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Basic Genetics In First and Second Grade

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by Kathleen Ayr

I. Introduction

Citizens of the twenty-first century urgently need to be literate in the field of genetics. It is a field that will radically change medicine and biology. By the year 2005, the Human Genome Project hopes to find the location of about 100,000 genes and to read the maps or genetic scripts of humans, which may include 3 billion bits of information. The huge increase in genetic knowledge has puzzled and even frightened many adults. This explosion of knowledge is similar to the awesome capacities of computers. A million machines that could instantly manipulate facts and figures seemed frighteningly powerful to elementary teachers in 1970 but now most teachers use a computer in school and many use one at home. Learning genetics does require a bit of effort and sophisticated terms are plentiful-but the understanding will provide teachers with the tools needed to pry open the mystery box of genetics. The need for this knowledge has increased as primary teachers are increasingly asked to teach children with genetic disorders. A respect for all humans and awareness of small genetic differences can open the door for supportive discussions about special needs children. A teacher who is comfortable discussing basic genetic principles can improve her science and social studies curriculum at a first through second grade level with this unit.

This knowledge will help them interpret the confusing media coverage that frequently occurs when new experiments are published. Children can easily imagine a creature with eyes on top of its head, on its knees and on its chest. Such a creature was genetically engineered and it actually flew. This news will often grab tabloid headlines but it is part of serious research in Switzerland. The image of science fiction flies coming to swarm our homes can be replaced with accurate knowledge. To start, lets look at the creature with so many eyes. It was actually a swarm of tiny fruit flies that were genetically altered so scientists could try to unravel the blueprint for eyes. The scientists at the University of Basel in Switzerland were studying a gene known as eyeless. Any fruit fly that failed to carry this gene would end up without eyes. So how powerful can one gene for eyes be? When they inserted several copies of this gene into fruit fly embryos, the flies grew up to 14 sets of eyes in addition to their normal location. When researchers then inserted a gene into the flies that controls eye movement in mice, the embryos again produced flies with multiple eyes. Now the science world is wondering how the “master control” system of genes can span different species of animals. The molecular biologist Charles Zuker was asked about the meaning of all this latest research. His humorous reply was that “It means that we are basically just big flies.” (Time) This genetics research brings us new perspectives about who we are as Homo Sapiens. Medical research is frequently uncovering the genetic markers for disease.

Students will need to apply genetic information to make medical and ethical decisions. The next generation needs genetic knowledge. This basic genetics unit can provide a foundation that integrates easily into the primary grades.

II. Curriculum Unit Objectives

This genetics unit will start with basic anatomy and lead to a sameness versus differences continuum. It blends family inheritance and reproduction of cells. The name of Mendel is not part of first grade science but a poem about the laws of inheritance can be easily introduced. Rules of probability are studied with two-colored chips and the rules of inheritance can be studied through a hands-on comparison of wrinkled and smooth pea seeds. Family pictures, seed comparisons and observations of baby animal pictures will be used to talk about features or traits that we get from our parents.

The concept of magnification helps these young students understand how genetics developed. A bit of genetic history develops a definition of science and leads to a experiments with a major tool of genetics, the microscope. The workings of a cell involve hands-on experiments to reinforce new vocabulary words and observational skills. Discussions about genetic disease introduce the fact that some of our classmates have genetic traits that are challenging but not impossible to overcome. Culminating activities include raising a batch of butterflies and observing the life cycle of animals on various field trips. Genetics extends basic science to a more sophisticated level and prepares students for biology.

Objective 1

The first objective is to increase basic body knowledge and awareness . The following objectives will lead to physical comparisons of genetically based differences. Students will have opportunities to

A. Learn major body parts through books, body tracings, and audio-visual aids.
B. Learn some basic facts on human reproduction
In this unit the children benefit from knowing about egg cell, sperm cell, ball of cells, fertilization, pregnancy, and womb, because these facts relate to geneticstudy.
Most children know that they were born in a hospital but don’t realize that their body was checked and tested for several genetic diseases, before and after birth.
C. Use a family tree chart to record parents and grandparents
D. Graph the classroom observations on six selected genetic traits and `use a family facts worksheet on these six traits
This same/different continuum creates many hands-on activities that relate to children’s interests and self-awareness.
E. Discriminate a physical trait from a personality trait

Lesson One

Children love to compare one person's characteristics to another person's. The goal of comparing is to motivate young children to become better observers and to measure carefully. This comparing and measuring process connects easily to a study of genetics and relates science to math. For example, measures of height will show a spread of sizes that can be charted. If they can also hypothesize about why some people are taller, they are ready to learn a few fun rules of inheritance.

Many of our inherited features provide a springboard for scientific observations of genetic features. These include ear lobes, eye color, thumb bends, hair, thumb prints and tongue curls. The children's body tracings form the "big" map of various features that we all inherit from our parents. A CD ROM on the human body by the Magic School Bus Books can support these objectives as can an elementary book like "How the Body Works" by Steve Parker. Labels on the major body parts will be in contrast to the later labels of a tiny cell map. A chart will be used to list six body parts that we all have in common. These might include ears, noses, eyes, tongues, hands and hair. Worksheets will record each child's initial observations of themselves . Activities for these six features will highlight genetic differences. These include tongue curls, eye color, ear lobe attachment, curly or not curly hair, thumbprints, and thumb bends.

Objective 2

Students will have the opportunity to

A. Learn about science and two genetic scientists, Mendel and Morgan.
1. A man named Mendel started studying wrinkled and smooth seeds that belong to the pea family. Mendel used visual observations and notes to predict the dominant and recessive genes for wrinkled and smooth seeds.
2. Scientists like Morgan took Mendel's rules and applied them to animals, plants and people.
3. The major rule of genetics is based on the concept of dominant and recessive genes.
B. Learn about microscopes and scientific techniques
1. The scientists use special microscopes to study the inner parts of a cell where the genetic code or plans are located.
2. Genetics looks at parents, grandparents, and other relatives to find body features that are handed down or inherited.
3. There are a billion gene patterns and each of us has a different pattern of genes.
C. Experiment with probability using two-colored beans.
1. Genetic predictions are based on dominant and recessive rules.
2. Math probability rules games show how difficult it is to predict when certain traits might happen to people
3. Read the Usborne book on Scientists (Reid and Fara) to discuss how genetic scientists learn about many diseases and help people understand how genetic diseases happen.
4. Discuss how genetic scientists do many experiments, sometimes changing the structure of a gene. Children can participate in lessons that look inside familiar items, for example, the structure of a cut apple's star pattern, a bean seed growing in a moist paper towel, and jelly beans that can be split and attached to other colors.
5. Complete a clay art project to demonstrate a large structure of a cell and nucleus. Students will make 46 tiny chromosome-like structures out of clay. These will be arranged in the nucleus of a

large clay circle
D. Observe the life cycle of fruit flies and butterflies
1. Thomas Morgan used Mendel's rules and a microscope as he bred a change in the eye color of fruit flies, from red to white. This is described at a child's level in the Usborne Book on Scientists. (Reid and Fara)
2. Ripe fruit can be used as a host to observe the multiplication of fruit flies
3. Two life stages of butterflies can be observed in an indoor butterfly garden available in most early childhood catalogs.
4. Students can observe and describe the designs on the butterflies

Lesson Two

Magnifying glasses and microscopes are similar tools used to observe different levels of smallness. It is quite difficult for these young students to grasp cell size concepts but they do benefit from carefully observing themselves and nature with magnifying glasses. A stapled booklet of worksheets allows children to record information while promoting a looking and writing connection. Microscope Worksheet "A" requires observations of a variety of living and non-living things like salt. pepper, yarn and leaves. Observations become more precise when a real microscope is introduced. A toy microscope will be used first to explain how microscopes allow us to see very small items, like hair or salt crystals.. An explanation of cell size and the fact that life continues on because we keep making new cells utilize children's science books. The video "Honey I Blew Up the Kids" is a humorous look at cell magnification. A real microscope will be sought from a science teacher in a nearby middle-school so that more precise observations can be made. A children's videoscope is now made for pre-k and older children. It allows a class to observe an eight inch screen at 20x to 50x magnification. It is available in many catalogs for about sixty-five dollars. The teacher can create interest in

viewing cells and introduce the fact that each cell has a plan or control system. This system cannot be seen with school microscopes so it can be introduced as the “secret code” or blueprint plan. Remind the students that the forty-six chromosomes in our clay model contain genetic information. Each of us wears the genetic plan that we get or inherit from our parents. The six body parts selected for previous traits observations were linked to parent’s traits. That is our genetic code in action. If it is appropriate and possible, the teacher will use the family facts worksheet about these traits so children can see a genetic link. This activity sheet can go into a booklet called “A Recipe for Me.” This would contain a fill-in the face worksheet, thumbprints descriptions, artwork of their family, a classroom trait comparisons graph, and the family facts home worksheet.

Objective 3

Students will have opportunities to

A. Learn basic vocabulary words needed to discuss cells and genetics
B. Learn how cells reproduce by dividing and how the twinning of chromosomes passes on a full set of chromosomes with their genetic code.
C. Participate in activities that explore key concepts like cell division, patterns, double helix, DNA, genes and sex chromosomes,
D. Participate in code or pattern games using letters like DNA, ATCG, XX, XY, and the chromosome numbers 46 and 23.
1 Each person has a set pattern of growth based in our genes.
2. Patterns are set up before we are even born
3. Parents get their patterns from their parents
4. Genes contain long molecules of DNA that is arranged in a pattern (A T C and G) and then twisted 5. A C T and G are chemical codes that tell the cell how to build structures, proteins and other important materials.
6. A boy has an X and a Y chromosome and a girl has two XX chromosomes.

Lesson Three

Children enjoy a lesson on how life begins as a tiny cell. Each person has their pattern of growth determined at a very early time .To form a base of concepts, students will use one inch blocks that are labeled XX or XY. Boys and girls can line up behind their symbol . Before a baby is born, guessing the sex of a child is like flipping two colored chips. A math lesson can be devoted to charting the results of such flipping and guessing. After many trials, it may motivate students to know that scientists can go inside a mother’s womb with a long needle to get some tiny cells from the baby’s fluid environment. A small amount of fluid from the womb can

tell more than the sex of the baby. It can tell about genetic diseases and lung maturity. The teacher can again emphasize that every cell has a genetic code that can be studied by scientists. Their job is to match the pairs of chromosomes and label the pairs. To show this symmetry each child can design some water color dots on one half of a folded paper circle. Then they can fold up the paper cell to duplicate the design on the other side. This simple example of symmetry demonstrates how our cells blueprint plan can be repeated. Each cell has chromosome pairs that can divide to form a new set of chromosomes. The cell membrane pinches in two to make a new cell. As it grows, the DNA in the chromosome copies itself. This process is called mitosis. Students can make a large model of a cell using a circle of clay as a symbol of a magnified cell. Tiny jelly beans can form the matched pairs of chromosomes in another project. The matching of 46 jelly beans into 23 pairs reinforces basic math concepts that are introduced in first and second grade.

Objective 4

Students will have opportunities to learn about genetic problems

A. Students will learn that some inherited traits cause problems or disease
B. Students will discriminate between an inherited disease and an infection that is caused by something in the environment
C. Students will discuss the observable traits of Turner syndrome and Williams Syndrome, noting problems, challenges and benefits.

Lesson Four

The lessons on genetics will link real genetic disorders to literature in order to emphasize differences and sameness in all people. The story of two very different characters getting along is the theme in “How Joe The Bear and Sam the Mouse Got Together.”(Farr). This story contrasts the different opinions and sizes of two characters who manage to find similarities in their taste for ice cream.. A group discussion about the problems that very short and very tall people have will promote understanding for a student with Turner Syndrome which causes very short stature. Such a student resents being treated like a mascot or a baby but may find it difficult to open heavy doors. Students and teachers can discuss the common problems we all have, like near-vision and hearing problems.. If a student is comfortable with their identified disorder, young children are fascinated to learn that other children have this same disability. They enjoy learning that scientists have developed a name for many traits or features that people can have. There are many kinds of genetic differences people can have without even noticing. Only some of these differences cause problems or challenges for people. The Wizard of Oz movie shows many little people or dwarfs as actors. The children can list the challenges that a very short and a very tall person face. To promote acceptance of a really different-looking friend, the teacher might show the movie E.T. Williams Syndrome is another genetic syndrome that can cause exclusion based on features. For example, a Williams Syndrome child frequently drools and sometimes stares. If students can see these problems as another example of traits that are inherited, they can give supportive reminders about swallowing or staring. The ideal outcome would be that these students can understand the sameness in people who look or learn differently.

Objective 5

Students will participate in culminating activities that promote observations of animal life cycles

A. Field trips to the beach, pond and farm will reinforce genetic concepts.
The students will apply some of their genetic learning as they visit the farm, pond or ocean. The class will note the markings and traits of animals and draw animals in different life stages. They can look for patterns of color, shape and size. They can guess about inherited problems or illnesses that might happen to animals. Story books that touch on these issues include the Ugly Duckling, Clifford the Big Red Dog, and Are You My Mother? The annotated student bibliography includes many other science books.
B. Students will use learning centers in classroom to further stimulate interest and awareness of genetic influences
Teaching strategies for Learning Centers
1.Math observations, comparisons and measurements
Each month there is a unit or theme measuring item . These include fall fruits, leaves, insects and pumpkins. The six traits that were compared in earlier lessons are an extension of this measuring and comparison process. Art projects can focus on thumb prints, hand prints and tracings of funny faces parts.(Berger, Braun and Sperling)
2. Art and games to reinforce genetic concepts
Worksheets D and E provide helix and chromosome drawings for coloring.
3. Literature and films about unique characters who face syndrome-like problems.
The movie Babe features a pig who attempts to act like the border collie who raised her. Children’s’ literature has many characters who face problems due to their inherited traits or environmental demands. The movie E.T. also illustrates the difficulty of an alien who shares few of our traits but manages to evoke a range of very human emotions.
4. Science explorations with magnifying glasses and microscopes
Worksheets B and C provide suggested items for the microscope and thumbprint classifications

Bibliography for Teachers

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Facklam, Margery and Howard, From Cell To Clone: The Story Of Genetic Engineering. Harcourt Press, 1979

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Gonick, Larry and Mark Wheels, The Cartoon Guide to Genetics. Harper Perennial, 1983.

Holiday, Ensory. More Altair Design. Pantheon Books, 1974.

Jackson, John F., Genetics And You. Humana Press, 1996.

Mange, Arthur and Elaine J. Genetics: Human Aspects. Sinauer Assoc. Inc., 1990.

Nash, Madeleine J., Jeepers! Creepy Peepers! Time Magazine, p.61., April 3,1995.

Singer, Sam.. Human Genetics: An Introduction To The Principles of Heredity. W. H. Freeman and Co., N. Y. 1985.

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Ardley, Neil. The Science Book Of Things That Grow. Gulliver Books, Harcourt Brace and Co., 1991.

Bidwell, Norman. Clifford The Small Red Puppy. Scholastic Books, NY 1987.

The topic of cell division and growth can be brought to a child’s level with this popular dog who grows too quickly for his owners.

Berger, Joan, Karen Braun and Anita Sperling. Funny Faces Tracing Fun. Scholastic Inc., NY, 19 87.

For the non-artist teacher, these drawings of ears, tongues, hair, eyes and bodies can help in comparison lessons and funny creations are easily made.

Carle, Eric, The Mixed-Up Chameleon. Thomas Crowell, NY 1984.

A bored chameleon wants to be like other animals but after trying on their body parts, it decides to be itself.

Cole, Joanna and Bruce Degan. The Magic School Bus Explores the Human Body. C.D. ROM, Microsoft,1994. Scholastic Books, NY, 1989.

Heller, Ruth, Animals Born Alive And Well. Scholastic Books, NY, 1982.

Levy, Judith. Grandmother Remembers. Steward, Tabori and Chang Publ., NY, 1983.

Grandmothers family tree can reveal some interesting inherited traits.

McMahan, Harry and Gloria. Grandpa Was Quite A Boy. Mariposa Press. 1981.

The traits of Grandpa cause children to recognize the traits that they might have in common.

Parker, Steve. How The Body Works. Reader's Digest Association Inc.,

Pleasantville, NY, 1994.

Glossy pictures on every page invite children to ask and learn. Grade one to six will en joy various parts of this book.

Parker, Steve. How Nature Works. Random House. NY, 1992.

An encyclopedia on nature for young children that is big and colorful.

Reid, Struan and Patricia Fara. The Usborne Book of Scientists. Scholastic Books, N.Y.,1996.

Introduces students to many famous scientists and pictures allow varying degrees of difficulty to be met.

Rowan, James P., A New True Book Of Butterflies and Moths. Childrens Press. Danbury, CT. 1983.

A colorful and comprehensive study that is also fun to just look at.

Sabini, Francine. Human Body. Troll Associates, Mahwah, NJ, 1985

A small paperback that covers the basics in 30 pages.

Treimer, Margaret. Plant Life. Creative Teaching Press, Inc., Huntington Beach, Ca. 1987.

Lots of hands-on experiments to study cell growth through plant growth.

Wheeler, Sharon. Our Bodies. Creative Teaching Press, Inc., Huntington Beach, Ca. 1987.

A workbook to introduce the body written for Kindergarten-first grade.

Teacher Resources

Big Screen Microscope, Lakeside Learning Materials, Carson, Ca.

A group of children can take turns viewing objects on this eight inch screen.

Costs about $75.00.

Big View Magnifier. Lakeside Learning Materials, Carson, Ca.

A four inch lens is mounted securely to stand so that little hands can hold objects underneath. About $10.00.

Herkowitz, Joel. Double Talking Helix Blues, Cold Spring Harbor press. Plainview, NY, 1993

A colorful book accompanied by a cassette that sings the words to this book. The concepts are above first grade level but teachers can learn and inspire interest using this novel approach top a complicated subject.

I Made My own Microscope . Homecrafters Manufacturing Corp., Snellville, Ga., 1996.

An easy put-together microscope with ideas and worksheets for about $15.00.

Schmidt, F.X., A Reef of Colors: Can you Find Them? Readers Digest Assoc. Inc. Victoria House Publ. Ltd., 1993.

A puzzle that comes with magnifying glasses and encourages children to notice small markings and traits of sea animals.

Simple Microscope with Light. Lakeside Learning Materials, Carson, Ca.,

A 50x magnification presents a clear image for elementary students. An animal slide kit is also available. About $64.00.

(figure available in print form)

WORKSHEET A

WORKSHEETB

MICROSCOPE AND MAGNIFICATION ACTIVITIES

1. Basic observations and comparisons
Collect the following items and place them on the labeled circles found on worksheet A You can use a glue stick on each circle so that objects stay secured. Objects include an ant, bug, fly, yarn, hair, leaf, seed, sand, stone, pepper, bread crumbs, cereal, sugar, salt, and a dollar bill.
2. Write down the discoveries that most surprised you:
3. Did you see any colors that were not visible with just your eyes?Talk about the colors in pepper and sand.
4. What shapes did you discover?
Sale is _____
Sand is _____
Bread is _____

WORKSHEETC

FIGERPRINTING

Every person has a different fingerprint pattern. Scientists and police use these prints to identify people. The hospital does footprints of babies so that they can identify one baby from another. There are three groups of fingerprint patterns. They are the arch, loop and whorl.

ACTIVITIES

1. Study your pointer finger under the magnifying glass or a microscope. See if you can match it to one of these patterns.
(figure available in print form)
2. Use an ink pad to stamp the class fingerprints on a piece of paper. Blow up the prints on a copy machine to about 150% magnification. Discuss differences and sameness.

(figure available in print form)

WORKSHEET D

(figure available in print form)

WORKSHEET E