Curriculum Vitae (2023 August)

Jeffrey H. Thomas

Associate Professor Department of Cell Biology and Biochemistry School of Medicine Texas Tech University Health Sciences Center

Address:

Department of Cell Biology and Biochemistry Texas Tech University Health Sciences Center 3601 4th Street, STOP 6540 Lubbock, TX 79430 Phone: (806) 743-4219 FAX: (806) 743-2990 e-mail: Jeffrey.Thomas@ttuhsc.edu

Education and Training:

University of Virginia	B.A.	1989	Biology
Massachusetts Institute of Technology	Ph.D.	1997	Biology
Princeton University	Post-doc	1997-2004	
Northwestern University	Post-doc	2004	

Academic Appointments:

School of Medicine, TTUHSC: Assistant Professor, 2005-2019 Associate Professor, 2019-present Graduate School of Biomedical Sciences, TTUHSC: Cell and Molecular Biology, Primary Appointment, 2005-2014 Biochemistry and Molecular Genetics, Associate Appointment, 2005-2014 Biochemistry, Cell and Molecular Biology, Primary Appointment, 2015present Biotechnology, Joint Appointment, 2005-present

Fellowships:

Howard Hughes Medical Institute Predoctoral Fellowship, 1989-1994 National Institutes of Health Postdoctoral Fellowship, 1997-2002 Howard Hughes Medical Institute Postdoctoral Fellowship, 2002-2004

Honors:

Echols Scholar, 1985-1989 Intermediate Honors, 1987 Biological Honor Society of the University of Virginia, 1987 Golden Key Honor Society, 1988 Miller Scholarship, 1989 Phi Beta Kappa, 1989
Graduated with Highest Distinction (summa cum laude), 1989
Sigma Xi, The Scientific Research Honor Society, MIT Chapter, Associate Member, 1997
President of the Graduate Faculty, Elected, 2020-2021
Sigma Xi, The Scientific Research Honor Society, MIT Chapter, Elected to Full Membership, 2021

Awards:

Outstanding Faculty Mentor, TTU Center for Undergraduate Research, 2009 Nominated for Outstanding Faculty Mentor, TTU Center for Undergraduate Research, 2011

Unsung Hero Award, TTUHSC Dept. of Cell Biology and Biochemistry, 2014 Nominated for 17th International Royan Award in Embryology, 2016 Unsung Hero Award, TTUHSC Dept. of Cell Biology and Biochemistry, 2020 Dean's Teaching Award in Biomedical Sciences, 2023

Professional Society Memberships:

Sigma Xi Research Association, MIT Chapter (elected), 1997 - present American Association for the Advancement of Science, 2000 - present New York Academy of Sciences, 2000 - present Genetics Society of America, 2006 - present Society for Developmental Biology, 2009 - present

Professional Service, Editor:

Review Editor, Editorial Board of Morphogenesis and Patterning, Frontiers in Cell and Developmental Biology

Professional Service, Journal Reviewer (ad hoc):

Biomechanics and Modeling i

Wellcome Trust, London, United Kingdom, 2004. TTUHSC Seed Grants, 2010

Professional Service, Advisory

Institutional Biohazards Committee (IBC), ad hoc Advisor, Institutional, 2007-2008 Institutional Biosafety Committee (IBC), Institutional, 2008-2019. Genetics Advisor, for the IBC, NIH-required position, Institutional, 2008-2019. Summer Accelerated Biomedical Research (SABR) Program Steering Committee. School (GSBS), 2008-2009 Program Review Committee for the Evaluation of the Pharmacology and Neuroscience Graduate Program, School (GSBS), 2008-2009 Imaging Center Design Committee, Institutional, 2009-2011 Stem Cell Oversight Committee, Institutional, 2011-2015 Dean's Representative for Student Defense, School (GSBS), 2011 Genetics Curriculum Committee, 2011-present, School (SOM), 2011-2015 Selection Committee for the 2012 GSBS Outstanding Student Award and 2012 Dean's Recognition Award, 2012 Program Review Committee for the Evaluation of the Graduate Program, School (GSBS), 2012-2013 Biophysics Interviewer, Department of Physics, (TTU), 2013 Graduate School Admissions Committee, School (GSBS), 2013-2014 Graduate School Ph.D. Selection Committee, School (GSBS), 2015-2019 Cell and Molecular Biology Program Committee, School (GSBS), 2013-2015 Chair. 2013-2015 Curriculum and Course Evaluation and Awards Committee, School (GSBS), 2013-present Graduate Council, School (GSBS), 2013-present Graduate Student Stipend Committee, School (GSBS), 2013-present Advisory Committee for the Image Analysis Core (Institutional), 2013-2014 Hematology and Hematopoiesis Education Committee (SOM), 2013-2015 Biochemistry, Cell and Molecular Biology Faculty Evaluation Committee. (Departmon Co

Evaluation of GSBS External Review Committee Report, 2022 Evaluation of GSBS External Review Committee Report, 2022 Chair GSBS Course Evaluation Committee, 2022-present GSBS Department Chairs Quarterly Meeting, 2022-present

Academic Administration:

Graduate Advisor, Cell and Molecular Biology Concentration, School (GSBS),

GBTC 6301 Introduction to Biotechnology (3 hrs.), Fall 2008-2010 GSBS 5373 Core III: Genes (3 hrs.), Fall 2011-2019 GSBS 5373 Core III: Genes (5 hrs.), Fall 2020 GSBS 5373 Core III: Genes (8 hrs.), Fall 2021 GSBS 5373 Core III: Genes (8.5 hrs.), Fall 2022-present GANM 6620 Advanced Cell Biology I

Advisor, Post-doctoral Fellows: Ashish Chougule, Ph.D. (2014-2016) Namanh Buiphu, Ph.D. (2017-2020) Subhash Kairamkonda, Ph.D. (2018-2019)

Advisor, Graduate Students:

Taylor Strong, M.S. Cell and Molecular Biology, 2007, (Fall 2005-Summer 2007) Swetha Gadwala, M

Chris Upton, Summer 2005 [TTU] Sashanda Russell, SABR 2005 [Voorhees College] Spencer Thomas, Summer 2006 - Summer 2008 [TTU] Brian Friesen, SABR 2006, 2007 [Oklahoma Baptist University] Bilal Siddiqui, SABR 2008, 2009 [Harvard University] Allison Spencer, HHMI and McNair Scholar, Summer 2008-Spring 2010 [TTU] Sishir Subedi, HHMI Scholar, Summer 2009-Spring 2011 [TTU] Stephanie Pleasant, HHMI Scholar, Summer 2012-Spring 2012 [TTU] Ryan Dean, Honors College, HHMI Scholar, Spring 2013-Summer 2014 [TTU] Victoria Young, SABR 2013 [TTU] Joe Bargo, 2014 [TTU] Alex Sanders, SABR 2014 [University of Central Arkansas] Jun Park, SABR 2019 [Cornell University] Jacob Moore, SABR 2021 [University of Texas, Austin] Hailey Hawkins, SABR 2022 [University of San Angelo] Satish Banjara, 2022 [University of Texas, Austin]

Advisor, High School Students - Research:

Henderson, 2011-2014 Souvik Karmarkar, Ph.D. 2014, Advisor: Afzal Siddigui, 2012-2014 Souvik Karmarkar, Qualifying Examination Committee, Advisor: Afzal Siddigui, 2013 Brad Youngblood, Ph.D. 2014, Advisor: Clinton MacDonald, 2012-2014 Brad Youngblood, Qualifying Examination Committee, Advisor: Clinton MacDonald, 2013 Jessica Smith, Ph.D., 2018, Advisor: Brandt Schneider, 2014-2018 Michael C. Holcomb, Ph.D. 2019 [TTU Physics], Advisor: Jerzy Blawzdziewicz 2017-2019 Hunter Edwards, Ph.D. Candidate [TTU Mechanical Engineering], 2017-2019 Mahsa Servati, M.S. 2018, [TTU Physics], Advisor: Jerzy Blawzdziewicz 2017-2018 F.6601.(7."06.'2(X9[-[2(?@?@2(Y//*+\$6\$>'("+,(O\$6.5*6"%(O15%\$#1\$6\$>'2(((4, E10\$%0(W"16(G\$%+H"662(4#,*6(I"/\$\$,2(?@AUC?@?@[(39"H+(O"59"2(X9) - [2(X9) - [(G"+.1, "&.2(4, E10\$)(X"&)]5J(8, '+\$6, 02(?@?AC?@??(8., $H''+(16$'2(X9[-[(]*'6<'1+>(NL''/1+''41$+(G$/'14...(^))=(O.59''+15''6($

 $(N+>l+..\%l+>_2(4, E10\%)(^.\%a'(76''Ha, a1, H15a2(?@??)(Alexis Rodriguez, Ph.D. Candidate, Advisor: Jannette Dufour, Summer 2023-present$

present

Other Educational:

QEP Case Facilitator, Interprofessional Teamwork Symposium, October 25, 2013 TTUHSC Student Research Week Judge, 2012

TTU Undergraduate Research Conference, Judge, 2012

TTUHSC Special Student Research Week Judge for Confidential Research, 2022 Panelist for GSBS CV (

* Co-first authors

Jeffrey H. Thomas and <u>H. Robert Horvitz</u>. (1999). The *C. elegans* gene *lin-36* acts cell autonomously in the *lin-35 Rb*

Thomas, J.H. and H.R. Horvitz (1996). Lineage analysis of synthetic Multivulva genes. East Coast *C. elegans* Meeting, Piscataway, NJ.

Lu, W.X., J.H. Thomas, and H.R. Horvitz (1997). Molecular analyses of the class B synthetic Multivulva genes *lin-37*, *lin-35* and *lin-53*. International *C. elegans* Meeting, Madison, WI.

Thomas, J.H. and E. Wieschaus (1999). Loci controlling cephalic furrow formation. Annual Drosophila Research Conference 40, Seattle, WA.

Thomas, J.H. and E. Wieschaus (2000). Loci controlling cephalic furrow formation. Annual Drosophila Research Conference 41, Pittsburg, PA.

Thomas, J.H. and E.F. Wieschaus (2000). Genes controlling an epithelial invagination in Drosophila embryos. Molec. Biol. Cell 11 (Suppl.): 514a. 40th American Society for Cell Biology Annual Meeting, San Francisco, CA.

Hoang, R., T. Blankenship, J. Grosshans, P. Sung, J. Thomas and E. Wieschaus (2001). An ectopic expression approach to gastrulation. Annual Drosophila Research Conference 42, Washington, DC.

Thomas, J.H. and E. Wieschaus (2001). Genes controlling cephalic furrow formation in the Drosophila embryo, Annual Drosophila Research Conference 42, Washington, DC.

Thomas, J.H. and E. Wieschaus (2002). Analysis of a gene controlling cephalic furrow formation. Annual Drosophila Research Conference 43, San Diego, CA.

Thomas, J.H. and E. Wieschaus (2003). *src64* involvement in cellularization. Annual Drosophila Research Conference 44, Chicago, IL.

Thomas, J.H., K. Ng and E. Wieschaus (2005). Genes that control Drosophila cephalic furrow invagination. Morphogenesis and Regenerative Medicine Symposium, Charlottesville, VA.

Strong, T.C. and J.H. Thomas (2007). A Molecular Analysis of *src64* and its impact on cytoskeletal organization in the Drosophila embryo. Annual TTUHSC Student Research Week 19, Lubbock, TX.

Strong, T.C. and J.H. Thomas (2007). A molecular analysis of *Src64* during cellularization. Annual Drosophila Research Conference 48, Philadelphia, PA.

Thomas, J.H., T.C. Strong, R. Rosales and S. Thomas (2007). Drosophila Src64 and the cytoskeleton. Texas Tech Cancer Research Symposium, Lubbock, TX.

8/30/23

Curricu

Carter, T.Y., S. Gadwala, N. Cormier and J.H. Thomas (2010). src64 signaling i

Chougule, A.B., R. Rosales and **J.H. Thomas** (2011). Regulation of actomyosin contraction by Src64 through Rok and MLCK during cellularization. TTUHSC Annual Cancer Symposium, Amarillo, TX.

Thomas, J.H., R. Rosales and A.B. Chougule (2011). Src64 regulates myosin regulatory light chain during basal closure of the Drosophila cellular blastoderm. Society for Develo

Chougule, A.B., M.C. Hastert, R. Rosales, J.H. Thomas (2014). Regulation of actomyosin dynamics by Rho kinase and myosin light chain kinases during Drosophila cellularization. Annual TTUHSC Student Research Week 26, Lubbock, TX., March 2014.

Thomas, J.H., A. Spencer, A. and B. Siddiqui (2014). Formation of the cephalic furrow during Drosophila gastrulation. Society of Developmental Biology 73rd Annual Meeting, University of Washington, Seattle, WA.

Holcomb, M., G-J. Gao, J. Thomas and J. Blawzdziewicz (2016). Embryo as an active granular fluid: stress-coordinated cellular constriction chains. 69th Annual Meeting of the APS Division of Fluid Dynamics. Portland, Oregon. November, 2016. *Abstract published in *Bulletin of the American Physical Society*, 61: 20, D30.00002.

Blawzdziewicz, J., G-J. Gao, M.

Blawzdziewicz J, Holcomb MC, Gao GJJ, Servati M, Schneider D, Presley Mcneely P, Thomas JH (2019). Mechanical Feedback during Ventral Furrow Formation in the Drosophila embryo: Intercellular Coordina Thomas, J.H. and E. Wiescha

Gadwala, S. and J.H. Thomas (2008). Role of tyrosine phosphorylated proteins in Drosophila embryo development. Annual TTUHSC Student Research Week 20, Lubbock, TX.

Carter, T.Y., N. Cormier and J.H. Thomas (2009). Src64 signaling pathway during Drosophila cellularization. Annual TTUHSC Student Research Week 21, Lubbock, TX. *Award: 2nd Place, Senior Ph.D. Student Division, Institutional.

Spencer, A.K. and **J.H. Thomas** (2009) Visualizing the cephalic furrow formation during Drosophila gastrulation. Annual TTUHSC Student Research Week 21, Lubbock, TX.

Roh, J., H. Singh, A. Tarpara, M. Yim, Q. Zaidi, and **J.H. Thomas** (2010). Implementation of mobile clinic program in overcoming barriers to health care for treating Type II Diabetics in rural west Texas. School of Medicine Population Health Project EXPO, Lubbock, TX.

Thomas, J.H., Spencer, A.K., Siddiqui, B. and S. Subedi (2010). Multiple morphogenetic processes drive Drosophila cephalic furrow infolding. Society for Developmental Biology 2010 Southwest Regional Meeting, Austin, TX.

Subedi, S. and J.H. Thomas (2010). A study of the *ImpE1* gene and its role in cephalic furrow formation in the Drosophila embryo. UNTHSC Undergraduate Research Symposium, Fort Worth, TX. * Award: 3rd Place, UNTHSC Undergraduate Research Symposium Award

Thomas, J.H., T.C. Strong, G. Kaur and J. Lee (2010). Role of the catalytic loop HRD mo

Chougule, A.B., R. Rosales and **J.H. Thomas** (2011). Regulation of actomyosin contraction by Src64 through Rok and MLCK during cellularization. TTUHSC Annual Cancer Sympo

Coordination and Robustness. Meeting of the Texas Section of the American Physical Society, AAPT and Zone 13 of the Society of Physics Students. Richardson, Texas. October, 2017.

Blawzdziewicz, J., Gao, G-J., Holcomb, M., and Thomas, J. H. (2017). Stochastic Phase of Ventral Furrow Formation in Drosophila Embryo: Cellular Constriction Chains, Mechanical Feedback and Robustness. American Physical Society Physics Meeting. New Orleans, Louisiana. March, 2017.

Servati, M., Blawzdziewicz, J. and Thomas, J. (2018). Exploring Cellular Constriction Chain Dynamics in the Drosophila Embryo. American Physical Society Physics Meeting. Los Angeles, California. March, 2018.

Servati, M., Holcomb, M.C., Gao, G-J.J., Schneider, D., Blawzdziewicz, J. and **Thomas, J.H.** (2018). Exploring Cellular Constriction Chain Dynamics in the Drosophila Embryo. Annual Graduate Student Poster Competition. Los Angeles, California. March, 2018.

Sharma, K., Y. Ming, A.B. Chougule, P. Liaw, S. Yanofsky, S. Ungashe, J.H. Thomas, W. Garland, F. McCormick, M. Holderfield (2018). KRAS and Metabolism: An Interesting Interplay. Targeting RAS-Driven Cancers Meeting. American Association for Cancer Research December, 2018.

Bui, A.P.N., T.Y. Carter, J.H. Thomas

Synthetic Multivulva Genes, East Coast *C. elegans* Meeting, Johns Hopkins University, Baltimore, MD, June, 1994.

Src64 regulates myosin regulatory light chain during basal closure of the Drosophila cellular blastoderm. Selected Short Talk: Society for Developmental Biology 70th Annual Meeting, Chicago, IL, July 23, 2011.

Cellular Morphogenesis in the Drosophila Embryo. Invited Speaker: Texas Institute for Environmental and Human Health, Lubbock, TX, April 16, 2012.

Identification of targets of a Drosophila homologue of *src*, a gene involved in breast cancer. Laura W. Bush Institute for Women's Health: Gender Specific Women's Health Conference, Lubbock, TX. October 3, 2012.

Developmental Biology and Genetics, GSBS Retreat, Lubbock, TX, September, 2013.

Regulation of Actin Organization and Myosin Activity in the Drosophila Embryo. Invited Speaker, Department of Immunology and Molecular Microbiology2().L"0().59(=+1E.01(I."09(351.+5.0(G.+1.), Lubbock, TX, April 9, 2014

Overview of Recent Developments and Findings in Drosophila Research. Invited Speaker, Tosk, Inc., Sunnyvale, CA, July 29, 2014.

Update on Fly Research in the Thomas Laboratory at Texas Tech. Invited Speaker, Tosk, Inc., Sunnyvale, CA, July 29, 2014.

Cell Shape Change and the Generation of Embryonic Structure. Invited Speaker, Department of Immunology and Molecular Microbiology, Texas Tech University Health Sciences Center, Lubbock, TX, October, 2016

Developing Screens for Other Oncogenic KRAS Mutants. Invited Speaker, Tosk, Inc., Sunnyvale, CA, August 7, 2018.

Flies and Oncogenes. Invited Speaker, Depar

) 9. (#1\$K9 '015"6(/ .59"+10 / (\$<(0.6.5&1E.(5"+5.%(&%."& / .+&(*01+>(6\$HC1+&.+01&'(*6&%"0\$*+,(8\$6.0(G\$CY+E.0&1>"&\$%(:Uh(.<<\$%);(

(

(

(

(

(

(

(

(

```
 \begin{array}{l} GX 8 Y ) C(W \% " + \&(( \\ ) & 8 NGCX3 4 (: ! 1*;( \\ 4 ( <. "01 \# 161\&' ( 0\&*, ' ( $<( 0.6.5\&1E.( 5"+5.\%( "#6"\&1$+( 1+( "( 0$61,( \&* / $\%( / $,.6( *01+>( *6\&\% "0$*+,C1+,*5.,( \%.0$+"+5.0(4(#1$ / .59"+15"6(0\&\% "\&.>' (<$\%(5"+5.\%(\&\% ."\& / .+\&( 8$6.0(G$66"#$\% "\&\% PG$+0*6\&"+\&(: U h (.<<$\%\&;( \\ & Y I C \setminus YWO 3(8 VU( ( ( ( ( C ( @TP@AP?@?TC@VPVAP?@?D( O$\%K9$>.+.&15(O .59"+10 / 0(1+(\&9.( -\% 80$K916"(76"0\&$,.\% / ( )
```

```
Research Support, Current:
```

8\$6.0(X[Y](

```
) 9. (\underline{GI}(R\$^{+}, "\&1\$+( ( ( ( ( @AP@AP?@?VCA?PVAP?@?V(?, #'#$%"5@("0("(/ $, .6(<$\(4 - P4 - 8 - 0(NE"6*"\&1\$+($<(Y - i(:Yj / ( \ $\(( - .", (i . \&;( "0("(0*05.K\&1#161\&'(>.+.(<\(( . / .+\&1"[( Principal Investigator: Jeffrey H. Thomas $$54,833.00 direct costs
```

Research Support, to be Resubmitted:

```
) 8NGCX34(:!1^*;(
```

```
 \begin{array}{l} 4(<:"01\#161\&'(0\&^{*}, '(\$<(0.6.5\&1E.(5"+5.\%("\#6"\&1\$+(1+("(0\$61,(\&^{*}/\$\%(/\$,.6(*01+>(*6\&\%"0\$^{*},.6(*01+>(*6\&\%"0\$^{*},.1+,*5.,(\%.0\$+"+5.)(4(\#1\$/.59"+15"6(0\&\%"\&.>'(<\$\%(5"+5.\%(\&\%."\&/.+\&(*01+>(*6\&\%"0\$^{*},.1+,*5.)(*0))))))))))) \\ \times \begin{array}{l} 4(<:"01\%"(0\$^{*}, '(\$), 0\$^{*}, 0)) \\ \times \begin{array}{l} 4(<::"01\%"(0\$^{*}, 0)) \\ \times \begin{array}{l} 4() \\ \times \end{array}{)} \\ \times \begin{array}{l} 4() \\ \times \begin{array}{l} 4() \\ \times \begin{array}{l} 4() \\ \times \end{array}{)} \\ \times \begin{array}{l} 4() \\ \times \begin{array}{l} 4() \\ \times \begin{array}{l} 4() \\ \times \end{array}{)} \\ \times \begin{array}{l} 4() \\ \times \begin{array}{l} 4() \\ \times \end{array}{)} \\ \times \begin{array}{l} 4() \\ \times \begin{array}{l} 4() \\ \times \end{array}{)} \\ \times \begin{array}{l} 4() \\ \times \begin{array}{l} 4() \\ \times \end{array}{)} \\ \times \begin{array}{l} 4() \\ \times \begin{array}{l} 4() \\ \times \end{array}{)} \\ \times \end{array}{)} \\ \times \begin{array}{l} 4() \\ \times \end{array}{)} \\ \times \begin{array}{l} 4() \\ \times \end{array}{)} \\ \times
```

```
\YIC\YWO3(8VU( ( ( ( @TP@AP?@?TC@VPVAP?@?D(
O$%K9$>.+.&15(O.59"+10 / 0(1+(&9.( - %$0$K916"(76"0&$,.% / (
8$6.0(X[Y](
```

Research Support, Previous:

```
Anson L. Clark Foundation 05/01/2022-07/30/2022

A \% @ 3 \& ("+, (45\& / '$0]+(81+>(G$+0\& 15\& 1$+(,*\$1+>(-\$$0$K916"(G.6*6"\$1a"\& 1$+(Principal Investigator: Jeffrey H. Thomas

$750.00 direct costs
```

3\$*&9(X6"1+0(R\$*+, "&1\$+(3...,((@DP@AP?@ADCA?PVAP?@?@((C-GAP, a Key to the Role of the Cytoskeleton during Epithelial Folding Principal Investigator: Jeffrey H. Thomas \$15,000 direct costs

2R44-CA189549-02A1 (NIH-NCI) 09/01/2017-08/31/2019 Suppressors of kRAS Activity Discovered Using a Fruit Fly-based in-vivo Screen Principal Investigators: William A. Garland, Jeffrey H. Thomas Role: Multiple-Pl \$1,538,363 direct costs (\$1,999,872 total costs) (3*&9(X6'')+0(R*+, '&1+(3...,(@DP@AP?@AMC@ZPVAP?@AZ((((Functional identification of signaling and cytoskeletal proteins regulated by Src64 Principal Investigator: Jeffrey H. Thomas \$15,000 direct costs

 1R43CA 189549-01
 (NIH-NCI)
 07/01/2014-06/30/2015

 Screening with D. melanogaster to discov
 07/01/2014-06/30/2015

(

 $X = \frac{1}{3} - \frac{1}{3} = \frac{1}{3} - \frac{1}{3} = \frac{1}{3} - \frac{1}{3} = \frac{1}{3} - \frac{1}{3} = \frac{1}{3} = \frac{1}{3} - \frac{1}{3} = \frac{1}{3} =$ ((:Uh(N<<\$%&2(kA@2@@@; W\$"60()\$(,.&.%/1+.(H9.&9.%(',7>=(5\$+&%\$60(/15%\$<16"/.+&(%1+>(5\$+&%"5&1\$+(,*%1+>(- %\$0\$K916"(5.66*6"%1a"&1\$+(#'(%.>*6"&1+>(/'\$01+("5&1E1&'(\$%(#'(\$%>"+1a1+>("5&1+[((3*&9(X6'')+0(R*+, "&1+(W%"+&0((((@DP@AP?@@UC@ZPVAP?@@B(- .&.% / 1+"&1\$+(\$<(&9.(O.59"+10 / (\$<(',7>=C / .,1"&.,(G\$+&%\$6(\$<(G'&\$0J.6.&"6(G\$+&%"5&1\$+[(($X = \frac{1}{100} \times \frac{1}{100} \times$:?@h(.<<\$%&2(kA@2@@@;[(W\$"60()\$(,.&.%/1+.(H9.&9.%(',7>=(5\$+&%\$60(/15%\$<16"/.+&(%1+>(5\$+&%"5&1\$+(,*%1+>(- %\$0\$K916"(5.66*6"%1a"&1\$+(#'(%.>*6"&1+>(/'\$01+("5&1E1&'(\$%(#'(\$%>"+1a1+>("5&1+[(359\$6(\$<(O.,151+.(3..,(W%"+&Q)((@DP@AP?@@UC@ZPVAP?@@B(

 $\begin{aligned} &4 + "6' 010(\$<("(-\$)\$0\$K916"(W.+.(\$9"\&(-.6"'0(NK1\&9.61"6(Y+E">1+"\&1\$+[((X\%1+51K"6(Y+E.0\&1>"\&\$\%0(`.<<\%.'(I[()9$/"0(((15\% effort, $20,000).(W\$"60())$(/$6.5*6"\%6'(1,.+&1<'(\&9.(+.H6'(,105\$E.\%.,(>.+.($@4'8:)C4,,#D)"+,(59"\%"5\&.\%1a.(1\&0(\%\$6.(1+(-\%$0$K916"(5.K9"615(<*\%\%$H(<\%/$