Beaker Creatures

Materials

- plastic bags
- beakers
- red DNA puzzle strips
- green m-RNA puzzle pieces
- blue amino acid puzzle pieces
- white trait puzzle pieces
- blank 8.5" x 11" white paper
- scissors
- glue stick

Procedures

1. Copy and laminate puzzle pieces in the colors listed on each puzzle piece page.
2. Place a complete set of red strips along with green, blue, and white puzzle pieces in a plastic bag, and place in a beaker. Distribute one beaker of puzzle pieces per group with a blank piece of paper.
3. Ask the students to sort the pieces according to color. Have them try to fit the red puzzle pieces to the green puzzle pieces.
4. After connecting all of the red and green puzzle pieces together, the students should then connect the blue puzzle pieces to the green pieces.
5. The last step will be to connect the white puzzle pieces to the blue pieces.
6. After the students have completed the initial puzzle and recorded their observations, allow the students to fit the white pieces together to form an imaginary organism called a "Beaker Creature". Then have them glue the pieces on their paper.

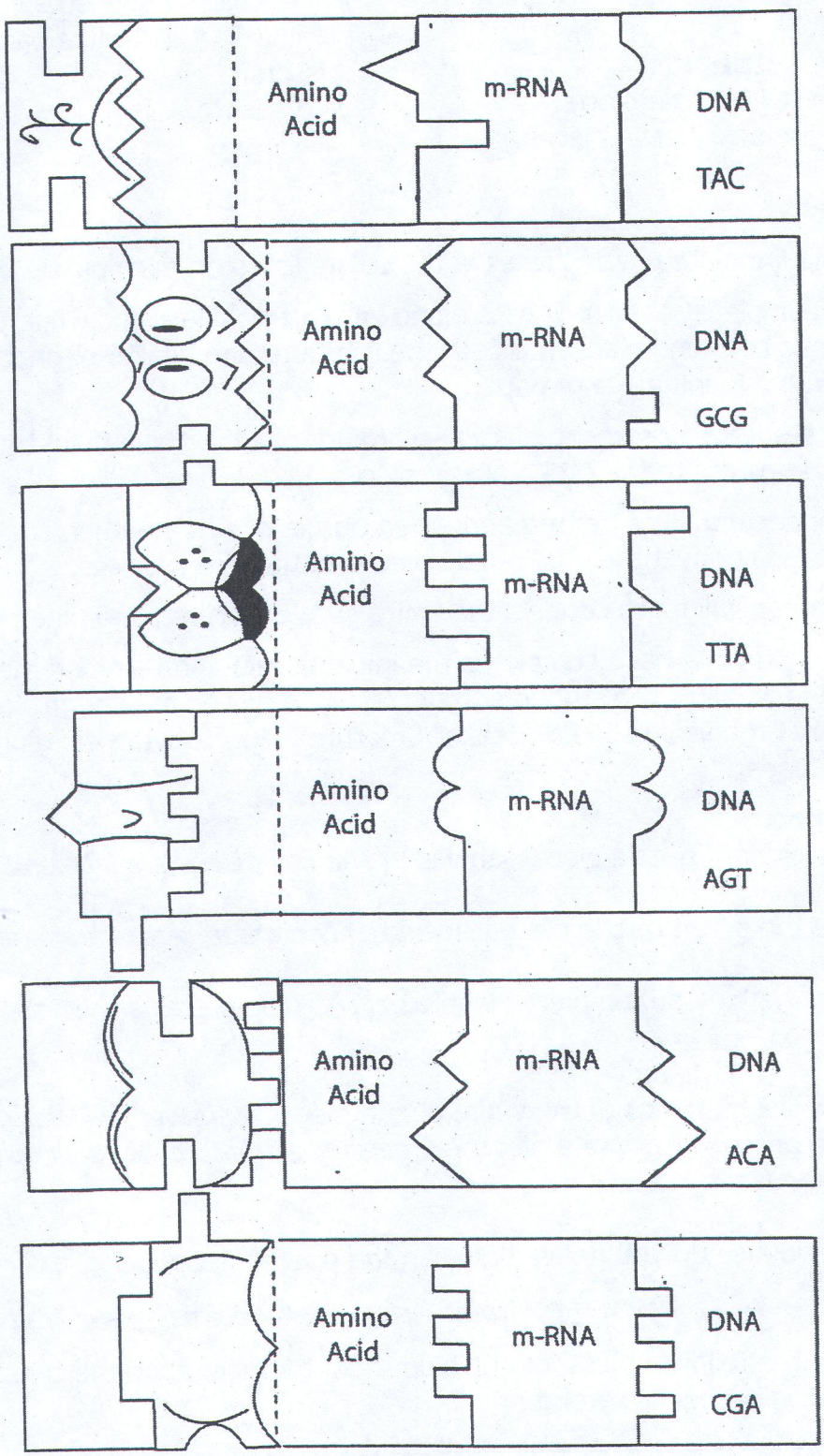
Observations

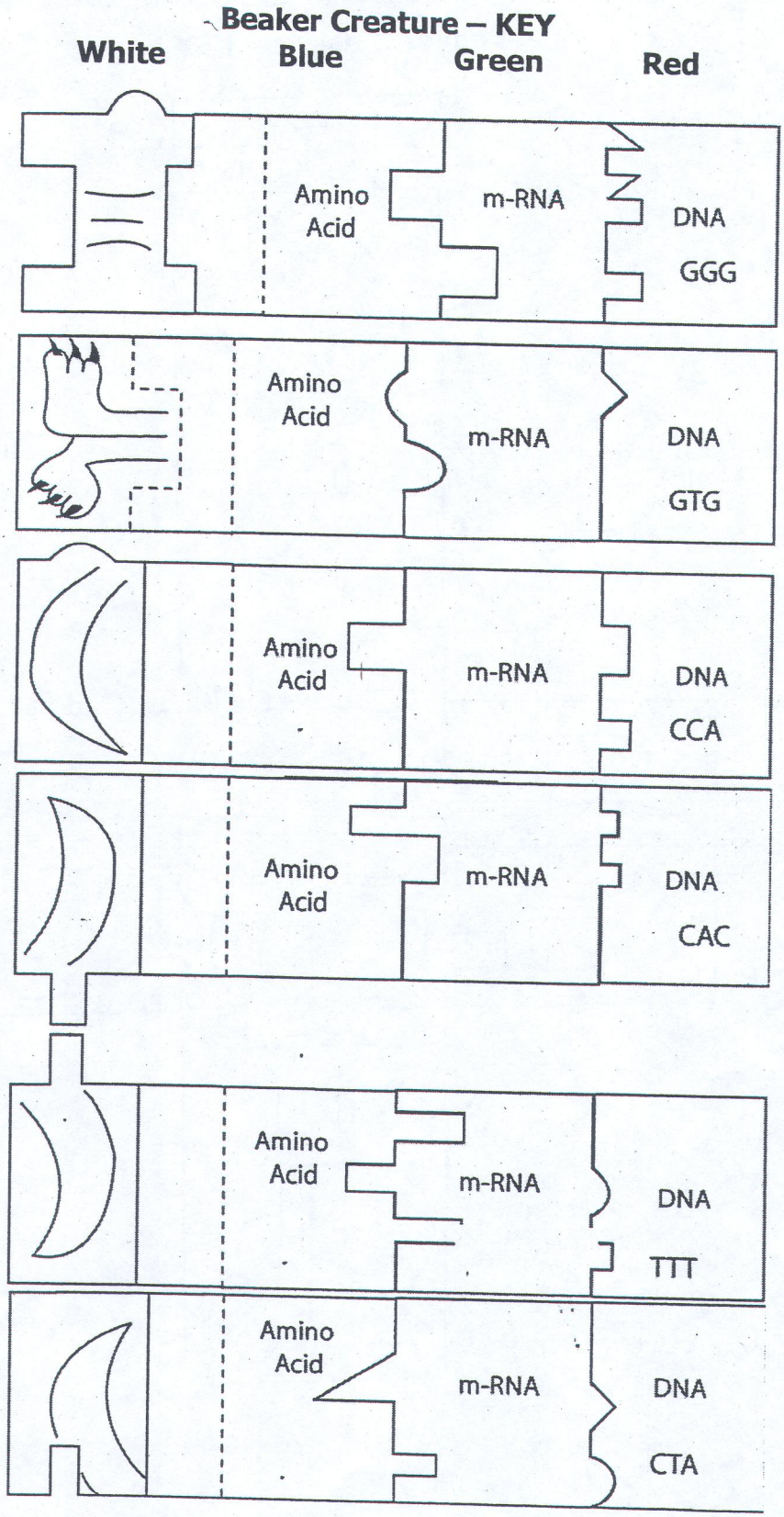
1. How are the red puzzle pieces labeled? *(The red pieces are labeled DNA.)*
2. How are the green puzzle pieces labeled? *(The green pieces are labeled m-RNA.)*
3. How are the blue puzzle pieces labeled? *(The blue pieces are labeled amino acids.)*
4. Describe the markings of the white puzzle pieces. *(answers will vary)* What label could be given to the white pieces? *(Features are also called traits, so they could be labeled traits.)*
5. What sequence do you notice between the puzzle pieces?

DNA → *m-RNA* → *Amino Acids* → *Proteins* → *Traits*

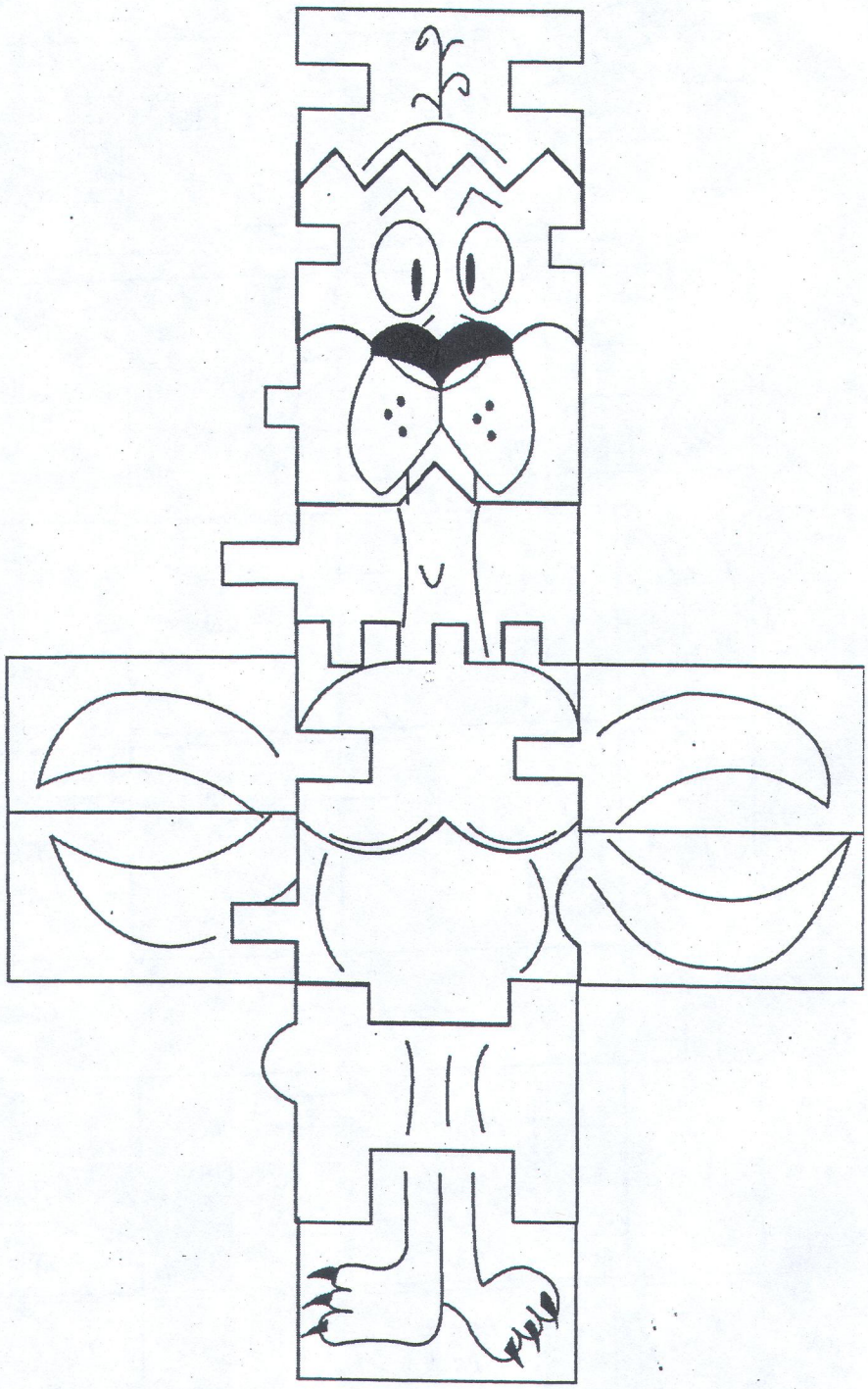
Explain that the following lessons will help them to understand the connections between these sequenced words.

Beaker Creature - KEY





Beaker Creature - KEY



Building a DNA Model

Materials for each group:

- strips of each of S ,P, C ,G, A, and T shape pieces in a plastic bag (each bag will need 8P, 6S, and 4 of each base)
- *shape Patterns are found separately on the following pages
- DNA Student Data Sheet
- scissors
- glue stick
- blank 8.5" x 11" paper

Procedures

1. Ask students to cut out the shape pieces on the strips in their bags. Encourage them to find ways that the pieces might fit together like a puzzle, and list the description of each model part on the data sheet.
2. Students should assemble the model, and glue it on the data sheet

As an extension of this activity, students may enjoy visiting these interactive DNA Websites.

Genetic Science Learning Center features an interactive "Build a DNA Molecule" that allows students to click and drag DNA parts to put them together.
http://gslc.genetics.utah.edu/units/basics/builddna/

Transcription and Translation in a DNA Molecule Animated, interactive
http://gslc.genetics.utah.edu/units/basics/transcribe/

Building a DNA Model- KEY

Procedures

1. Cut out the shape pieces on the strips of colored paper in the plastic bag. Find ways that the pieces might fit together like a puzzle.
2. List the description of each model part on the data sheet.
3. Assemble the model, and glue it on the blank 8.5 x 11 piece of paper

Use the table below to list the parts of the DNA model in the plastic bag.

Description of Piece	Part of DNA Molecule Represented
White, 2 parallel sides, labeled P	Phosphate
Orange, 1 straight side, labeled S	Deoxyribose Sugar
Yellow, labeled C	Cytosine
Green, labeled G	Guanine
Blue, labeled A	Adenine
Red, labeled T	Thymine

1. One nucleotide consists of one phosphate, one deoxyribose sugar, and one nitrogen base. Circle 4 nucleotides on your model, each with a different nitrogen base.
2. Label the names of the nitrogen bases that always pair together

Thymine= Red
Guanine= Green
Adenine= Blue
Cytosine= Yellow

The bases are joined by weak hydrogen bonds where they fit together.

3. Look at your DNA model. How does it give instructions to the cell? Notice the sequence of the nitrogen bases. The code is written in three letter "words" Write the triplet letter codes in your DNA model. How many are present?

   Triplets *(Answers will vary)*

4. Each triplet will code for an amino acid. How many amino acids will your model code for? (Answers will vary)

RNA and Protein Synthesis

DNA must stay in the nucleus, so another molecule, called RNA, or ribonucleic acid, carries the information in the base code out of the nucleus. RNA is similar to DNA, except that it has a different kind of sugar (ribose), and it has the nitrogen base uracil instead of thymine. Look at the base pairs below that compare DNA to RNA. A **purple** piece in the same shape as thymine will represent uracil in the RNA model.

DNA	**RNA**
A(blue) pairs with **T**(red)	**A**(blue) pairs with **U**(purple)

1. Why does uracil have to have the same shape as thymine? *(It bonds with Adenine, and the shapes have to match.)*

2. List the nitrogen bases of the m-RNA strand that would be formed from your model.

Transcription

The first step of protein synthesis is transcription. Transcribe means "to copy". During transcription, the genetic information code is copied into m-RNA. (Remember that in RNA, adenine pairs up with uracil.) m-RNA is known as "messenger" RNA, because it carries the DNA code or message to the ribosome so that proteins can be produced. The copied code in m-RNA will be used to make proteins during the translation stage of protein synthesis.

1. List the nitrogen bases of the m-RNA strand that would be formed from your DNA model. Place a red vertical line between every third nitrogen base listed in the strand. A series of 3 nitrogen bases (letters) makes up a codon that codes for a specific amino acid.

Translation

The second step of protein synthesis is translation. During translation, m-RNA attaches to a ribosome. Amino acids are transported to the ribosome by t-RNA, whose anticodons plug into the exposed codons of m-RNA.
m-RNA. At the beginning of each protein, a universal start codon, AUG, tells the ribosome to start translating. Three stop codons (UAA, UAG, and UGA) tell the ribosome to stop translating the protein.

mRNA Codons and Amino Acids

First Base	Second Base: U	Second Base: C	Second Base: A	Second Base: G	Third Base
U	UUU Phenylalanine UUC Phenylalanine UUA Leucine UUG Leucine	UCU Serine UCC Serine UCA Serine UCG Serine	UAU Tyrosine UAC Tyrosine UAA Stop UAG Stop	UGU Cysteine UGC Cysteine UGA Stop UGG Tryptophan	U C A G
C	CUU Leucine CUC Leucine CUA Leucine CUG Leucine	CCU Proline CCC Proline CCA Proline CCG Proline	CAU Histidine CAC Histidine CAA Glutamine CAG Glutamine	CGU Arginine CGC Arginine CGA Arginine CGG Arginine	U C A G
A	AUU Isolecuine AUC Isolecuine AUA Isolecuine AUG Methionine Start	ACU Threonine ACC Threonine ACA Threonine ACU Threonine	AAU Asparagine AAC Asparagine AAA Lysine AAG Lysine	AGU Serine AGC Serine AGA Arginine AGG Arginine	U C A G
G	GUU Valine GUC Valine GUA Valine GUG Valine	GCU Alanine GCC Alanine GCA Alanine GCG Alanine	GAU Asparatic acid GAC Asparatic acid GAA Glutamic acid GAG Glutamic acid	GGU Glycine GGC Glycine GGA Glycine GGG Glycine	U C A G

Decoding a Codon

To decode a sample codon, such as **UAC**, follow these steps:

1. Using the chart is similar to reading a sentence. Start on the left side of the chart, labeled "First Base." Find the first letter of the codon, which is U. Note that all of the codons in this row have a first base of U.

2. Look at the top of the chart, labeled "Second Base." Find the second letter of the codon at the top of the chart by moving across the row until you find the column labeled A. Note that all of the codons in this column have a second base of A.

3. Look at the right side of the chart, labeled "Third Base". Move down the Second base column until you get to the row of codons whose third base is C. The codon UAC codes for the amino acid called Tyrosine.

Revisiting Beaker Creatures- KEY

Materials

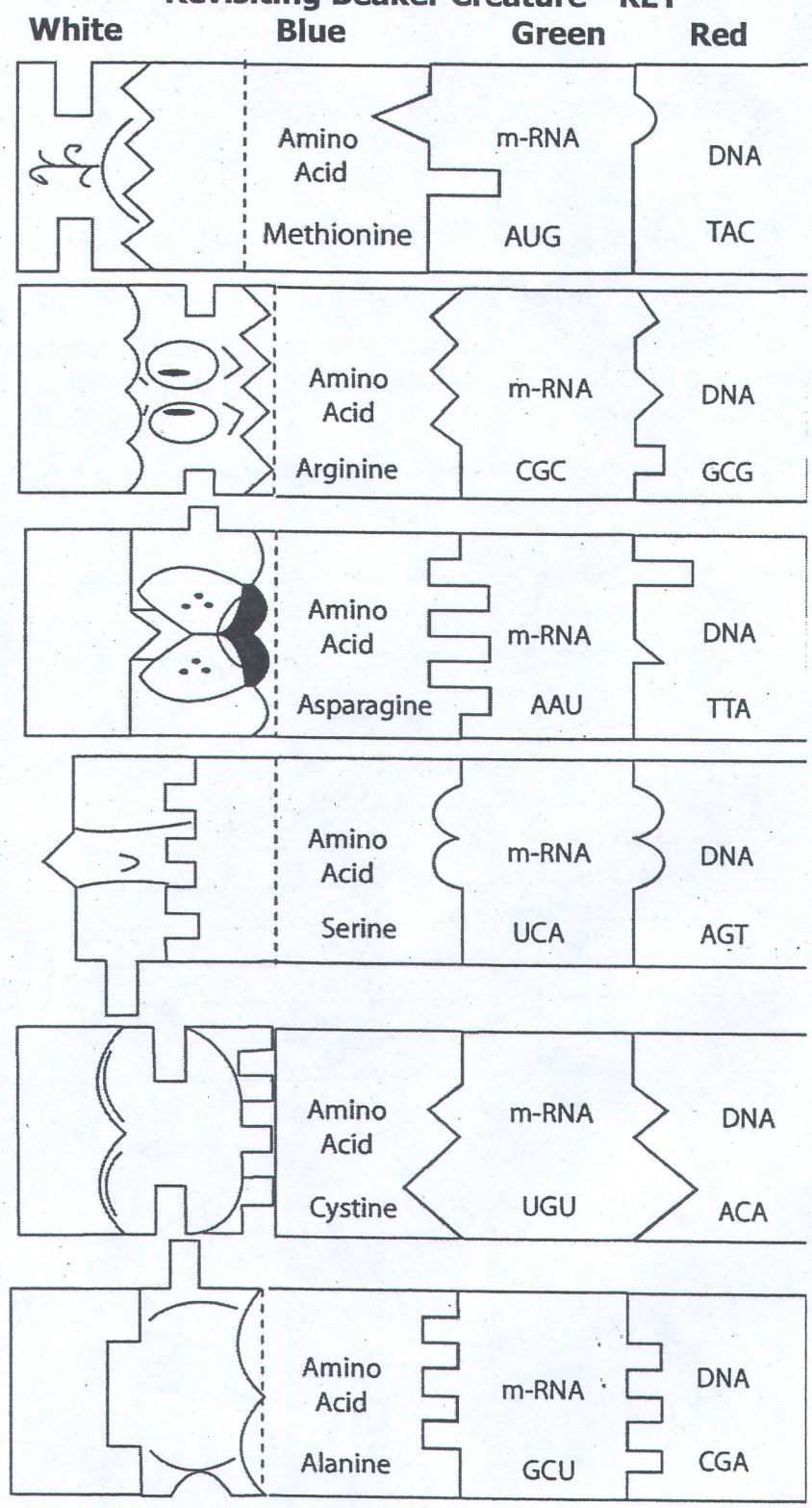
- Plastic bags containing puzzle pieces for DNA, m-RNA, Amino Acids and Traits

Procedures

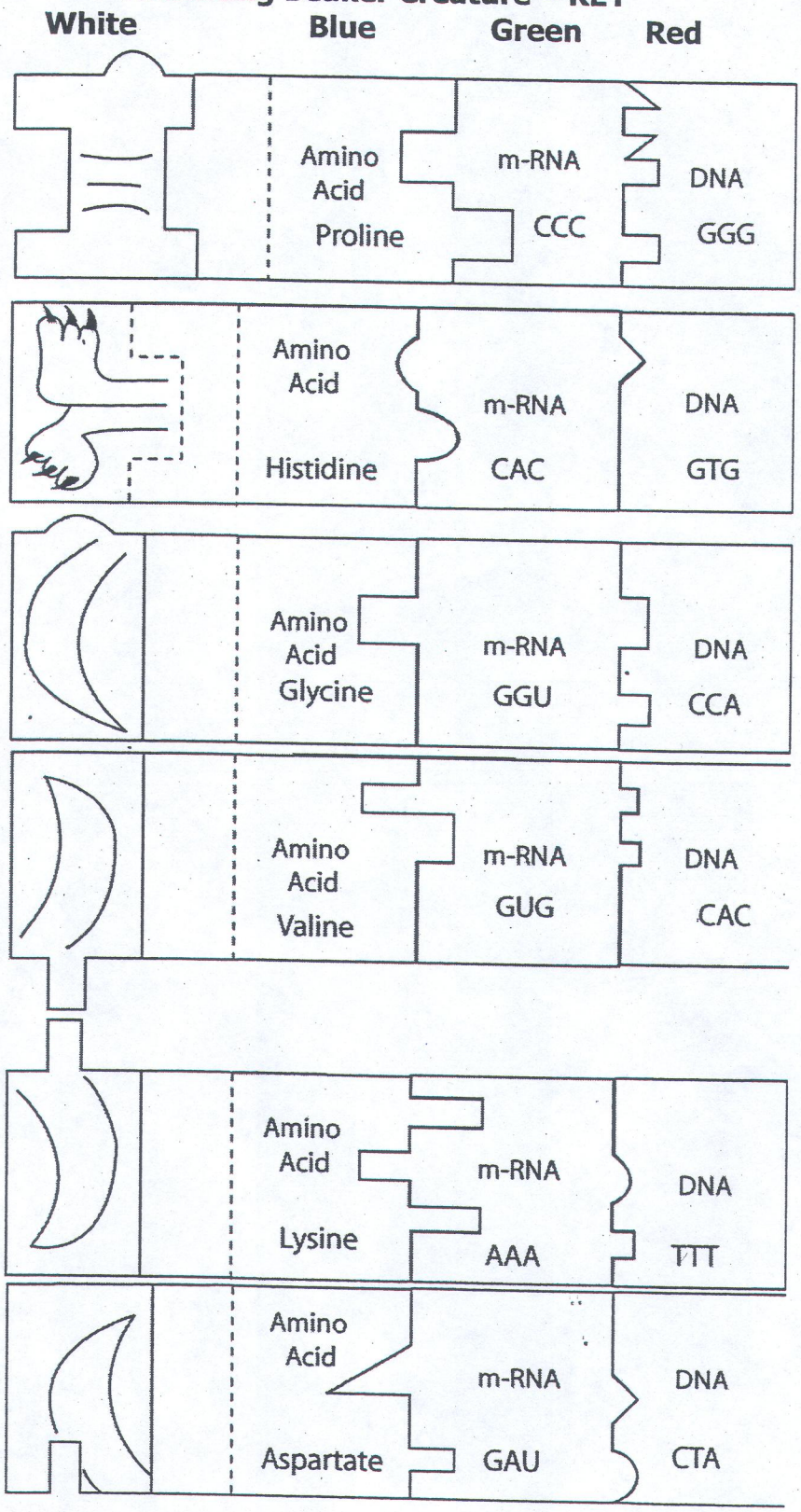
1. Take out the puzzle pieces, and group them again by color.
2. Look at the red DNA pieces, and note the triplet code on each piece.
3. Use your knowledge of DNA, RNA, transcription and translation to discover the amino acids coded for in the creature's DNA. Use the m-RNA codons and Amino Acid chart for help.
4. The amino acid sequence determines the proteins that will be formed, which is expressed as the phenotype or traits of the creature.

DNA	m-RNA	Amino Acid
TAC	AUG	Methionine
GCG	CGC	Arginine
TTA	AAU	Asparagine
AGT	UCA	Serine
ACA	UGU	Cystine
CGA	GCU	Alanine
GGG	CCC	Proline
GTG	CAC	Histidine
CCA	GGU	Glycine
CAC	GUG	Valine
TTT	AAA	Lysine
CTA	GAU	Asparatic

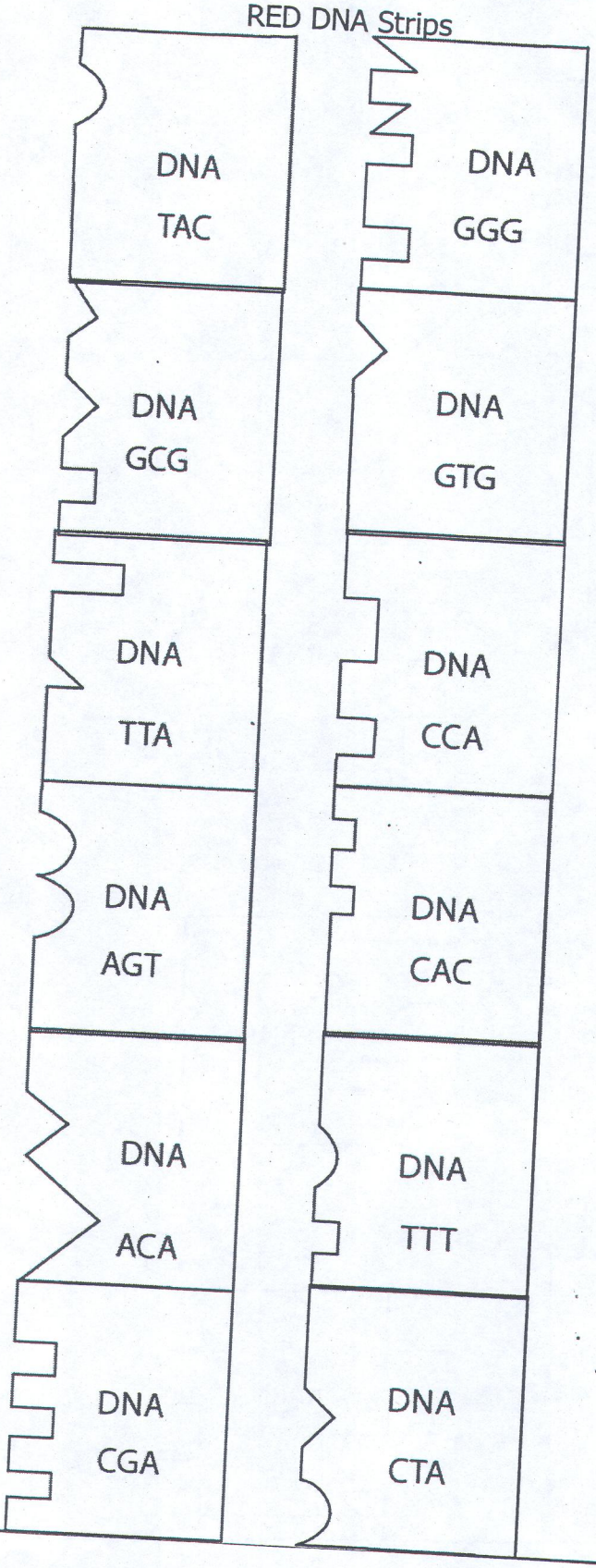
Revisiting Beaker Creature - KEY



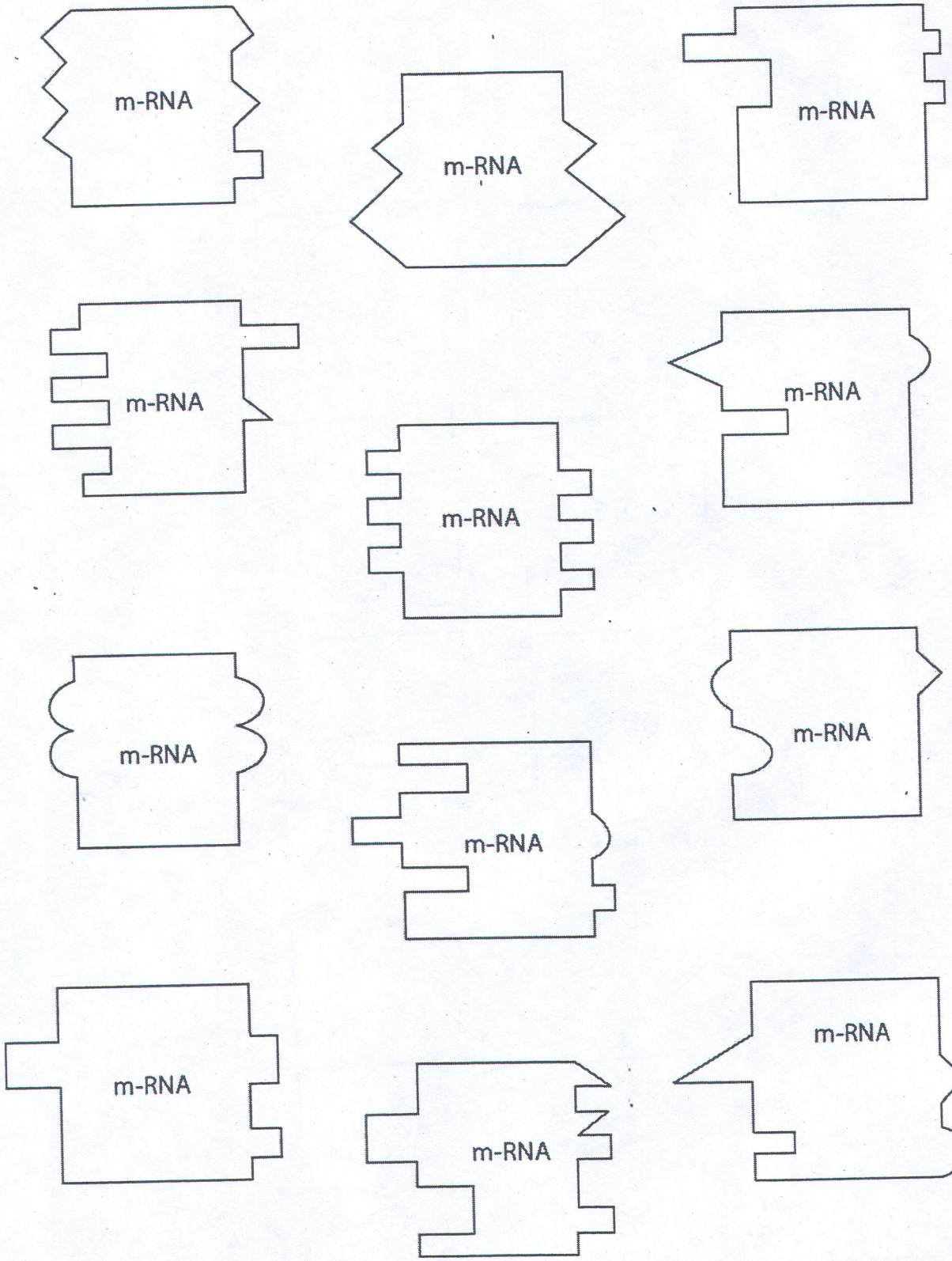
Revisiting Beaker Creature – KEY



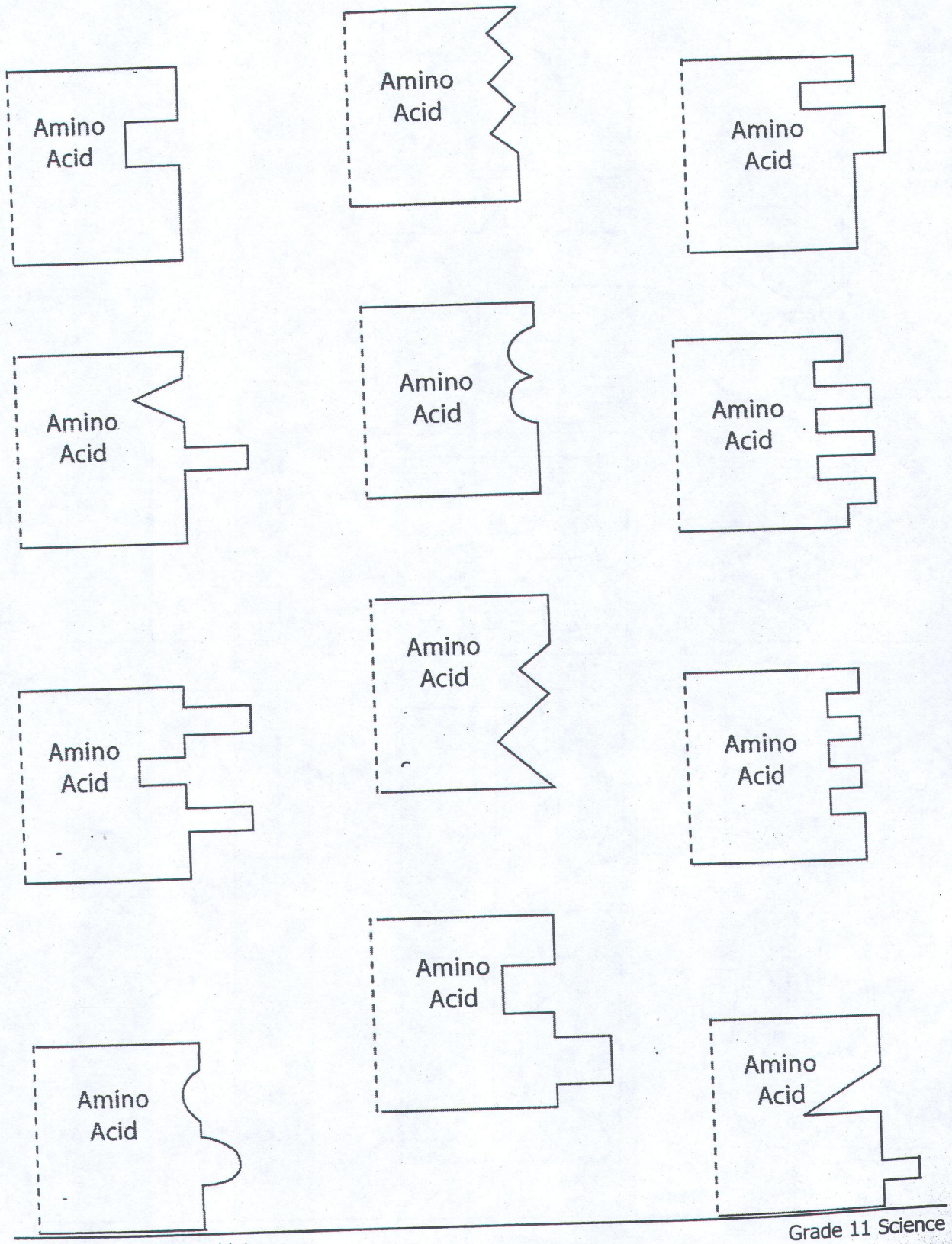
RED DNA Strips



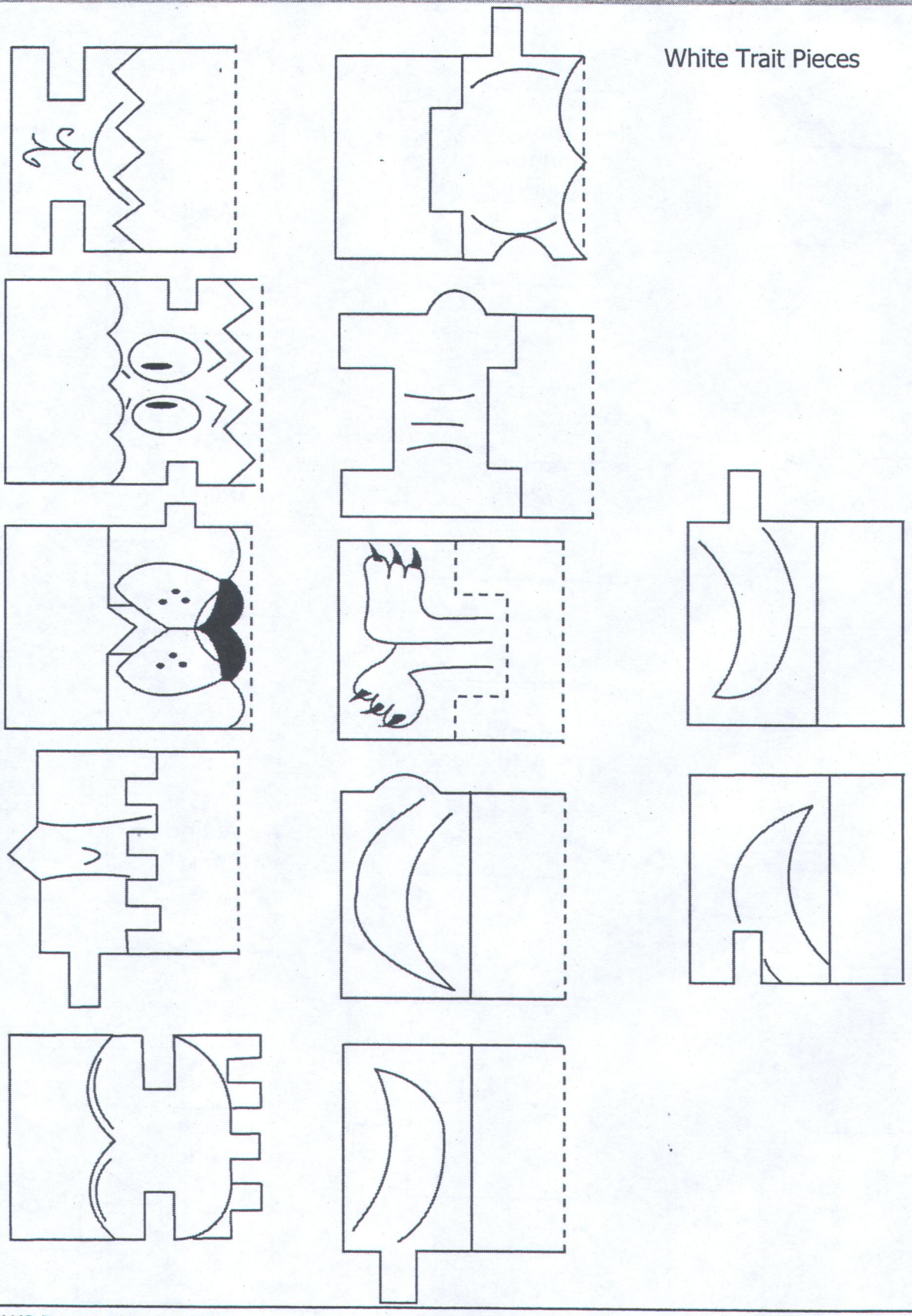
Green



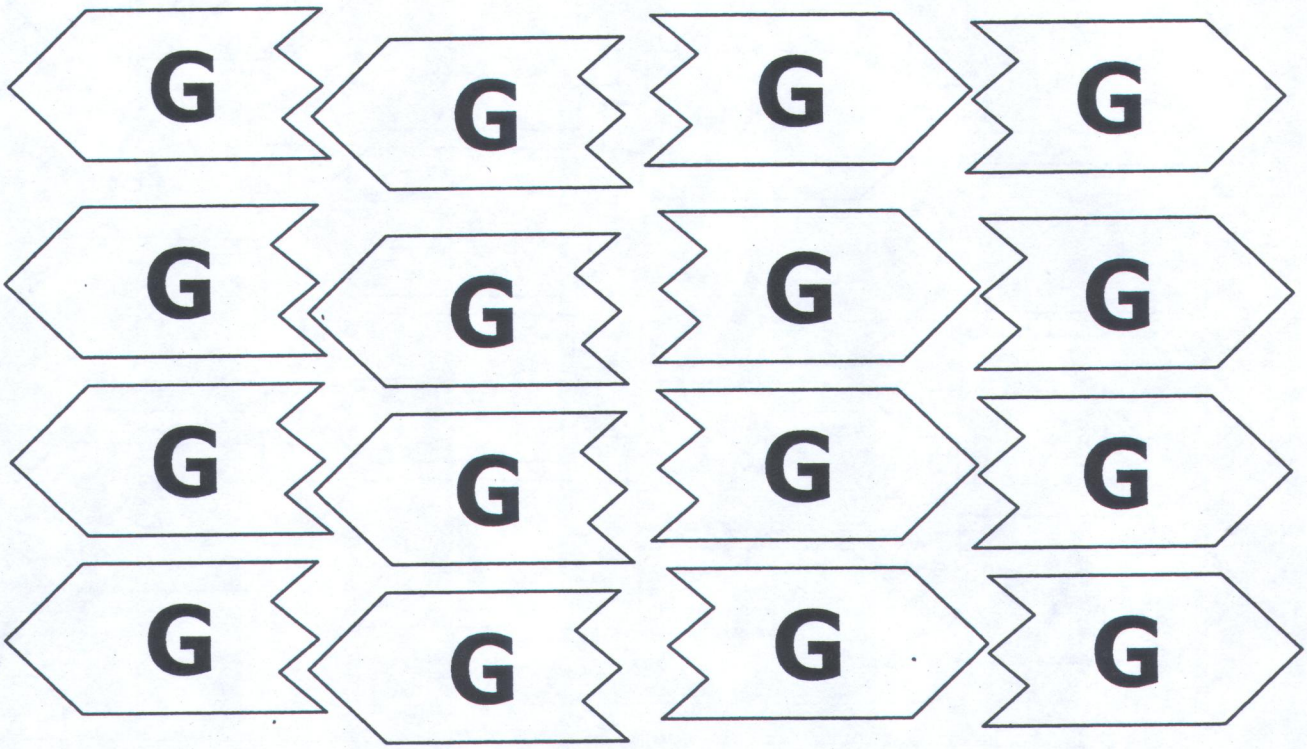
Blue



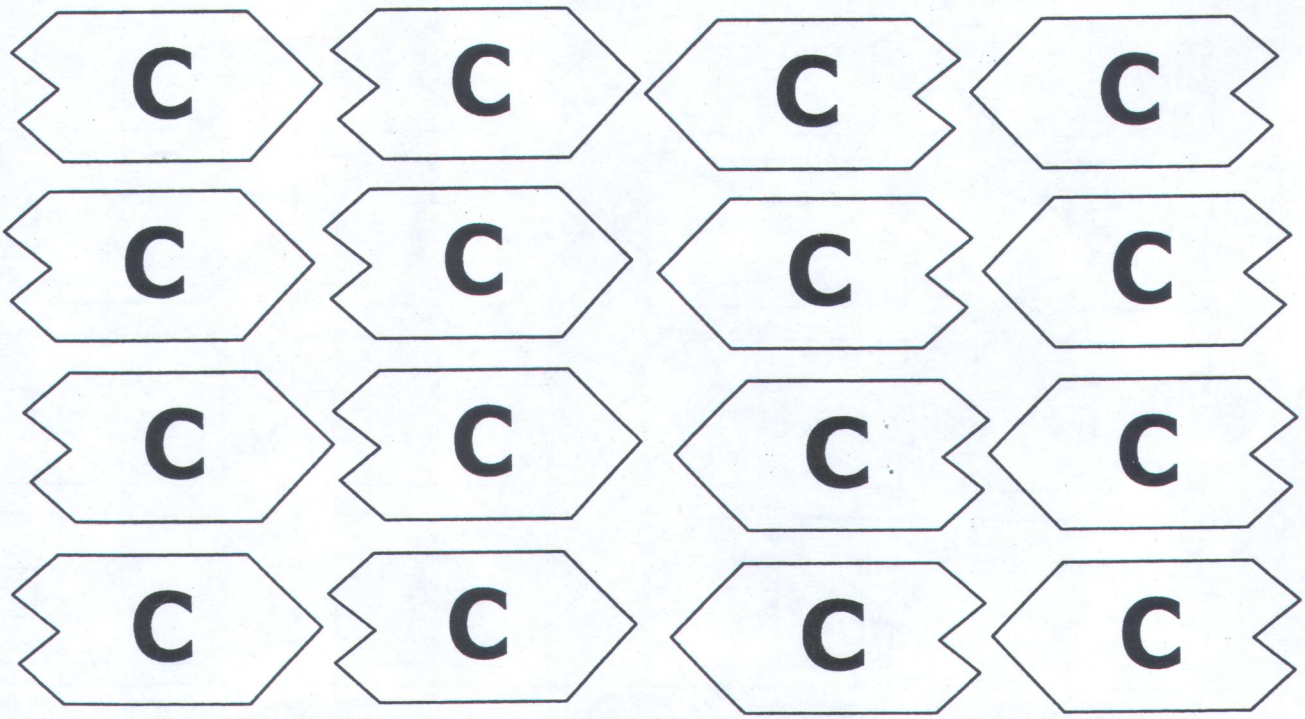
White Trait Pieces



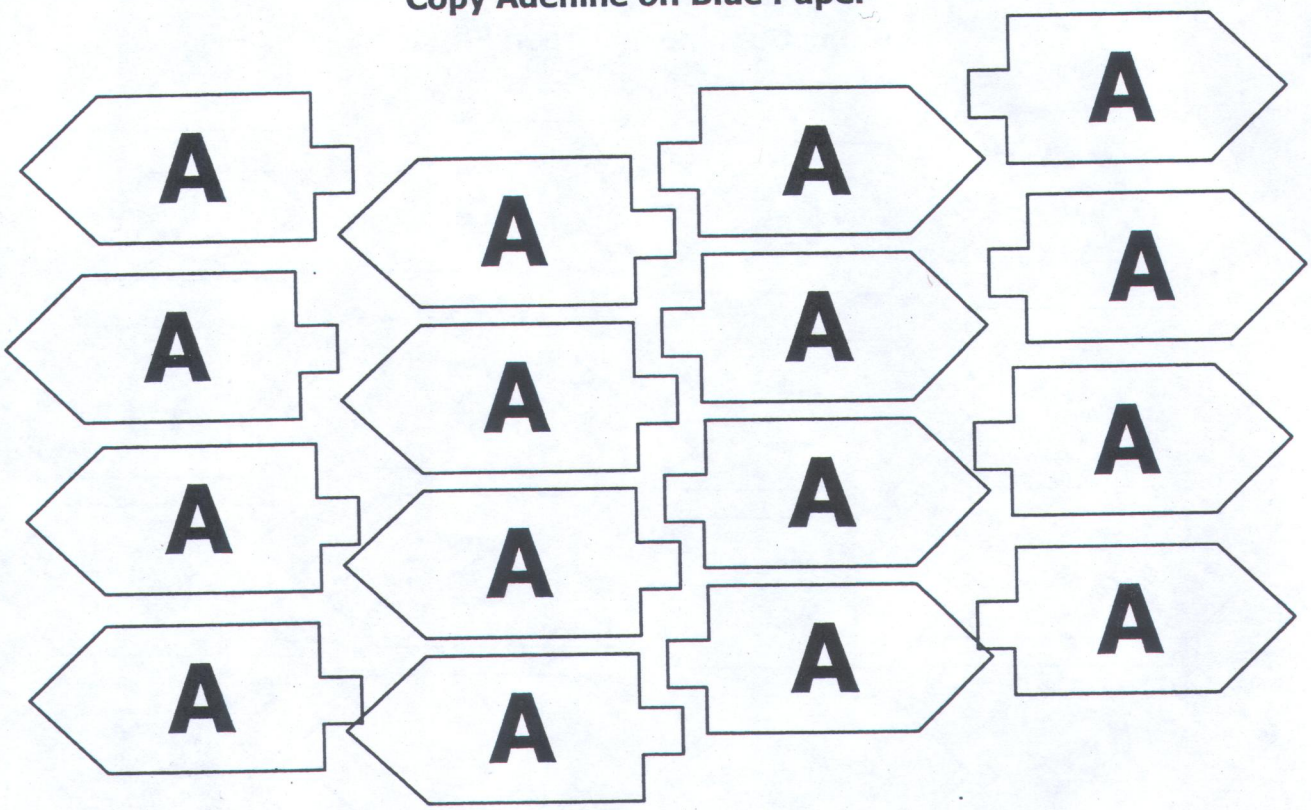
Copy Guanine on Green Paper



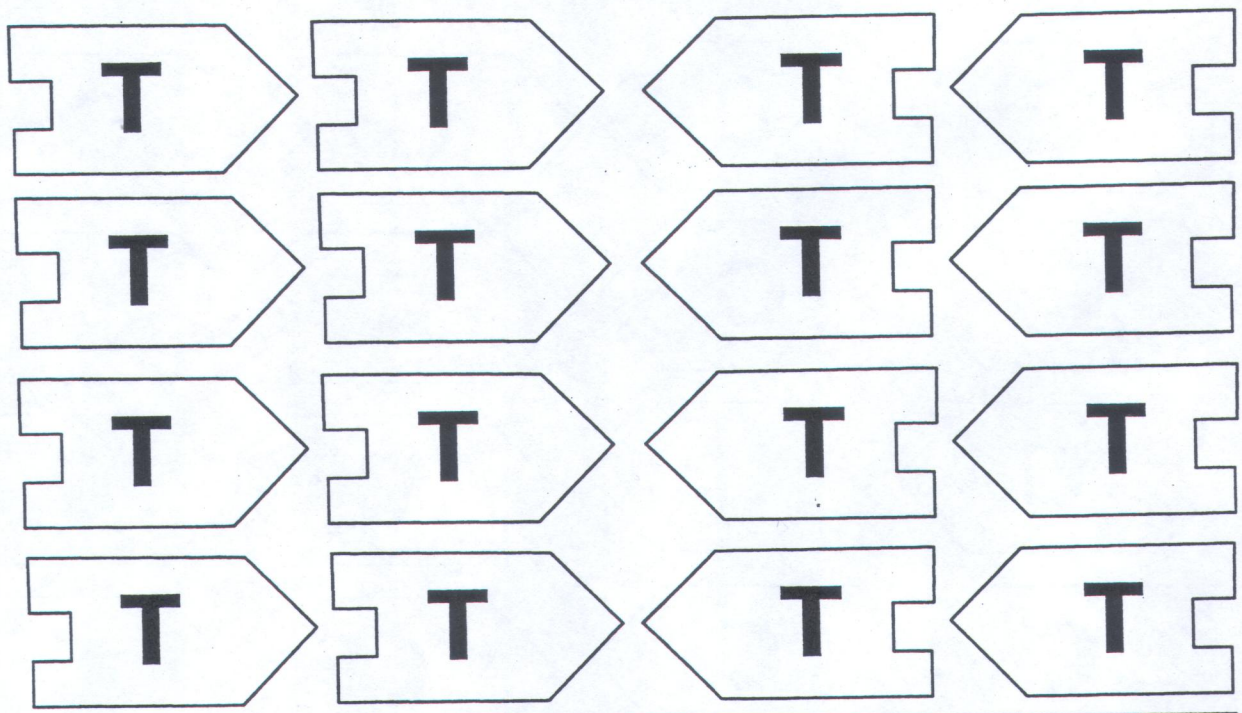
Copy Cytosine on Yellow Paper



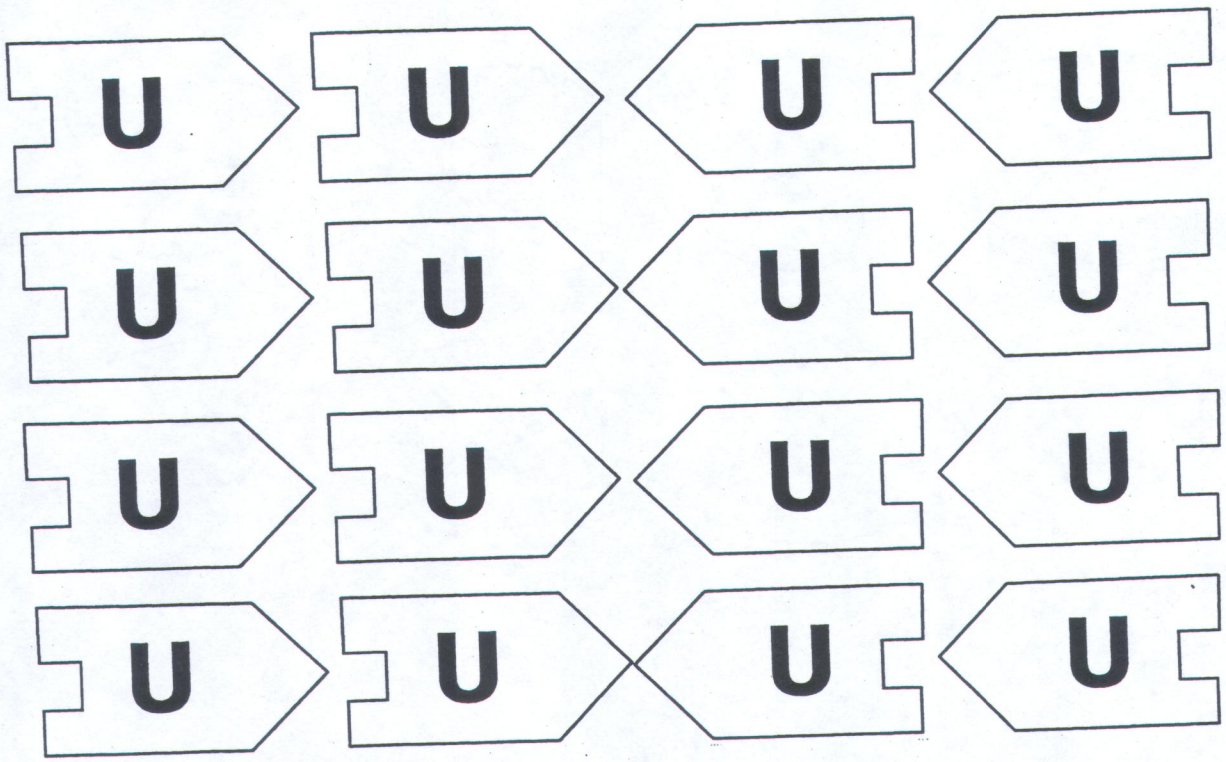
Copy Adenine on Blue Paper



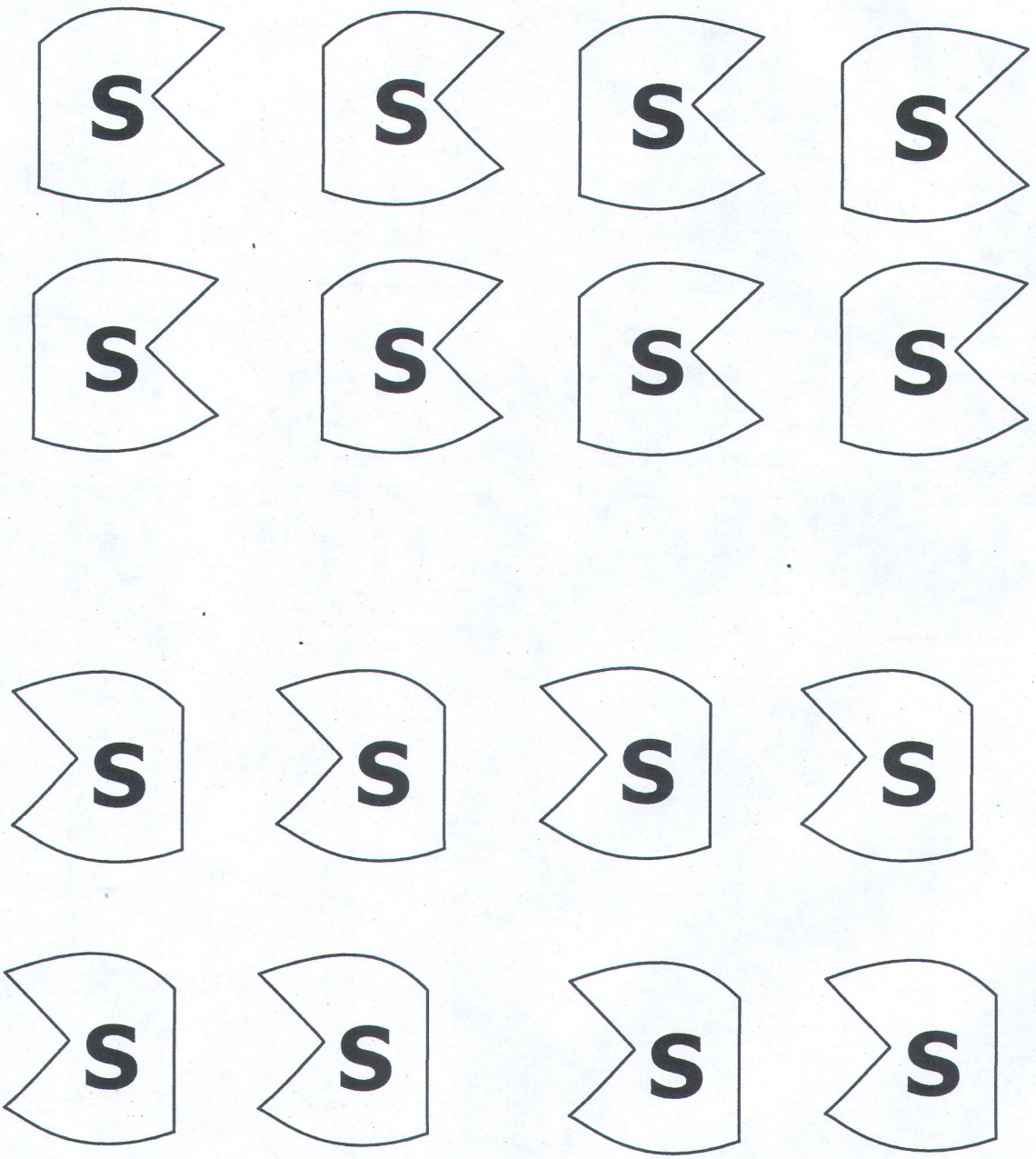
Copy Thymine on Red Paper



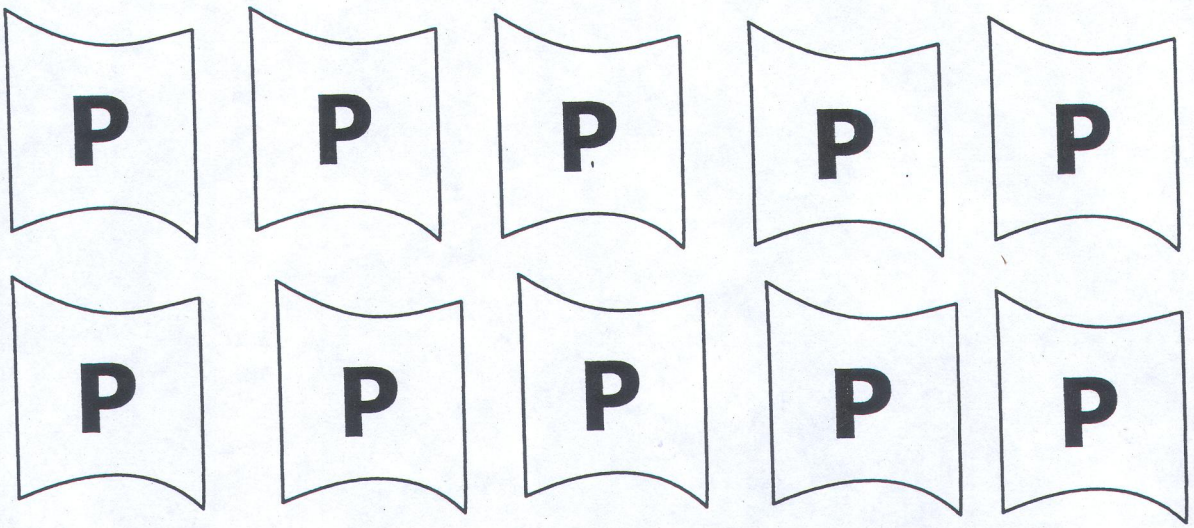
Copy Uracil on Purple Paper

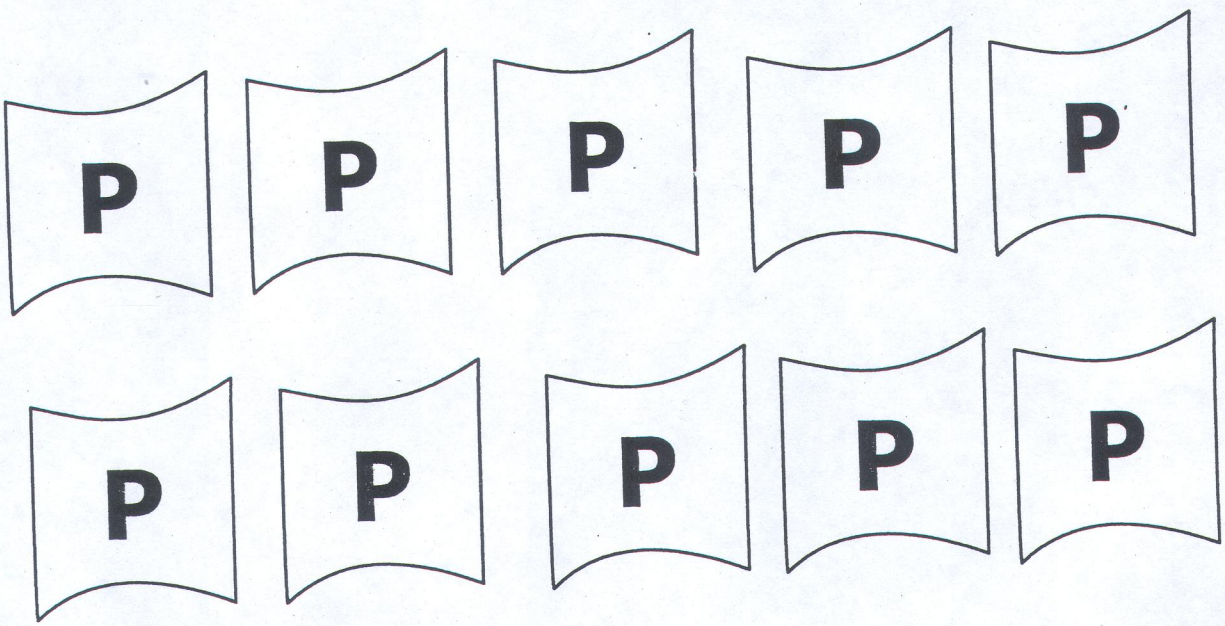


Copy Deoxyribose Sugars on Orange Paper



Copy Phosphates on White Paper





Lesson: Genetics

Name: _____ **Date:** _____

Beaker Creature

Materials

- plastic bags
- beakers
- red puzzle pieces
- green puzzle pieces
- blue puzzle pieces
- white puzzle pieces
- blank 8.5" x 11" white paper
- scissors
- glue stick

Procedures

1. Remove the pieces from the plastic bag, and sort them by color.
2. Try to fit the red puzzle pieces to the green puzzle pieces.
3. After connecting all of the red and green puzzle pieces together, connect the blue puzzle pieces to the green pieces.
4. Connect the white puzzle pieces to the blue pieces.
5. After completing your observations, try to fit the white pieces together to form an imaginary organism.

Observations

1. How are the red puzzle pieces labeled?
2. How are the green puzzle pieces labeled?
3. How are the blue puzzle pieces labeled?
4. Describe the markings of the white puzzle pieces. What label could be given to the white pieces?
5. What sequence do you notice between the puzzle pieces?

Building a DNA Model

Procedures

1. Cut out the shape pieces on the strips of colored paper in the plastic bag. Find ways that the pieces might fit together like a puzzle.
2. List the description of each model part on the data sheet.
3. Assemble the model, and glue it on the an 8.5" x 11" piece of paper

Use the table below to list the parts of the DNA model in the plastic bag.

Description of Piece	Part of DNA Molecule Represented
	Phosphate
	Deoxyribose Sugar
	Cytosine nitrogen base
	Guanine nitrogen base
	Adenine nitrogen base
	Thymine nitrogen base

4. One nucleotide consists of one phosphate, one deoxyribose sugar, and one nitrogen base. Circle 4 nucleotides on your model, each with a different nitrogen base.
5. Label the names of the nitrogen bases that always pair together, using the chart above if needed.

_____= Red pairs with _____= Blue
_____= Green pairs with _____= Yellow

6. Look at your DNA model. How does it give instructions to the cell? Notice the sequence of the nitrogen bases. The code is written in three letter "words" Write the triplet letter codes in your DNA model. How many are present?

   Triplets:
7. Each triplet will code for an amino acid. How many amino acids will your model code for?
8. If DNA needs to make a copy of itself, it can unzip, using enzymes to break its weak hydrogen bonds. It can also unzip to transcribe its message into m-RNA.

Name: _____ **Date:** _____

m-RNA -The Information Messenger

DNA must stay in the nucleus, so another molecule called RNA, or ribonucleic acid, carries the information in the base code out of the nucleus. RNA is similar to DNA, except that it has a different kind of sugar (ribose), and it has the nitrogen base uracil instead of thymine. Look at the base pairs below that compare DNA to RNA, A **purple** paper in the same shape as thymine will represent uracil in the RNA model.

DNA	**RNA**
A (blue) pairs with **T**(red)	**A** (blue) pairs with **U**(**purple**)

1. Why does Uracil have to have the same shape as thymine?

Transcription

Transcribe means "to copy", and during transcription, the genetic information code is copied into RNA. (Remember that in RNA, Adenine pairs up with Uracil.) There are two types of RNA, called m-RNA and t-RNA. m-RNA is also known as "messenger" RNA, because it carries the DNA code or message to the ribosome so that proteins can be produced. The copied code in RNA will be used to make proteins during the translation stage of protein synthesis.

2. List the nitrogen bases of the m-RNA strand that would be formed from your DNA model. Place a red vertical line between every third base listed in the strand. This models the sequence of "codons" in the m-RNA strand, making each codon into a three letter word that codes for a specific amino acid.

Name: _____ **Date:** _____

Translation

During translation, m-RNA attaches to a ribosome. Amino acids are transported to the m-RNA strand by t-RNA, whose anticodons plug into the exposed codons of m-RNA. At the beginning of each protein, a universal start codon, AUG, tells the ribosome to start translating. Three stop codons (UAA, UAG, and UGA) tell the ribosome to stop translating the protein.

mRNA Codons and Amino Acids

First Base	Second Base: U	Second Base: C	Second Base: A	Second Base: G	Third Base
U	UUU Phenylalanine UUC Phenylalanine UUA Leucine UUG Leucine	UCU Serine UCC Serine UCA Serine UCG Serine	UAU Tyrosine UAC Tyrosine UAA Stop UAG Stop	UGU Cysteine UGC Cysteine UGA Stop UGG Tryptophan	U C A G
C	CUU Leucine CUC Leucine CUA Leucine CUG Leucine	CCU Proline CCC Proline CCA Proline CCG Proline	CAU Histidine CAC Histidine CAA Glutamine CAG Glutamine	CGU Arginine CGC Arginine CGA Arginine CGG Arginine	U C A G
A	AUU Isolecuine AUC Isolecuine AUA Isolecuine AUG Methionine Start	ACU Threonine ACC Threonine ACA Threonine ACU Threonine	AAU Asparagine AAC Asparagine AAA Lysine AAG Lysine	AGU Serine AGC Serine AGA Arginine AGG Arginine	U C A G
G	GUU Valine GUC Valine GUA Valine GUG Valine	GCU Alanine GCC Alanine GCA Alanine GCG Alanine	GAU Asparatic acid GAC Asparatic acid GAA Glutamic acid GAG Glutamic acid	GGU Glycine GGC Glycine GGA Glycine GGG Glycine	U C A G

Decoding a Codon

To decode a sample codon, such as **UAC**, follow these steps:

1. Using the chart is similar to reading a sentence. Start on the left side of the chart, labeled "First Base." Find the first letter of the codon, which is U. Note that all of the codons in this row have a first base of U.

2. Look at the top of the chart, labeled "Second Base." Find the second letter of the codon at the top of the chart by moving across the row until you find the column labeled A. Note that all of the codons in this column have a second base of A.

3. Look at the right side of the chart, labeled "Third Base,". Move down the Second base column until you get to the row of codons whose third base is C. The codon UAC codes for the amino acid called Tyrosine.

Revisiting Beaker Creatures

Materials

- Plastic bags containing puzzle pieces for DNA, m-RNA, Amino Acids and Traits

Procedures

1. Take out the puzzle pieces, and group them again by color.
2. Look at the red DNA pieces, and note the triplet code on each piece.
3. Use your knowledge of DNA, RNA, transcription and translation to discover the amino acids coded for in the creature's DNA. Use the m-RNA codons and Amino Acid chart on the previous page for help.
4. The amino acid sequence determines the proteins that will be formed, which is expressed as the phenotype or traits of the creature.

DNA	m-RNA	Amino Acid