly grasped the electrode. Turn the current off before removing the electrode from the client's hand. The indirect application stimulates all cell functions without the irritation that could occur with direct application. This treatment is beneficial for sensitive, dehydrated skin. ☑ L04

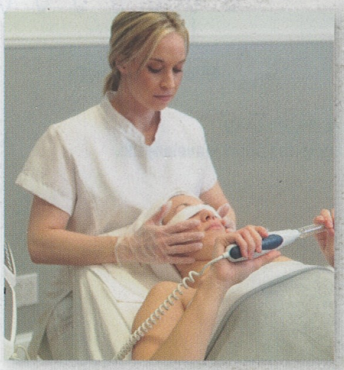
CAUTION!

As you learn more about facials and treatments, you will become familiar with the term *contraindication.* A contraindication is a predetermined condition that exists in your client that excludes them from using certain ingredients or products and/or from having treatments.

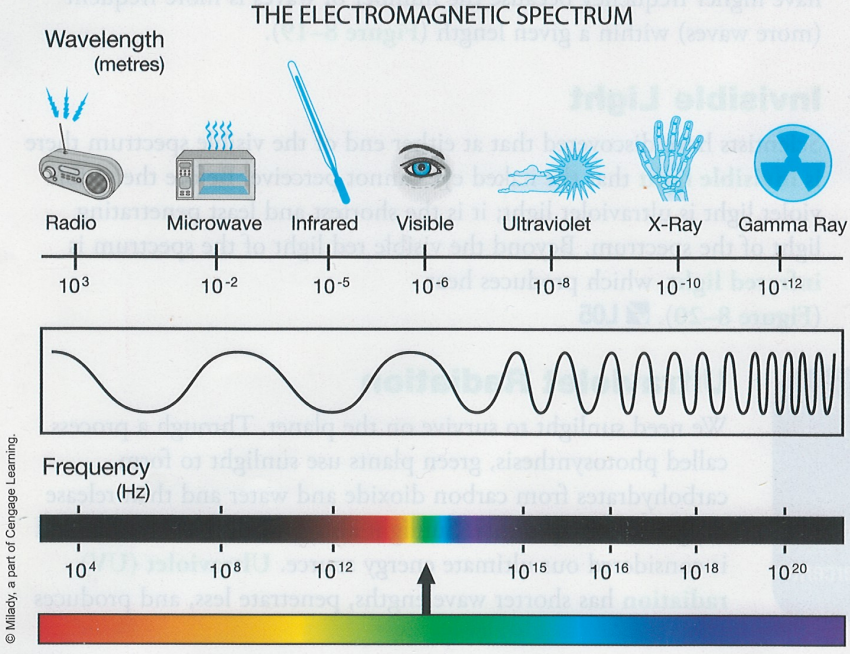
▲ Figure 8–16
Direct high-frequency application.

Light Energy, Lasers, and LED (Light-Emitting Diode)

There are three types of electromagnetic energy: visible light, invisible infrared light, and invisible ultraviolet radiation. The **electromagnetic spectrum** (Figure 8–18) is a form of energy that travels through space in waves and has both electric and magnetic properties.



▲ Figure 8–17
Indirect high-frequency application.



◀ Figure 8–18
The electromagnetic spectrum.

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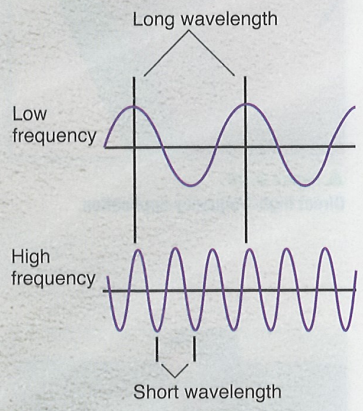
LONG WAVELENGTHS AND SHORT WAVELENGTHS

LONG WAVELENGTHS	SHORT WAVELENGTHS
Low Frequency	High Frequency
Penetrate Deeper	Penetrate Less
Have Less Energy	Have More Energy

Did You Know?

If light from the sun is passed through a glass prism, it will appear in seven different colors, known as the rainbow, arrayed in the following manner: violet (the shortest wavelength), indigo, blue, green, yellow, orange, and red (the longest wavelength). These colors, which are visible to the eye, constitute visible light.



▲ Figure 8–19
Long and short wavelengths.

Visible Light

Visible light is electromagnetic radiation that we can see. Electromagnetic radiation is also called *radiant energy* because it carries, or radiates, energy through space on waves. These waves are similar to the waves caused when a stone is dropped on the surface of the water. The distance between two successive peaks is called the **wavelength**.

Long wavelengths have low frequency, meaning the number of waves is less frequent (fewer waves) within a given length. Short wavelengths have higher frequency because the number of waves is more frequent (more waves) within a given length (**Figure 8–19**).

Invisible Light

Scientists have discovered that at either end of the visible spectrum there is **invisible light** that the naked eye cannot perceive. Before the visible violet light is ultraviolet light; it is the shortest and least penetrating light of the spectrum. Beyond the visible red light of the spectrum is **infrared light**, which produces heat (**Figure 8–20**). ☑ L05

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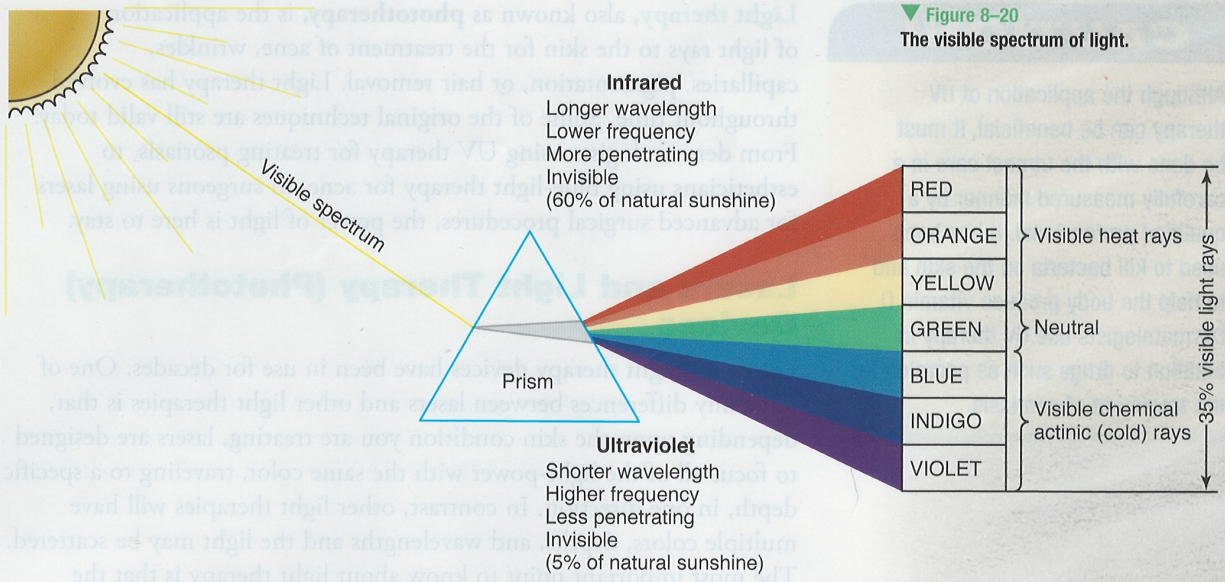
Natural sunlight is made up of three types of electromagnetic radiation:

- Visible Light = 35 percent
- Invisible Infrared Light = 60 percent
- Invisible Ultraviolet Light = 5 percent

Ultraviolet Radiation

We need sunlight to survive on the planet. Through a process called photosynthesis, green plants use sunlight to form carbohydrates from carbon dioxide and water and then release oxygen as a by-product. Sunlight also controls our weather and is considered our ultimate energy source. **Ultraviolet (UV) radiation** has shorter wavelengths, penetrate less, and produces



▼ Figure 8–20
The visible spectrum of light.

less heat than visible light does. UV also produces chemical effects and kills germs.

Small amounts of exposure to the sun can be beneficial in the production of vitamin D; however, recent studies have shown that overexposure to the sun causes skin damage, premature aging, and skin cancer. There are three types of UV radiation:

- ***Ultraviolet A (UVA).*** Ultraviolet A has the longest wavelength of the UV light spectrum and penetrates directly into the dermis of the skin, damaging the collagen and elastin. Ultraviolet A is often called the aging ray. UVA light is the light that is often used in tanning beds.
- ***Ultraviolet B (UVB).*** Ultraviolet B is often called the burning ray, because it is most associated with sunburns. Both UVA and UVB light cause skin cancers.
- ***Ultraviolet C (UVC).*** Ultraviolet C is blocked by the ozone layer. If the Earth loses the protective layer of the ozone, life will no longer exists as we know it. UVC radiation will virtually *cook* the Earth. We do not want to deplete the ozone layer, because it protects us from UVC radiation.

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We all need to strike a delicate balance with sunlight exposure. Keep in mind that tanned skin is damaged skin. Tanning will eventually cause photoaging (premature aging due to sun exposure) and irreversibly damage the skin's collagen-building properties.

Did You Know?

Some animals can see parts of the electromagnetic spectrum that humans cannot. For example, many insects can see ultraviolet (UV) radiation.

Did You Know?

When we hear the term **white light** it is actually referring to combination light because it is a combination of all the visible rays of the spectrum.

Did You Know?

We often hear the term "rays" used in association with sun light, such as UV rays, UVA and UVB rays, or light rays. The word ray in these cases represents the term *radiation.*

CAUTION!

Although the application of UV therapy can be beneficial, it must be done with the utmost care in a carefully measured manner by a qualified professional. It has been used to kill bacteria on the skin and to help the body produce vitamin D. Dermatologists use UV therapy in addition to drugs such as psoralen for the treatment of psoriasis.

Light therapy, also known as **phototherapy,** is the application of light rays to the skin for the treatment of acne, wrinkles, capillaries, pigmentation, or hair removal. Light therapy has evolved throughout time. Some of the original techniques are still valid today. From dermatologists using UV therapy for treating psoriasis, to estheticians using blue-light therapy for acne, to surgeons using lasers for advanced surgical procedures, the power of light is here to stay.

Lasers and Light Therapy (Phototherapy) Devices

Lasers and light therapy devices have been in use for decades. One of the many differences between lasers and other light therapies is that, depending upon the skin condition you are treating, lasers are designed to focus all of the light-power with the same color, traveling to a specific depth, in one direction. In contrast, other light therapies will have multiple colors, depths, and wavelengths and the light may be scattered. The most important point to know about light therapy is that the equipment you use is selected based on the skin type and condition you are treating.

Did You Know?

Over 1 million new cases of skin cancer are diagnosed each year. It is estimated that 1 in 5 Americans will develop skin cancer, and 90 percent of those cancers will be the result of exposure to UV radiation from the sun and from tanning beds.

Lasers

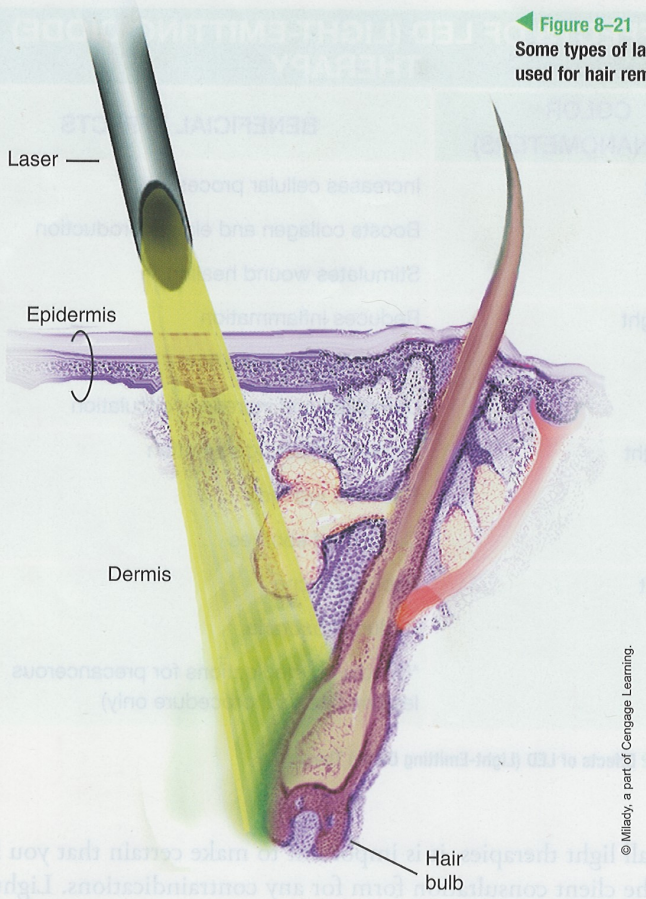
Laser is an acronym that stands for *light amplification stimulation emission of radiation.* Because lasers are used to treat a variety of conditions, there are many kinds of lasers to choose from. All lasers work by selective **photothermolysis**, a process that turns the light from the laser into heat. Depending on the intended use and type, lasers can remove blood vessels, disable hair follicles, remove tattoos, or eliminate some wrinkles without destroying surrounding tissue. Lasers have been used for decades in a variety of surgical procedures.

REGULATORY **AGENCY ALERT**

Always make certain that you are in compliance with your state's recommendations for licensing and use of laser and light devices.

Lasers work by means of a medium (solid, liquid or gas, or semiconductor) that emits light when excited by a power source. The medium is placed in a specifically designed chamber with mirrors located at both ends of the inside. The chamber is stimulated by an energy source such as electrical current, which in turn excites the particles. The reflective surfaces create light that becomes trapped and goes back and forth through the medium, gaining energy with each pass. The medium determines the wavelength of the laser and thus its use (**Figure 8–21**).

Most lasers are classified as Level II or above, which means that estheticians must be working under the supervision of a qualified physician to operate a laser. ☑ L06



◀ Figure 8–21
Some types of lasers are used for hair removal.

Did You Know?

Some 40 years ago, NASA in space studies found LED (light-emitting diode) to improve human tissue in the areas of healing and tissue growth. These original studies have laid the foundation for LED use in skin rejuvenation using light energy with specific colors to obtain responses in the skin such as increasing collagen reproduction and killing certain types of bacteria that create acne.

LED or Light-Emitting Diode

LED is the acronym for *light-emitting diode*, a device used to reduce acne, increase skin circulation, and improve the collagen content in the skin. The LED works by releasing light onto the skin to stimulate specific responses, at precise depths of the skin. Each color of light corresponds to a different depth (nanometer) in the skin. The LED color of light is also seeking color in the skin known as a chromophore. The term chromophore is derived from the Greek term *chroma* meaning color. A **chromophore** is a color component within the skin such as blood or melanin. When the colored light reaches a specific depth in the skin, it triggers a reaction such as the stimulation of circulation or reducing the amount of bacteria.

Depending on the type of equipment, the LED can be blue, red, yellow, or green (**Table 8–2** on page 194). LED in **blue light** has been shown to reduce acne, and **red light** increases circulation and improves the collagen and elastin production in the skin. **Yellow light** has been shown to reduce swelling and inflammation, and **green light** reduces hyperpigmentation. (**Figure 8–22**).

▲ Figure 8–22
LED treatment reduces redness and improves collagen content in the skin.

EFFECTS OF LED (LIGHT-EMITTING DIODE) THERAPY	
COLOR NM (NANOMETERS)	BENEFICIAL EFFECTS
Red light 640 nm	Increases cellular processes Boosts collagen and elastin production Stimulates wound healing
Yellow light 590 nm	Reduces inflammation Improves lymphatic flow Detoxifies and increases circulation
Green light 525 nm	Lessens hyperpigmentation Reduces redness Calms and soothes
Blue light 570 nm	Improves acne Reduces bacteria *Used with medications for precancerous lesions (medical procedure only)

▲ Table 8–2 Effects of LED (Light-Emitting Diode) Therapy.

As with all light therapies, it is important to make certain that you have viewed the client consultation form for any contraindications. Light therapy should not be performed on anyone who has light sensitivities (photosensitivities), phototoxic reactions, is taking antibiotics, has cancer or epilepsy, is pregnant, or is under a physician's care. If you are unsure whether you should apply a treatment, always refer the client to their physician. ☑ L07

Infrared Light

Infrared lamps have been used in salons for heating conditioners and chemicals in hair treatments. They are also used in spas and saunas for relaxation and warming up muscles. There are uses of near infrared light for signs of aging (such as for wrinkles), wound healing, and increasing circulation as it has the longest wavelength of all of the light therapy's and thus can penetrate the deepest into the skin.

Intense Pulse Light

Intense pulse light is a medical device that uses multiple colors and wavelengths (broad spectrum) of focused light to treat spider veins, hyperpigmentation, rosacea/redness, wrinkles, enlarged hair follicles/pores, and excessive hair. As with most devices, multiple treatments are required. A thorough medical history is taken, and these treatments are provided under the supervision of a qualified physician.

Web Resources

Several Web sites can provide additional information about electricity. Try these:
www.ezistim.com
www.eia.doe.gov
www.howto.altenergystore.com
www.loc.gov
www.bio-therapeutic.com

Review Questions

1. Why is it important for estheticians to have a basic understanding of electricity?
2. What is the difference between conductors and insulators?
3. Describe the two types of electric current, and give examples of each.
4. Define volt, amp, ohm, and watt.
5. Why should you look for the UL symbol on electrical devices?
6. What are the modalities used in electrotherapy? What kind of current is each one?
7. List the effects of the positive pole and the negative pole of a galvanic current.
8. What is iontophoresis? What is desincrustation?
9. What is microcurrent and what are its benefits?
10. Name the benefits of Tesla high-frequency current.
11. What is the electromagnetic spectrum? What is visible light?
12. List and describe the five main types of light therapy.
13. Why must exposure to ultraviolet rays be carefully monitored?
14. What does the acronym *laser* stand for?

Glossary

active electrode	Electrode of an electrotherapy device that is used on the area to be treated.
alternating current	Abbreviated AC; rapid and interrupted current, flowing first in one direction and then in the opposite direction; produced by mechanical means and changes directions 60 times per second.
ampere	Abbreviated A and also known as *amp*; unit that measures the amount of an electric current (quantity of electrons flowing through a conductor).
anaphoresis	Process of infusing an alkaline (negative) product into the tissues from the negative pole toward the positive pole.
anode	Positive electrode; the anode is usually red and is marked with a P or a plus (+) sign.
blue light	A light-emitting diode for use on clients with acne.
cataphoresis	Process of forcing an acidic (positive) product into deeper tissues using galvanic current from the positive pole toward the negative pole; tightens and calms the skin.
cathode	Negative electrode; the cathode is usually black and is marked with a N or a minus (-) sign.
chromophore	The colored cells or target in the epidermis or dermis that absorbs the laser beam's thermal energy, causing the desired injury or destruction of the material.
circuit breaker	Switch that automatically interrupts or shuts off an electric circuit at the first indication of overload.
complete electric circuit	The path of an electric current from the generating source through conductors and back to its original source.

Glossary

conductor	Any substance, material, or medium that easily transmits electricity.
converter	Apparatus that changes direct current to alternating current.
desincrustation	Process used to soften and emulsify sebum and blackheads in the follicles.
direct current	Abbreviated DC; constant, even-flowing current that travels in one direction only and is produced by chemical means.
electric current	The flow of electricity along a conductor.
electricity	The movement of particles around an atom that creates pure energy; form of energy that, when in mothion, exhibits magnetic, chemical, or thermal effects; a flow of electrons.
electrode	Also known as *probe*; applicator for directing the electric current from an electrotherapy device to the client's skin.
electromagnetic spectrum	Also known as *electromagnetic spectrum of radiation*; made up of all forms of energy whose spectrum ranges from the longest waves to the shortest.
electrotherapy	The use of electrical devices to treat the skin and for therapeutic benefits.
fuse	A special device that prevents excessive current from passing through a circuit.
galvanic current	A constant and direct current (DC); uses a positive and negative pole to produce the chemical reactions (desincrustation) and ionic reactions (iontophoresis).
green light	A light-emitting diode for use on clients with hyperpigmentation or for detoxifying the skin.
grounding	The *ground* connection completes the circuit and carries the current safely away to the ground.
inactive electrode	Opposite pole from the active electrode.
infrared light	Infrared light has longer wavelengths, penetrates more deeply, has less energy, and produces more heat than visible light; makes up 60 percent of natural sunlight.
insulator	Also known as *nonconductor*; substance that does not easily transmit electricity.
intense pulse light	Abbreviated IPL; a medical device that uses multiple colors and wavelengths (broad spectrum) of focused light to treat spider veins, hyperpigmentation, rosacea and redness, wrinkles, enlarged hair follicles and pores, and excessive hair.
invisible light	Light at either end of the visible spectrum of light that is invisible to the naked eye.
iontophoresis	Also know as *ionization*; process of infusing water-soluble products into the skin with the use of electric current, such as the use of positive and negative poles of a galvanic machine or a microcurrent device.
kilowatt	Abbreviated K; 1,000 watts.
laser	Acronym for *light amplification stimulation emission of radiation*; a medical device that uses electromagnetic radiation for hair removal and skin treatments.
LED	Acronym for *light-emitting diode*; a device used to reduce acne, increase skin circulation, and improve the collagen content in the skin.

Glossary

light therapy	Also known as *phototherapy*; the application of light rays to the skin for the treatment of acne, wrinkles, capillaries, pigmentation, or hair removal.
microcurrent	An extremely low level of electricity that mirrors the body's natural electrical impulses.
milliampere	Abbreviated mA; one-thousandth of an ampere.
modalities	Currents used in electrical facial and scalp treatments.
ohm	Abbreviated O; unit that measures the resistance of an electric current.
photothermolysis	Process by which light from a laser is turned into heat.
plug	Two- or three-prong connector at the end of an electrical cord that connects an apparatus to an electrical outlet.
polarity	Negative or positive pole of an electric current.
rectifier	Apparatus that changes alternating current to direct current.
red light	A light-emitting diode for use on clients in the stimulation of circulation and collagen and elastin production.
Tesla high-frequency current	Also known as *violet ray*; thermal or heat-producing current with a high rate of oscillation or vibration that is commonly used for scalp and facial treatments.
ultraviolet (UV) radiation	Invisible rays that have short wavelengths, are the least penetrating rays, produce chemical effects, and kill germs.
visible light	The primary source of light used in facial and scalp treatments.
volt	Abbreviated V and also known as *voltage*; unit that measures the pressure or force that pushes the flow of electrons forward through a conductor.
watt	Abbreviated W; measurement of how much electric energy is being used in one second.
wavelength	Distance between two successive peaks of electromagnetic waves.
white light	Referred to as *combination light* because it is a combination of all the visible rays of the spectrum.
yellow light	A light-emitting diode which aids in reducing inflammation and swelling